OVERVIEW

Approximately one-third of the people in the Southern African Development Community (SADC) region live in drought-prone areas. Meteorological drought causes substantial socio-economic hardships, decline in public health, land degradation and biodiversity loss. Drought impacts on crop and livestock production in the region, endangers local ecosystems and threatens agriculture-based communities. Over the past 30 years, rainfall has been increasing in the humid tropical zone and declining in the southern African drylands.

Between 2018 and 2019, food insecurity increased by 28% across the region, 7.4% higher than it was during the severe El Niño-induced drought of 2016/17. Roughly 45 million southern Africans were food insecure as the region entered the peak of the lean season from January-March 2020 and a year later, that number increased to 51.3 million people. Back-to-back droughts (in Angola and Madagascar) and erratic rainfall; compounded by COVID-19 (in all SADC countries); displacements due to the growing insecurity related to cattle raiding (in Madagascar); internal conflict (DRC and Mozambique) and political and economic instability (Zimbabwe) contributed to these record-high levels of food insecurity in the region. In 2020/21, around 21.8 million people in the Democratic Republic of Congo (DRC) experienced high levels of acute food insecurity (IPC Phase 3 or above), making it home to the highest number of people in urgent need of be water-abundant humanitarian assistance in the world. The risk of drought occurrences even threatens those countries previously thought to be water-abundant.

Several southern African countries lack an objective forecast-based early warning and response mechanism that enables early identification of the onset of drought. Ex-post reactive responses coupled with the lack of anticipatory and preparedness measures focus on crisis management and humanitarian interventions as opposed to building long-term resilience at the household and community level. Generally, they also come at a higher cost to the economy.

Effective and implementable drought policies and plans are vital, and these should include actions and incentives to promote the building of adaptive capacity and resilience in different communities and economic sectors alongside those centered on preparedness and mitigation efforts. Currently, drought-related response efforts tend to be reactive and crisis-led, and this is a costlier approach to people, the economy and the environment than proactive management in which resilience is developed and relief actions are agreed upon beforehand.

To help facilitate this proactive approach, the World Bank has embarked on a multi-year drought resilience "advisory services and analytics" initiative – the Southern African Drought Resilience Initiative (SADRI) – that leverages expertise across its Global Practices (GPs) and Country Units. The objective of SADRI is to build analytical and institutional foundations to catalyze national and regional investment in integrated drought resilience. By helping to convene around a regional approach, the initiative aims to provide a forum for knowledge exchange among SADC Member States and development partners on effective drought risk management.

As part of SADRI's activities, the SADC Drought Resilience Profiles have been developed, to provide snapshot overviews of drought resilience capacity in each of the 16 SADC Member States. They consist of a stocktaking and needs assessment at the country level to identify institutional capacity, policies and programs, ongoing activities, key partners, gaps and opportunities, including to identify low-hanging fruit for necessary analytical work and drought resilience investment prioritization.

Each profile provides base information on national capacity in terms of the Integrated Drought Risk Management Framework, a three-pillar approach centered around interconnected, multi-disciplinary, multi-institutional activities. These pillars are 1) Vulnerability and impact assessment; 2) Monitoring and early warning systems (EWS) and 3) Mitigation, preparedness and response.

The goal of the Vulnerability and Impact Assessment pillar is to determine the primary historical, current and future impacts associated with drought and to assess the root causes of these impacts. Drought impact and vulnerability assessment is directed at gaining an understanding of both the natural and human processes associated with drought and the impacts that occur. An outcome of this pillar is, ideally, the creation of a vulnerability profile for each sector, region, population group or community. An archive of drought impacts that have occurred historically does not exist for most countries, although anecdotal information on recent and

This document is meant to provide a brief overview of drought risk issues in the SADC region. The key resources at the end of the document provide more in-depth analyses. The contents of this profile do not necessarily reflect the views of World Bank, CIWA, NDMC or IWMI.

In terms of the Monitoring and EWS pillar, a key objective for countries should be the establishment of a drought early warning system (DEWS). Governments maintain DEWS to warn their citizens and themselves about impending drought conditions. A DEWS identifies climate and water supply trends and detects the emergence or probability of occurrence and the likely severity of drought and its impacts. Reliable information must be communicated in a timely manner to water and land managers, policy makers and the public through appropriate communication channels. That information, if used effectively, can be the basis for reducing vulnerability and improving mitigation and response capacities of people and systems at risk.

Effective drought monitoring and early warning should ideally integrate precipitation and other climatic parameters with water information such as stream flow, ground water levels, reservoir and lake levels and soil moisture into a comprehensive assessment of current and future drought and water supply conditions. In addition, monitoring the impacts (i.e. social indicators) that occur on the ground as a drought develops helps to calibrate assessments of severity for local areas. These assessments can then trigger appropriate mitigation and response actions that have been identified previously (WMO/GWP, 2016).

Finally, the drought mitigation, preparedness and response pillar comprizes the appropriate measures and actions aimed at reducing vulnerability to drought and reducing the impacts of droughts. The goal of this pillar is to determine appropriate mitigation and response actions aimed at risk reduction, the identification of appropriate triggers to phase in and phase out mitigation actions, particularly short-term actions, during drought onset and termination and, finally, to identify agencies, ministries or organizations to develop and implement mitigation actions (FAO, 2019).

This regional Drought Resilience Profile for SADC contains highlights of drought information based on these three pillars as documented in the 16 country-specific profiles. Key sections cover climate and projected changes, sector impacts and vulnerabilities to drought, the policy context and information regarding ongoing drought and related projects in southern Africa.

The pillar summaries provide an overview of defining characteristics and major themes across the SADC countries as depicted in the country-specific profiles, and what the key gaps and opportunities are for improved drought resilience. Key throughout this profile is the central role that the SADC Secretariat could and should play in institutional and stakeholder coordination across all pillars.

Important in these collective efforts is the concerted focus on strengthening institutional capacity, monitoring infrastructure and enhancing information systems within and between countries in the region. Table 1 refers to the consolidation of course assessments of each SADC Member State's capacity in the three pillars as captured in the country profiles).

Table 1. SADC Member State capacity in terms of the Integrated Drought Risk Management Framework as documented in the country-specific drought resilience profiles

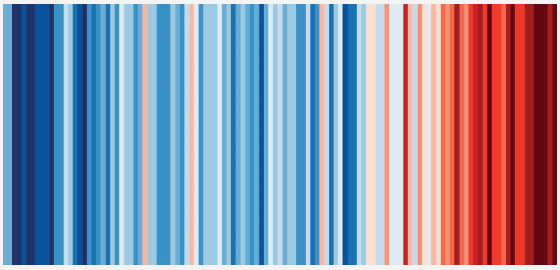
Country	Vulnerability and impact assessment	Monitoring and EWS	Mitigation, preparedness and response
Angola	🟥	🟥	🟥
Botswana	🟧	🟧	🟧
Comoros	🟧	🟥	🟧
Democratic Republic of Congo	🟥	🟥	🟥
Eswatini	🟧	🟧	🟧
Lesotho	🟧	🟥	🟧
Madagascar	🟥	🟥	🟧
Malawi	🟧	🟧	🟧
Mauritius	🟧	🟧	🟧
Mozambique	🟧	🟧	🟧
Namibia	🟧	🟧	🟧
Seychelles	🟥	🟧	🟧
South Africa	🟧	🟧	🟧
Tanzania	🟧	🟧	🟧
Zambia	🟥	🟧	🟧
Zimbabwe	🟧	🟧	🟧

Key: 🟥 Low 🟧 Medium

Historical climate

- As illustrated in the #ShowYourStripes 'warming stripe' graphic for Africa in Fig 1, the stripes turn from mainly blue to mainly red in more recent years, illustrating the rise in average temperature since 1901, an observable trend for all 16 SADC countries as depicted in the country-specific profiles.
- More severe droughts, affecting several SADC countries, are typically experienced every decade, with the most widespread droughts occurring in 1981, 1990, 2001, 2007, 2015/16, and 2019 (Table 2).
- Increased mean, maximum and minimum temperatures, with more rapid increases in minimum temperatures (1-1.5°C on average), occur especially in the interior regions (1.6-2°C on average) (USAID, 2016).
- Reduced late summer precipitation (November-March) has occurred in Botswana, Namibia, Zimbabwe and Zambia (ibid).
- Increased summer rainfall has occurred in Lesotho, Namibia and South Africa, with increased variability in Angola (ibid).
- Changes in the onset, duration and intensity of rainfall have occurred throughout the region, including increased frequency of dry spells (breaks in the rainy season of at least five days where no significant rain is received) (ibid).

Fig 1, Temperature change across the African continent, 1901-2019



Source: Berkley Earth/#ShowYourStripes

Future climate

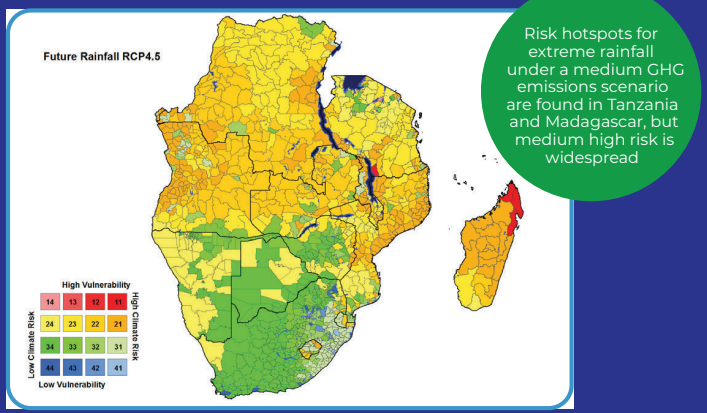
- Mean temperature rise is expected to exceed 2°C (or more), particularly in arid regions, with projected warming between 3.4°C and 4.2°C above 1981-2000 averages, and with more pronounced increases in the summer (November-March) (USAID, 2016).
- Minimum temperature rise may exceed the rise in maximum temperature (ibid).
- Slightly drier conditions (including potentially increased intensity and duration of dry spells) may be experienced on average, particularly from April to September (ibid).
- According to the Sixth Assessment Report (IPCC, 2021), the following future trends are predicted across the SADC mainland region:

-Observed decreases in mean precipitation;
-Observed and projected increases in heavy precipitation and pluvial flooding;
-Observed and projected increase in aridity, agricultural and ecological droughts.
Observed increase in meteorological drought, projected increase in meteorological droughts from 1.5°C, higher confidence with increasing global warming;
-Projected increases in mean wind speed; increases in fire weather conditions.

CLIMATE RISK HOTSPOTS

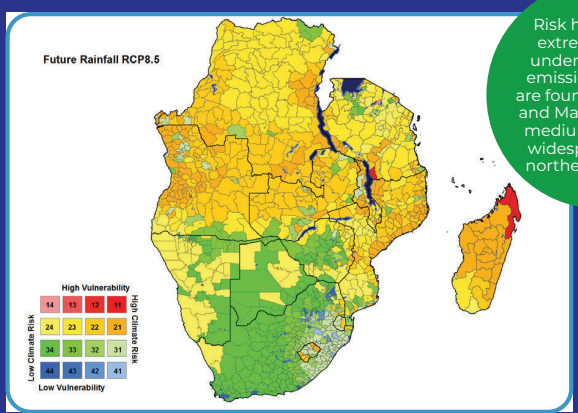
The bivariate maps in Fig. 2 and Fig. 3 illustrate combined current vulnerability within districts and future drought under the RCP4.5 and RCP8.5 scenarios. Vulnerability is represented from high (red), medium high (orange), medium low (green) and low (blue), while climate hazards are represented by color shading from high (darker) to low (lighter) risk (Quinn et al., 2020).

According to the SADC Futures: Developing Foresight Capacity for Climate Resilient Agricultural development project, potential hotspots of vulnerability to and risk of extreme droughts are evident under the RCP4.5 scenario along Lake Nyasha/Malawi with medium high vulnerability, and high drought risk seen across extensive areas of Namibia, northern Zambia, inland Tanzania, and across large areas of the DRC (Fig. 2). Under the RCP8.5 scenario the hotspots do not change significantly, with some climate risk reduced along the coast of Lake Nyasha/Malawi, and some increase in the area of the hotspot along the coast of Namibia (particularly IIKaras) (Fig. 3) (Quinn et al., 2020).



Risk hotspots for extreme rainfall under a medium GHG emissions scenario are found in Tanzania and Madagascar, but medium high risk is widespread

Fig 2. Bivariate map showing hotspots of vulnerability to and risk of extreme rainfall within the districts of each SADC region for the RCP4.5 scenario. The first number within each matrix color represents the normalized and rounded mean vulnerability value for the district, with the second number representing the rounded climate hazard value (i.e. 34 equates to 'medium low vulnerability', 'low climate hazard). (Source: Quinn et al., 2020)



Risk hotspots for extreme rainfall under a high GHG emissions scenario are found in Tanzania and Madagascar, but medium high risk is widespread across northern countries

Fig 3. Bivariate map showing hotspots of vulnerability to and risk of extreme rainfall within the districts of each SADC region for the RCP8.5 scenario. The first number within each matrix color represents the normalized and rounded mean vulnerability value for the district, with the second number representing the rounded climate hazard value (i.e. 34 equates to 'medium low vulnerability', 'low climate hazard). (Source: Quinn et al., 2020)

Table 2. Major droughts in SADC, 1980-2020 (Source: EM-DAT, 2020)

South Africa	- 1980	1981 -	Angola, Botswana, South Africa, Eswatini, Comoros, Madagascar, Mozambique, Namibia, Zambia, Zimbabwe
DRC, Lesotho, Zambia	- 1983	1984 -	Eswatini, Tanzania
Angola	- 1985	1986 -	South Africa
Malawi, Mozambique	- 1987	1988 -	South Africa, Madagascar, Tanzania
Angola	- 1989	1990 -	Botswana, Namibia, Lesotho, Eswatini, South Africa, Mozambique, Malawi, Zimbabwe, Tanzania, Zambia
Malawi	- 1992	1995 -	Namibia, South Africa, Zambia
Tanzania	- 1996	1997 -	Angola
Namibia, Mozambique, Zimbabwe	- 1998	1999 -	Mauritius
Angola, Namibia, Eswatini, Mozambique, Zimbabwe	- 2001	2002 -	Namibia, Lesotho, Madagascar, Malawi
Mozambique, Tanzania	- 2003	2004 -	Angola, South Africa, Tanzania
Madagascar, Malawi, Mozambique, Zambia	- 2005	2006 -	Tanzania
Lesotho, Eswatini, Mozambique, Malawi, Zimbabwe	- 2007	2008 -	Madagascar
Mozambique, Zimbabwe	- 2010	2011 -	Lesotho, Tanzania
Angola, Malawi	- 2012	2013 -	Namibia, Zimbabwe
Madagascar	- 2014	2015 -	Botswana, Namibia, South Africa, Malawi
DRC, Lesotho, Eswatini, Madagascar, Mozambique	- 2016	2017 -	Angola, South Africa
Madagascar	- 2018	2019 -	Botswana, DRC, Namibia, Lesotho, Eswatini, South Africa, Zambia, Zimbabwe
Lesotho, Madagascar, Mozambique	- 2020		

Use and application of integrated drought indexes

Using an approach developed by the International Water Management Institute (IWMI), the country-specific drought resilience profiles for SADC Member States assess drought risk using an Integrated Drought Severity Index (IDSI), and a higher level composite index of which the IDSI is a component, the National Drought Risk Index (NDRI). The IDSI is an integrated index that has been formulated using the Precipitation Condition Index (PCI), the Temperature Condition Index (TCI), and the Vegetation Condition Index (VCI) at 500m resolution for agricultural land-use over South Asia, and adapted to southern Africa.

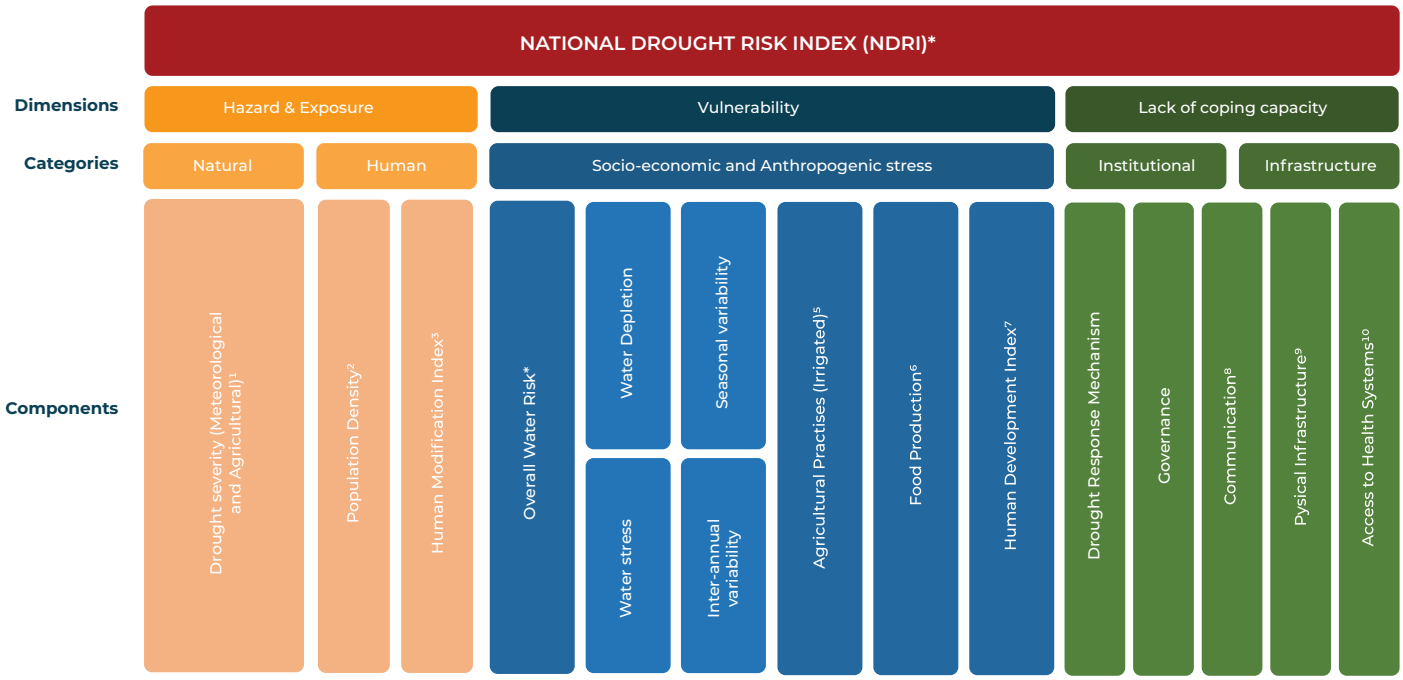
Similar to other drought indexes such as the Standardized Precipitation Index (SPI), the Soil Moisture Index (SMI), and the Combined Drought Indicator (CDI), the IDSI provides advanced drought monitoring and assessment information for various purposes. In tandem, these indices not only paint an accurate picture of any drought episode, but also provide invaluable decision-making tools. The drought severity maps that are produced deliver continuous geographic coverage over large areas, and have inherently finer spatial detail than other commonly available global drought products such as NESDIS NOAA and MODIS Global Terrestrial Drought Severity Index, using different data and approaches. The IDSI calculations integrate satellite-based observations of vegetation conditions and climate data and other biophysical information such as land cover/land use type, topography and river basin details.

The National Drought Risk Index (NDRI) considers several dimensions when assessing drought risk: by characterizing hazard and exposure to vulnerability and the lack of coping capacity. Multisource information is used from satellite-derived drought indices and socio-economic conditions. In terms of components, hazard is defined through meteorological and agricultural drought (i.e. as derived by the IDSI) and exposure is expressed through population density and the Human Modification Index (HMI). Vulnerability is expressed by a combination of socio-economic and anthropogenic stress (including water risk, water depletion, water stress, seasonal variability, inter-annual variability, agricultural practices, food production and the Human Development Index (HDI).

These, combined with the lack of coping capacity, defined in institutional and infrastructural terms, are combined to form the NDRI. The drought risk profile for a particular country is therefore based on the probabilistic estimation of hazard and vulnerability to assess the drought risk in the exposed areas.

While the IDSI is an important index to assess drought hazard and exposure (see Fig. 4), there are other important indicators to take into consideration. The Drought Resilience Profiles also showcase the CDI developed by the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln, in partnership with the World Bank. The CDI represents a consolidation of indices and indicators into one comprehensive drought map. While these two approaches are not integrated currently in the profiles, in future iterations, it is hoped that the CDI will be integrated into the NDRI.

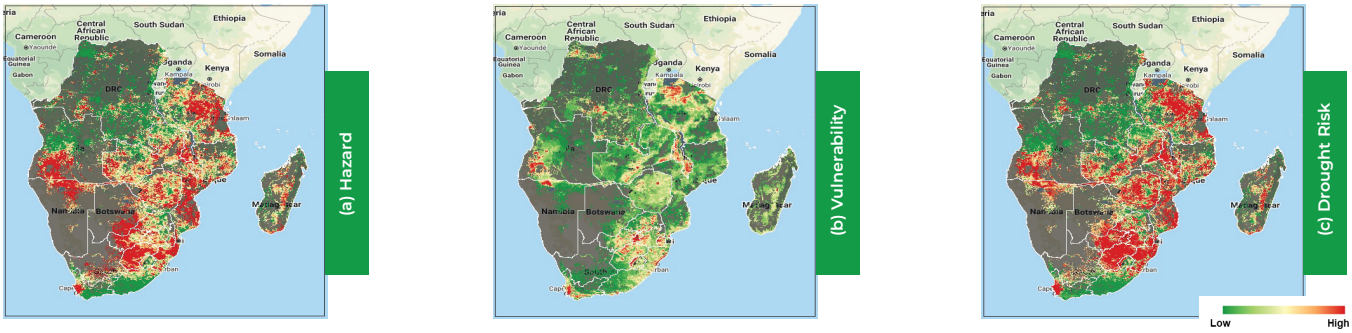
Fig 4. Data framework comprizing the National Drought Risk Index (NDRI)



[1]RemotSensing derived Intergrated Drought Severity Index; [2]WorldPop Gridded Data; [3]gHM using five anthropogenic stress (read Kennedy et al. 2019); [4]World Resource Institute Aqueduct Water Risk Atlas; [5]Irrigated Area; [6]HarvestChoice Spam; [7]UNDP HDI; [8]UNDP; [9]UNDP; [10]WHO;
*Implemented in Google Earth Engine

Source: **IWMI**

Fig 5a-c. Drought hazard, vulnerability and risk maps for SADC, October 2015



The above maps (Fig 5a-c) depict regional drought hazard areas (a), areas of vulnerability (b) and drought risk (c) for southern Africa during the El Nino event in October 2015. Among the drought-prone areas in SADC, the NDRI shows that the western and southern parts of the region, as well as the north-eastern parts, are more vulnerable and at a higher drought risk (maps generated by IWMI/WASA).

Drought impacts on food security and human health

Available data from thirteen Member States as per the SADC Regional Vulnerability Assessment & Analysis Program (RVAA) Synthesis Report for 2020 forecast that about 51.3 million people were unable to access the food they needed over the period January to March 2021 (SADC, 2020). This equates to a 25% increase in the food insecure population from the previous year, and is the highest figure ever recorded by the SADC RVAA system (ibid). However, a key challenge with this report is that national vulnerability assessments have limited coverage of the urban population in the region. This, together with the severe impacts of COVID-19 on the livelihoods of urban populations, particularly amongst the poor households that are predominantly reliant on informal employment and businesses, suggests that the food insecure population in the region could be significantly higher than these estimates.

The DRC, South Africa and Zimbabwe carry the largest share of the region's food insecure caseload. Most of South Africa's reported food insecure population are chronically food insecure people on the national social protection program. DRC, Mozambique and Zambia are projected to have the largest increase in the number of food insecure people compared to their five-year average, while Malawi, DRC and Eswatini show the largest year-on-year increases (ibid). Several factors contribute to food insecurity in the region, but the primary factor remains the quality of the rainfall season. Over the past six years, the lowest annual food insecurity was recorded following the best rainfall season (2013/14 and 2016/17). Conversely, the highest food-insecure caseloads were projected following the worst rainfall seasons (2015/16 and 2018/19). The adverse effects of a poor 2019/20 rainfall season were aggravated by the pervasive livelihood disruptions of commerce and travel restrictions all Member States put in place to control COVID-19.

Drought also has a negative impact on human health. Indicators of human well-being related to health for the region show improvement (before Covid-19), but are still relatively poor compared to other regions in Africa.

Table 3. Number of food insecure people in the SADC region (Source: SADC Member State NVACs, IPC)

Country	2019/20	5 year ave	2019/20		
			Rural	Urban	Total
Angola	1,139,064	869,177	1,051,800		1,051,800
Botswana	38,300	34,384	38,300		38,300
Comoros	-	-	-	-	-
Democratic Republic of Congo	13,100,000	8,319,663	21,800,000		21,800,000
Eswatini	232,373	275,484	335,421	30,840	366,261
Lesotho	433,410	443,403	582,169		582,169
Madagascar	916,201	1,148,254	554,000		554,000
Malawi	1,126,147	2,482,275	2,032,109	585,880	2,617,989
Mauritius	-	-	-	-	-
Mozambique	1,648,646	997,721	1,994,538	585,880	2,617,989
Namibia	289,644	457,137	434,000		434,000
Seychelles	-	6,967	-		-
South Africa	13,670,000	13,961,453	5,800,000	7,800,000	13,600,000
Tanzania	740,000	456,625	488,661		488,661
Zambia	2,330,182	1,116,777	1,976,351		1,976,351
Zimbabwe	5,529,209	3,457,494	5,454,270		5,454,270
SADC	41,193,176	33,669,395	42,541,619	8,781,109	51,322,728

The region faces a heavy disease burden largely due to poor waste management practices, inadequate drinking water and sanitation, limited access to health care facilities, scarce financial resources and poor governance.

Over 70% of the 250 million people living in the region rely on groundwater as their primary source of water

This in turn affects multiple health outcomes including diarrheal disease, malaria and other vector-borne diseases. In addition, the region is faced with a triple burden of malnutrition characterized by undernutrition (stunting and acute malnutrition); over-nutrition (obesity) and micronutrient deficiencies (SADC, 2020). Children under age 5 are fed predominantly poor diets: 9 SADC Member States report stunting rates above 30%, while 4 Member States report obesity rates of above 10% (ibid). Increasing temperatures and increased intensity, frequency and duration of drought pose additional threats to these challenges, through changes in agricultural productivity and water availability and increased distributions of disease-carrying vectors.

Recent estimates suggest that implementing adaptation measures in the health sector could reduce the number of children at risk from chronic under-nutrition and stunting by 10 million in sub-Saharan Africa, through improved disaster risk reduction measures that reduce vulnerability to extreme events such as droughts (USAID, 2016). A particular challenge from a climate perspective for the sector is the scant data available on the links between climate variables and disease patterns, which makes it difficult to design appropriate intervention and surveillance methods. The most effective measures to reduce vulnerability in the health sector in the short-term include promoting programs that implement and improve basic health system measures, such as the provision of safe water and improved sanitation; securing essential health care; increasing capacity for disaster preparedness and response and alleviating poverty (ibid).

Droughts impact on agriculture

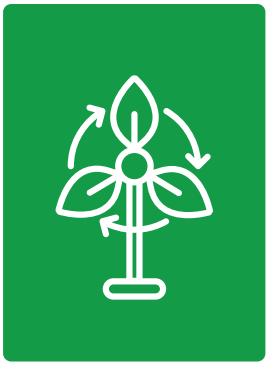
Agriculture in southern Africa is predominantly rain-fed (with the exception of wheat-producing areas in South Africa), which makes the region inherently vulnerable to droughts. Grain prices and market dependency are regional, with some countries (e.g. Botswana and Lesotho) relying on imports to meet national demand for maize and sorghum, derived mainly from South Africa, while other normally self-sufficient countries (Mozambique and Malawi) have in recent years relied on imports to meet demands due to losses resulting from recurring floods and droughts. Cereal production, availability and access are key food security challenges in southern Africa. **Over 40% of the region's land area is allocated to cereals**, with maize being the predominant crop, followed by millet (Namibia), paddy rice and sorghum (Mozambique) and wheat (South Africa). Drought is one of the major factors that influence the sector's vulnerability, which is already severely limited by poor infrastructure, stagnating farm incomes, reduced support agricultural extension services, lagging technological innovation and research, poor farming practices and an increase in pests and diseases. Regionally, drought impacts on the sector will be largely detrimental, placing greater emphasis on intra-regional markets and trade to meet food security demands (ibid).

Droughts have adverse effects on ecosystems

Southern Africa has unique and diverse terrestrial, freshwater and coastal ecosystems, including forests, which cover over 40% of the total land area of the 16 SADC countries (USAID, 2016). These ecosystems provide a multitude of services to rural communities including employment, shelter, food, energy, construction materials for use and other products. They also regulate core ecological processes on which people and livelihoods depend, including soil maintenance, water filtration, groundwater recharge rates and stream and river flows. These effects also extend beyond rural contexts, as a growing number droughts have impacted on urban economies, livelihoods, health and other sectors. **Deforestation in the SADC region is a major concern, with net forest loss from 2005-2010 recorded at 1.8 million hectares annually (FAO, 2010)**. High evaporative demand and the combination of high temperature and low humidity combine with low soil moisture to induce stress through closure of stomata, which can lead to carbon stress, loss of hydraulic function and mortality (Vose et al, 2020). Emerging evidence suggests that these ecosystems have already experienced shifting species ranges and reduced services. **In countries like DRC, increased temperatures and variable rainfall impact vast forest areas, which are already under threat from land use change and growing demand for charcoal and tropical forest products**. It is estimated that DRC's primary forest may be completely cleared by 2100.

Drought impacts on energy

Energy and water are closely linked in southern Africa. Water drives the turbines of hydroelectric power plants; coal processing and cooling in thermal and nuclear power plants require water; and energy is required to lift, treat and distribute water. This places climate at the forefront of the region's energy sector. Projected changes to the water sector, such as a more variable and changing climate, will have a negative impact that could pose large potential revenue losses for some hydropower-exporting countries and increase costs to consumers in countries reliant on energy imports. Access to and production of energy is a critical limiting factor to meeting development objectives in southern Africa and energy is a resource that, among others, remains unequally distributed. Roughly 48% of the total population in the region has access to electricity in terms of connectivity (75% for urban and 32% rural), with 62% of electricity generation coming from coal and 21% from hydropower (SACREEE, 2018). Nevertheless, cooperative agreements (including basin management plans and inter-basin transfers through regional coordination mechanisms) and an integrated view of available energy resources could offer a buffer against climate risks at the regional scale. For example, several electricity companies, organized under the SADC Southern African Power Pool (SAPP), are working to improve the common regional power grid to improve security of supply.



Drought impacts on water resources

Southern Africa's water resources cut across a number of transboundary river basins and are unevenly distributed, both seasonally and geographically. Infrastructural developments intended to safeguard water supplies have increased the geographical imbalance of water resources, as many dams have been built to store water during the unpredictable and often long dry periods, particularly in South Africa and Zimbabwe. In addition, some countries have significant untapped hydropower potential such as Mozambique, while others have no potential to further expand water storage capacity such as South Africa.

Drought affects both the quantity and quality of water in the region, and increased temperature leads to higher than normal evapotranspiration rates. For example, stream flows for the transboundary Limpopo and Okavango catchments are projected to decrease by 35% and 20% respectively, as a result of an increase in evapotranspiration. Rising demands and increasing levels of pollution across shared water resources are also a critical problem. The total regional water storage is also only 14% of the available annual renewable water resources.

Finally, the important role of groundwater in drought protection and management has been increasingly recognized in the SADC region as part of larger scale initiatives to collaborate on water management, particularly manifested in SADC's Regional Strategic Action Plans (RSAP). It is estimated that **over 70% of the 250 million people living in the SADC region rely on groundwater as their primary source of water**. In this regard, the SADC Secretariat continues to implement groundwater management programs through the SADC-Groundwater Management Institution (SADC-GMI). However, proper drought protection and management and climate change adaptation in the region are hampered by the lack of coordinated data and tools to support best practices and to facilitate better integration of groundwater, as a strategic resource, into planning and management of water resources in the region (Villholth et al, 2013).

Drought impacts on infrastructure

Damage to infrastructure resulting from extreme heat and dryness is projected to increase in the region, and has the potential to undermine economic development goals. Studies on the potential costs of not implementing climate change adaptation measures in the Zambezi basin, for example, suggest cumulative damages as large as USD45 billion to existing infrastructure (USAID, 2016). Although investments in the water sector are growing through SADC initiatives and donor support, they remain a regional challenge due to costly and unpredictable transport and logistics (especially for landlocked states); limited access to information and communications; inadequate information on meteorology and climate to guide planning and management of existing water resources and a high number of people without access to potable water, adequate sanitation facilities and water for irrigation. A more variable climate clearly impacts this fragility by damaging limited infrastructure resources.

Vulnerability and impact assessment capacity

Although the availability of data is scarce at the national level, the institutional apparatus and capacity to conduct vulnerability and impact assessments at the regional level is well established.

In 1999, SADC established the Regional Vulnerability Assessment Committee (RVAC). This committee has spearheaded critical improvements in vulnerability analysis and food security at both regional and country levels.

At the Member State level, National Vulnerability Assessment Committees (NVACs) coordinate the annual vulnerability assessments and analyses.

NVACs are multi-sectional committees led by relevant government ministries with wide-ranging memberships, which include different government departments, non-governmental organizations (NGOs) and international organizations involved in poverty reduction and socio-economic development. NVACs carry out annual and periodic vulnerability assessments, in addition to special studies on selected topics such as nutrition, climate change and related themes that are critical in vulnerability assessment and analysis (VAA). In 2006, building on previous initiatives, the SADC Secretariat began implementing the Regional Vulnerability Assessment and Analysis (RVAA) Program.

Since its inception, the Program has worked to create institutional and conceptual achievements, building strategies and interventions that integrate short-term responses to emergencies and livelihood hazards with broader, longer-term approaches to chronic poverty and livelihood vulnerability. The RVAA system is widely acknowledged as the main system to track, report and respond to food insecurity in the Region.

In many SADC countries where vulnerability and impact assessment capacity is limited or where no vulnerability assessments are conducted at the national level, the RVAA serves as the primary vulnerability and impact assessment reporting mechanism, on which Member States rely for national assessments. Evidence from the 2012-16 RVAA reports indicates that most of the countries in southern Africa conduct National Vulnerability Assessments and Analyses (NVAA) annually (Table 4).

The RVAA Program provides capacity building and other technical support to Member States' NVACs, and synthesizes and analyzes national VAA outputs into regional reports and policy briefs. The annual Regional Synthesis Dissemination reports provide an overview of the livelihood and food security situation in the SADC region, although more recent reports (post-2017, are not easily accessible).

To strengthen VAA in the region, the RVAA Program develops technical guidelines and special studies that provide in-depth research on priority areas such as guidelines on urban vulnerability; integration of nutrition, HIV and gender in vulnerability assessment and analysis and climate change and livelihoods.

Additionally, although the VAC system has become one of the most useful and reliable drought management tools in the SADC region, there are multiple methodologies that need harmonization. The IPC procedures allow for the incorporation of the most reliable relevant information from multiple sources. There is a system for weighing the credibility of the source. As the sources of data become more reliable the IPC estimates become more accurate, contributing toward improving the level of understanding of evolving food security situations.

Although the IPC protocols continue to gain currency across the region, there are challenges to its general adoption by national governments, due in part to differences in the manner some countries account for food security outcome indicators, some using actual metrics whereas others rely on proxies of those indicators (Braimoh et al, 2018). Despite the region's good progress under this pillar, several challenges remain. Firstly, data remains spread across various institutions and several databases.

Additionally, the network of observation and data management stations and systems needs to be improved in order to support decision-making. Thirdly, vulnerability and impact assessments are currently not routinized across countries, providing a patchy consolidation of impact assessment data at the regional level. Fourthly, how drought impact reporting mechanisms successfully feed into decision-making processes, as with the good practice case of Botswana listed below, should be shared across countries. This lesson-sharing contributes to the overall strength of NVAAs across the region.

Finally, having stakeholders involved in the design, implementation and reporting of vulnerability and impact assessments is now regarded as vital in ensuring that vulnerable groups are aware and can benefit from the process. The SADC Hydromet Forum provides one such opportunity for this inter-country dialogue and lesson sharing.

Institutionally, SADC countries would benefit from strengthening their relevant DRM ministries and local institutions and improving coordination between these agencies to develop and implement vulnerability and impact assessments. These challenges need to be overcome to provide better collection and systematization of data relevant for vulnerability mapping and assessments and, ultimately, strengthening of drought resilience.

Vulnerability and Impact Assessment

Table 4. NVAA Reports Consolidated into RVAA (2012-16) (Source: Braimoh et al, 2018)

	Year				
Country	2012	2013	2014	2015	2016
Angola	-	X	-	-	X
Botswana	X	X	X	X	X
Comoros	-	-	-	-	-
Democratic Republic of Congo	-	X	X	X	X
Eswatini	X	X	X	X	X
Lesotho	X	X	X	X	X
Madagascar	-	-	-	-	X
Malawi	X	X	-	X	X
Mauritius	-	-	-	-	-
Mozambique	X	X	X	X	X
Namibia	X	X	X	X	x
Seychelles	-	-	-	-	-
South Africa	X	-	-	-	X
Tanzania	X	X	X	X	X
Zambia	X	X	X	X	X
Zimbabwe	X	X	X	X	X
Total	10	11	9	10	13

Good practice case: Botswana's Drought and Household Food Security Outlook

Since its inception in 2008, the Botswana VAC has undertaken annual Drought and Household Food Security assessments that inform decision-making for drought interventions.

The Drought and Household Food Security Outlook assesses the current levels of human vulnerability and stressors and the possible effects of their interaction with the observed impacts of drought.

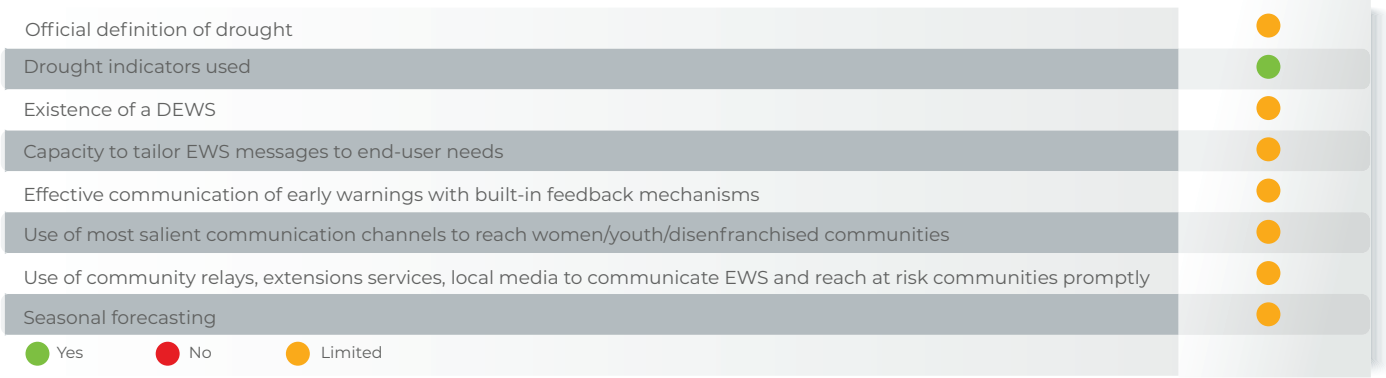
This includes but is not limited to, the nutritional status of under-five year olds, current and emerging trends in the number and distribution of destitute persons, as well as a review of implementation of the feeding and intensive labor works (Ipelegeng) program.

Monitoring and Early Warning Systems

Monitoring and early warning systems capacity

Table 5 represents a consolidated traffic light checklist to illustrate the state of monitoring and EWS capacity in SADC (see country-specific profiles for country level assessment).

Table 5. Summarized checklist of monitoring and EWS capacity



Monitoring and Early Warning Systems

Many southern African countries use a composite definition/s of drought that includes an assessment of meteorological, agricultural and hydrological indicators, but seldom include this definition in policy documents, or disaster management protocols. Most SADC countries also lack an objective forecast-based early warning and response mechanism that enables early identification of the onset of drought. If an EWS does exist, there are limitations to how the information is communicated to users, particularly vulnerable groups, and/or the degree to which this information triggers decision-making. As a result, support to water- and food-insecure households has been late and insufficient. Ex-post reactive responses that lack anticipatory and preparedness measures often ends up prioritizing costly, crisis management and humanitarian interventions over building long-term resilience at the household and community level.

The SADC region is facing increased demand for more sophisticated climate information services to protect lives and assets as well as to support economic activities in weather-sensitive sectors. However, inadequate observational station networks due to the lack of instrumentation and funding and a shortage of trained personnel, telecommunications systems, data processing and information dissemination facilities are major drawbacks. In most countries, the infrastructure and facilities have continued to deteriorate, leading to great difficulties in providing weather and climate services to meet national and regional needs. Nevertheless, the advent of remote sensing and GIS as well as numerical modelling has made it possible to monitor drought and other disasters even at the local level. While SADC countries may have the institutional frameworks in place, they are often poorly equipped and lack the human capacity to efficiently monitor and forecast droughts, not to mention the limitations to coordination across various institutions tasked with drought management.

As a result, several SADC countries have low levels of drought preparedness despite each having its own disaster management institution. Most of the existing EWS are also multi-hazard, and tend to focus on a few hazards, which often overlook all the components of more complex hazards such as drought.

However, the establishment of national-level DEWS have assisted several countries in developing more targeted drought communication and response strategies. Also notable in SADC countries is the presence of water and meteorological institutions/ departments, but the level of coordination between them is often limited to task committees convened at the ministerial level.

Current operational EWS use remote sensing products to monitor disasters and generally lack the forecasting component. The most notable is the Famine Early Warning System Network (FEWS-NET), a program of the United States Agency for International Development (USAID) focusing on the SADC region, with country offices in specific countries (Verdin et al. 2005).

The system employs a livelihoods framework to geographically characterize vulnerability and interpret hazards including drought, and provides decadal and monthly reports. As part of the FEWS-NET, the National Oceanic Atmospheric Administration (NOAA), United States Geological Survey (USGS), and National Aeronautics and Space Administration (NASA) provide routine reviews of a suite of monitoring and assessment products to produce a weekly Africa Weather Hazards Assessment (AWHA). the reports are distributed to partners and posted on the FEWS-NET website (Verdin et al, 2005).

There are also three operational climate data processing centers in the southern africa region. Two are dedicated to extreme weather monitoring – regional Specialized Meteorological Centers (RSMC), and a third devoted to satellite data processing for monitoring agricultural and environmental status. These include the RSMCs situated in Pretoria, South Africa and La Reunion Tropical Cyclone Centre in the Reunion Islands. The SADC Thematic Action on African Monitoring of Environment for Sustainable Development (AMESD) provides satellite data processing information outputs for crop monitoring, drought prevention and fire alert to Member States in the Region.

Finally, the African Centre of Meteorological Application for Development (ACMAD) also provides weather and climate information relevant to the SADC region at a continental scale.

To enhance EWS capacity in the region, the World Meteorological Organization (WMO) designed and conducted the Severe Weather Forecasting Demonstration Project (SWFDP), which uses a cascading forecasting process: Global Numerical Weather Prediction (NWP) Centers provide their products to RSMCs which interpret the information to prepare daily guidance products (1-5 day) for distribution to National Meteorological Centers (NMCs) which in turn issue alerts, advisories, severe weather warnings; liaise with disaster management and other economic sectors; and send feedback to SWFDP.

SWFDP has improved the lead-time and reliability of alerts and warnings for high-impact events such as heavy rains, severe winds and high waves, helping to protect lives and property and supporting vital sectors such as farming, fishing and transportation. As such, SWFDP provides a practical and beneficial platform for preparation and dissemination of multi-hazard early warnings. While progress has been made, the following recommendations could enhance EWS coordination in the region.

Firstly, there is a need to develop and strengthen the food security information system at both national and regional levels to meet the policy agendas of the African Union (AU) including the Comprehensive Africa Agriculture Development Program (CAADP), SADC as well as national priorities. The information could contribute to ongoing development programs, as well as to improving the effectiveness of the EWS, emergency preparedness, and response capacity.

There is also the need to support the strengthening of EWS legal regulatory, and institutional frameworks as well as improving coordination and ensuring clarity of roles and responsibilities. This will include developing common methodologies and procedures for data collection, management and data sharing across country borders, as well as developing strategies for the timely dissemination of actionable warnings.

SADC countries also need to invest in technical capacity development to enable the collection of high-quality agrometeorological crop production forecasts and vulnerability data. EWS require (a) improved capacity to incorporate global and regional climate forecasts to be meaningful at the local level; (b) strong weather observation networks with a wider coverage and (c) improved data collection for crop assessments, livestock assessments, and vulnerability assessments.

The SADC's VAA as well as the IPC methodologies should be harmonized or at least agree on minimum indicators to ensure quality assurance and comparison between countries.

Moreover, developing a common characterization of drought severity across the region that is contextualized and validated within each country should be a priority for improving communication, preparedness and response to droughts as they unfold (e.g. see section on CDI, immediately below).

In addition there is a need to strengthen public commitment and mainstream EWS considerations into national and sub-national policies, budgetary allocations and planning frameworks. This will require evidence-based advocacy to national and regional leaders and cooperation with development partners on the economic benefits of EWS.

Finally, further effort should be placed on the development of tools to support vulnerable households and communities to establish household and community support systems that can respond to emergencies.

Combined Drought Indicator (CDI)

Using a combined drought indicator (CDI) approach, the National Drought Mitigation Center (NDMC) at the University of Nebraska-Lincoln, in partnership with the World Bank, have developed a Drought Monitor that represents a consolidation of indices and indicators into one comprehensive drought map.

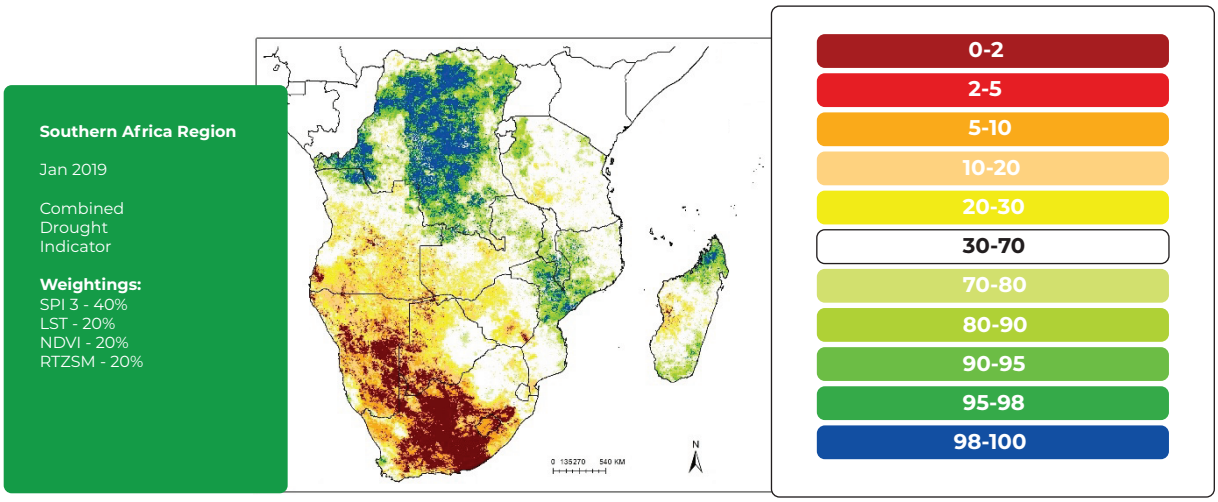
The CDI map for SADC was created using a weighted combination of four indicators of drought: precipitation, vegetation stress, land-surface temperature and soil moisture. January 2019 was selected to depict the severity of the recent 2018/19 drought, and provides an indication of the drought's magnitude (duration and intensity), spatial extent, probability of occurrence, and impacts. The January 2019 CDI map shows much of the region moderately-severely impacted by some degree of drought, particularly in the south-west (Namibia, South Africa, Botswana, Zimbabwe, Lesotho).

Without an effective drought monitoring and EWS to deliver timely information for early action, such as the CDI, effective impact assessment procedures, proactive risk management measures, preparedness plans aimed at increasing the coping capacity, and effective emergency response programs directed at reducing the impacts of drought, the country will continue to respond to drought in a reactive, crisis management mode.

Good practice case: Scaling CDIs

Country-specific CDIs have been developed for Botswana, Eswatini, and Zimbabwe, with other countries soon to follow. These have not only contributed to improved understanding of drought, but have led to enhanced communication and coordination among responsible institutions. Indeed, the value of countries developing composite indexes, such as the CDI, is growing in several SADC countries. There is a critically important coordination and capacity building role that the SADC Secretariat can play in further developing, expanding, and operationalizing the CDI across the region.

Fig 6. Combined Drought Indicator for SADC, January 2019



Drought policy framework

For a long time, the emphasis of drought strategies in the SADC region had been on short-term mitigation measures rather than on long-term prevention programs.

In recent years however, particularly since the major 2015/16 El Niño-induced drought that affected many countries in the region, new policies have been emerging in which preparedness, rehabilitation, prevention and planning are the key elements. Current drought management strategies are attempting to treat drought as a potentially serious recurring phenomenon and to integrate it into program management cycles aimed at mitigation and prevention.

The current regional policy framework relevant to drought includes:

- Regional Drought Management Strategy, 1999
- SADC Policy Paper on Climate Change, 2011
- SADC Climate Change Adaptation Strategy, 2011
- Regional Climate Change Strategy and Action Plan
- Framework of Sub-Regional Climate Programs, 2010
- Regional Disaster Preparedness and Response Strategy, 2016
- Regional Indicative Strategic Development Plan (RISDP) 2020–2030

Along with the acceptance that drought is a recurrent phenomenon, new policies tend to transfer the responsibility for dealing with the impacts of drought onto the farmer or the user of the land. New strategies are also designed to ensure that drought relief assistance and programs to support farmers are consistent with existing livelihood strategies and market development policies. This may require redefining drought relief programs, for example, designing market-based approaches using vouchers or cash to replace food and farm input handouts as a means of ensuring food security without distorting the market (SADC, 1999).

Compatibility between short-term and long-term development is an important element in the new policies, in which alternative ways of supporting farmers are recommended that will reduce their vulnerability to drought in the longer term. Long-term development programs could however be better linked with drought relief measures, e.g. infrastructure projects, such as the building of roads, dams and other utilities.

These may be accelerated during drought in the form of food or cash for work programs (FAO, 2004). SADC countries have also recognized the need to coordinate actions on regional issues that are common to them, such as water. However, many of these policies and legal frameworks are fragmented, and implementation plans and decision-making levels are often not well defined. Existing policies, strategies and structures should be consolidated and rationalized, perhaps in a single document.

What is needed is a clearer vision of the individual role of various government programs and structures in drought mitigation, preparedness, emergency response and rehabilitation (FAO, 2004).

Relevant strategic progress achieved by some of the SADC countries, and the lessons of which could be transferred to others, include the following areas:

- recognition that drought impact risk-reduction can be managed within the scope of long-term development planning;
- emphasis on drought policy formulation;
- establishment and support for functional implementation and coordination structures;
- special programs launched to support specific interventions at the regional level;
- implications for agricultural and general land use planning policies;
- changes in general policies as a direct result of new drought policy.

At the regional level, the UNCCD and other development partners are in the process of supporting the SADC Secretariat to develop a regional Drought Disaster Resilience Strategy (SDDRS). This strategy is meant to provide a holistic and comprehensive plan aimed at building and/or enhancing the resilience of vulnerable communities and ecosystems to the effects of recurrent droughts, while targeting simultaneous growth and sustainable development in the SADC region.

This initiative builds on the region's integrated development framework as spelled out in the SADC RISDP 2020-2030, the SADC RSAP 2015-2025 and several regional undertakings based on collective decisions to end drought emergencies, in particular, the Windhoek Declaration (2016).

Key to the successful implementation and uptake of this strategy by SADC Member States is the role and responsibility of SADC in emphasizing the importance of policy coherence between a regional plan such as this, and national drought plans across the region.

At the pan-African level, the African Development Bank (AfDB) and partners established the ClimDev Special Fund (ClimDev Fund) in 2009 as the investment arm of the Climate for Development in Africa Program.

The ClimDev Special Fund seeks to strengthen the institutional capacity of national and sub-regional bodies to formulate and implement effective climate-sensitive policies, and has funded noteworthy interventions including:

- Generation and wide dissemination of reliable and high-quality climate information in Africa;
- Capacity enhancement of policymakers and policy support institutions to integrate climate change information into development programs; and
- Implementation of pilot adaptation practices that demonstrate the value of mainstreaming climate information into development.

Mitigation, Preparedness and Response

Institutions and coordination

Policy developments in recent years tend either to promote the creation of independent drought institutions and funds or to embed drought within a multi-hazard policy framework. The latter is particularly common in countries where drought is not the primary natural disaster threat.

In addition, it is now commonplace for SADC countries to have inter-sectoral as well as sub-sectoral disaster or drought management committees. However, coordination between different institutional layers requires continuous effort, not only during drought periods, and this is less common throughout the region. In addition, focused building and maintaining of institutional capacities are important considerations. District/municipal drought committees should be strengthened to take up the responsibility for monitoring and reporting on drought impacts. Alongside the discrete actions of national governments, SADC coordinates policy discussions at the regional level, including the consideration of a range of drought, disaster risk reduction (DRR) and climate change initiatives.

- The Directorate of Infrastructure and Services houses the Climate Services Center (SADC-CSC). The Water Division, also under this Directorate, is responsible for coordinating the implementation of regional water-related activities.
- The Directorate of Food, Agriculture and Natural Resources, along with the Directorate of Policy Planning and Resource Mobilization, supports the institutionalization of international agreements on drought management, and climate change, as well as facilitates the Climate Change Inter-sectoral Technical Working Group that supports regional climate policy development.
- In 2011, SADC also established the Disaster Risk Reduction Unit.

Mitigation, preparedness and response capacity

Various drought response programs have been developed throughout the region. Many of these programs were developed on an ad hoc basis to enable countries' post-drought relief response strategies, without linkages to national development initiatives.

However, drought is becoming an important part of national and regional development planning and is being recognized as a chronic problem rather than a series of ad hoc emergencies. This is evidenced by the evolution of drought management policies and strategies in several SADC Member States.

The recent 2018/19 drought brought with it important lessons for the region, particularly in terms of drought risk financing.

By the end of 2019, several countries had declared national disasters and several more were facing debt distress with the combined burden of the Covid-19 pandemic, including Lesotho, Malawi, Mozambique, Zambia and Zimbabwe.

For example, South Africa announced a R500 billion, or USD30 billion (roughly 10% of GDP) relief package, Namibia announced a stimulus and relief package amounting to N$8.1 billion, or USD544 million (4.25% of GDP), and Lesotho allocated M1.9 billion, or USD113 million (about 6% of GDP), for the National COVID-19 Response Integrated Plan and emergency assistance.

The existing macro-financial risks facing the region have been exacerbated by the increasing levels of debt distress coupled with expansionary fiscal and monetary policies needed to limit the adverse effects of the COVID-19 and other shocks.

This has led to downgrades in credit ratings of Botswana (by S&P Global Ratings) and South Africa (by Fitch, leaving the country without an investment-grade rating for the first time in 25 years).

Key climate/disaster management development partners such as the Green Climate Fund (GCF), AfDB, World Bank have provided considerable support over the years to the region, but are often constrained by several barriers including:

- Lack of enabling environment for institutional effectiveness;
- Lack of coverage and scale for effective service delivery in terms of quantity and quality of hard infrastructure and inadequate soft infrastructure for ensuring delivery and uptake of risk information;
- Insufficiently coordinated interventions limit the effectiveness of existing support to SADC countries;
- Market barriers to creating enabling conditions;
- The complexities of production; dissemination and uptake of climate/drought risk information; and
- Limited governmental finances and budget allocations.

The post-pandemic transition to fiscal consolidation is important to improving debt sustainability, but, for the southern Africa region, a key part of this fiscal consolidation is strengthening countries' financial resilience to future shocks, because such shocks are costly.

'The Chronology of a Disaster' World Bank report finds that the cost of delayed response to drought could be as much as 3.9% of GDP per capita in low-income countries. Supporting countries to be better financially prepared to respond to shocks is a new yet rapidly expanding area of work for the World Bank Group in the southern Africa region, embedded in broader disaster risk management strategies. Countries are not only embracing tools and instruments to strengthen financial resilience, but also driving innovation in the space. Eswatini, Lesotho, South Africa and Zambia, among other countries in the region, have taken the first steps to increase their financial preparedness to respond to shocks, by developing a customized suite of risk financing instruments, protecting the budget and GDP and, most importantly, the poor and vulnerable.

In 2017/2018, Zambia bundled agriculture insurance with the Government's Farmer Input Subsidy Program (FISP). This increased the number of farmers with access to agriculture insurance from a mere 20,000 to over 900,000 within one year, making it the largest agriculture insurance program in sub-Saharan Africa. Although there are implementation challenges to this insurance program, this bold and innovative move by the government facilitated an expansion of agriculture insurance previously considered unobtainable (further discussion in the World Bank's Zambian Agriculture Finance Diagnostic report). Countries are also exploring the potential cost savings they can achieve through risk layering and establishing a suite of complementary risk financing instruments such as contingency funds, contingent credit and insurance.

A disaster risk finance diagnostic carried out in Lesotho estimated that, through adopting such an approach, the government could save on average USD4 million per year, and for an extreme shock as much as USD42 million. And finally, countries are increasing their preparedness by proactively developing strategies for financing future disaster response. In 2019, the Government of Malawi became the first country in southern Africa (and second in Africa) to adopt a national disaster risk financing strategy, which identified the country's strategic priorities for financing disaster response (Maher and Baskaran, 2020).

While various recommendations are made in the country-specific profiles, several regional-level conclusions can be made:

- There is an increasing shift from fragmented projects and ad hoc funding across all three pillars, to more integrated programs with sectoral solutions.
- Targeted preparedness and mitigation investments that increase drought resilience are needed in all countries, with some of these investments, such as a drought monitor and EWS, needed at the regional level.
- There is now an expansion of the drought management ecosystem beyond the public sector (NMHS) that encompasses public, private and research sectors as well as civil society.
- Continued investment and support is needed to strengthen institutional capacity and promote institutional coordination across all levels of government.
- Innovative risk financing instruments are now being implemented in several countries and this trend will continue as macro-financial risks facing the region continue to grow.

Table 6. Multisectoral mitigation measures (Source: UNDP Cap-Net, 2020)

Short-term measures	Both short and long-term Possible	Long-term measures
Legislation & public policy		
Issue emergency irrigation permits for using state waters for irrigation	Adopt an emergency water allocation strategy to be implemented during severe drought.	Adjust legal and institutional framework by, for example: - Prepare position papers for legislature on public policy issues - Examine regulations governing water rights for possible modification during shortages - Pass regulations to protect water flows - Pass regulations to protect and manage groundwater - Pass regulations providing guaranteed low-interest loans to farmers - Impose water use efficiency and limitation measures -Develop a water plan - Establish natural hazard mitigation committees - Provide technical support for developing contingency plans by all large water users
Water conservation and demand reduction		
○ Restrict uses (agricultural, municipal) ○ Divert water from given uses ○ Over-draft aquifers (temporarily) ○ Ration water supply ○ Dual distribution networks for drinking water supply ○ Adopt carry-over storage ○ Conjuctive use	○ Encourage and support voluntary water conservation ○ Require water users to decrease reliance on groundwater and implement conservation measures ○ Voluntarily insurance, pricing and economic incentives	○ Reduce use ○ Reduce losses (e.g. line canals or install piping to control seepage) ○ Review water allocation ○ Conjunctive use (surface-groundwater) ○ Establish stronger economic incentives for private private investment in water conservation ○ Improve water use and conveyance efficiencies ○ Implement water metering and leak detection programes ○ Reduce consumptive use by changing the type of water application system or using water meters ○ Promote innovative technologies, such as irrigation system improvements, waterless urinals and monitoring technologies

Short-term measures	Both short and long-term measures	Long-term measures
Enhancing supply		

• Exploit low-cost waters
• Adjust legal and institutional framework
• Locate new standby resources (for emergency)
• Provide permits to exploit additional resources
• Provide drilling equipment
• Issue emergency permits to water use
• Provide pumps and pipes for distribution
		• Increase storage capacity
		• Develop water transfers
		• Locate new potential resources
		  ◦ Aqueduct and canals
		  ◦ Groundwater recharge
		  ◦ Small-scale water collective/harvesting
		  ◦ Artificial precipitation
		  ◦ Desalination of brackish and saline water
		• Identify water treatment and reuse of wastewater/ recycling opportunities
		• Rehabilitate reservoirs and increase water storage
		• Compile an inventory and review reservoir operation plans Implement water quality management and wastewater reuse

Improve water management other than supply and demand		
• Temporarily reallocate water(on basis of assigned use priority) • Decrease transport and distribution costs • Provide emergency supplies • Compile an inventory of private wells; negotiate purchase of water rights for public use • Elaborate regulations on water markets • Elaborate alert procedures		• Compile an Inventory and monitor natural resources within the relevant areas
Public education and participation		
	• Organize drought information meetings for the public and the media • Establish a drought watch centre that distributes real-time weather and drought monitoring data	• Establish a public advisory committee • Include public participation in drought planning • Implement water conservation awareness programmes • Organize workshops on special drought-related topics • Establish a drought information centre • Develop training materials in several languages • Advise people on potential sources of water
Conflict resolution		
	• Resolve emerging water use conflicts • Suspend water use permits in watersheds with low water levels • Work with community-based organizations to promote public participation in conservation progamme	

Recent drought resilience efforts by the international community

Table 7. Selected projects focused on drought, or some aspect of it, in SADC.

World Bank

Southern African Drought Resilience Initiative (SADRI)
Time Period: 2020-2022

Accelerating Impacts of CGIAR Climate Research for Africa (AICCRA)
Budget (USD): 60M
Time Period: 2021-2023

SADC Drought and Groundwater Management Project

Zambezi River Basin Management Project
Budget (USD): 4M
Time Period: 2015-2018

SADC-Groundwater Management Institute (SADC GWMP, 10.2 million; Phase 2, 14.2M)
Budget (USD): 24.2-M
Time Period: Ongoing

JICA

Research Institute Program on Climate Change

USAID

Resilient Waters Program (RWP)

Southern Africa Regional Environmental Program (SAREP)
Time Period: 2010-2016

Resilience in the Limpopo Basin (RESILM)
Time Period: 2012-2017

BMZ/GIZ

Transboundary Water Management in SADC: Protecting a scarce resource in Southern Africa
Time Period: 2020-2023

African Union's New Partnership for Africa's Development (NEPAD)/ World Bank

African Resilient Landscapes Initiative
Time Period: 2015

FCDO

Climate Resilient Infrastructure Development Facility (CRIDF)
Budget (USD): 25M
Time Period: 2013-present

Future Climate for Africa (FCFA)
Time Period: On-going

Regional Climate Change Program (RCCP)
Time Period: 2007-2012

AfDB

ClimDEV

NDF

Mainstreaming Climate-Smart Agriculture in Solar Irrigation Schemes for Sustainable Local Business Development
Budget (USD): 10.2M
Time Period: 2013-2015

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Data Sources:
Climate Data: CHIRPS
Drought Risk : International Water Management Institute (IWMI)
CDI: National Drought Mitigation Center at the University of Nebraska-Lincoln
Population Data: WorldPop
Livestock, GDP: FAO, World Bank

About the Southern Africa Drought Resilience Initiative (SADRI)

SADRI is a World Bank initiative supported by the Cooperation in International Waters in Africa Program (CIWA) that integrates across the energy-water-food-environment nexus to help lay the foundations for making southern African countries more resilient to the multi-sectoral impacts of drought. Its main objectives are to generate tools and dialogue for enhancing partnerships and capacity across Member States and to inform future national and regional investments in drought-related activities.