Drought Risk Management and Mitigation Strategy (DRIMMS)

2022 – 2032

VOLUME 1

A GLOBAL REVIEW OF DROUGHT POLICIES AND MITIGATION STRATEGIES, AND THE LESSONS LEARNT FOR THE SADC REGION

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Volume 1: A Global Review of Drought Policies and Mitigation Strategies, and the Lessons Learnt for the SADC Region

Volume 2: Drought Vulnerability Assessment Report

Volume 3: Drought Risk Management and Mitigation Strategy and Recommended Implementing Arrangements

Executive Summary Document

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Abbreviations

ACAT	Africa Cooperative Action Trust
ACDRM	African Centre for Disaster Risk Management
ACRITEX	Agriculture, Technical and Extension Service
ADRA	Adventist Development and Relief Agency
ASMET	Advancement for Small & Microenterprises Development in Tanzania
AU	African Union
CBO	Community-based organisation
COMESA	Common Market for Eastern and Southern Africa
CRC	Conservation Resource Centre
DDMA	Department of Disaster Management Affairs
DENR	Department of Environment and Natural Resources
DMD	Disaster Management Department
DMMU	Disaster Management and Mitigation Unit
DRR	Disaster risk reduction
DWRM	Department of Water Resources Development
ECOT	Eswatini College of Technology
ECZ	Environmental Council of Zambia
EEC	Eswatini Electricity Company
ESWADE	Eswatini Water and Agricultural Development Enterprise
FANR	Food, Agriculture and Natural Resources Sector
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
GWP-SA	Global Water Partnership, Southern Africa
IFAD	International Fund for Agricultural Development
IGO	International governmental organisation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWMI	International Water Management Institute
MAE	Ministry of State Administration

MS	Member States
MT	Metric ton (tonne)
NAMBOARD	National Agricultural Marketing Board
NCCDM	National Committee on Disaster Management
NDMA	National Disaster Management Agency
NDMO	National Disaster Management Office
NEWU	National Early Warning System
NGOs	Non-governmental organisations
NMC	National Maize Corporation
RCP	Representative concentration pathway
REC	Regional economic committee
REWU	Regional early warning system
RISDP	Regional indicative strategic development plan
SDGs	Sustainable Development Goals
SADC	Southern African Development Community
SLM	Sustainable Land Management
SSA	Sub-Saharan Africa
TWLAT	Tanzania Women Land Access Trust
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Economic and Social Council
UNESWA	University of Eswatini
UNICEF	United Nations International Children's Emergency Fund
WB	World Bank
WFP	World Food Programme
WMO	World Meteorological Organization
ZimVAC	Zimbabwe Vulnerability Assessment
ZINWA	Zimbabwe National Water Authority
ZMD	Zambia Meteorological Department

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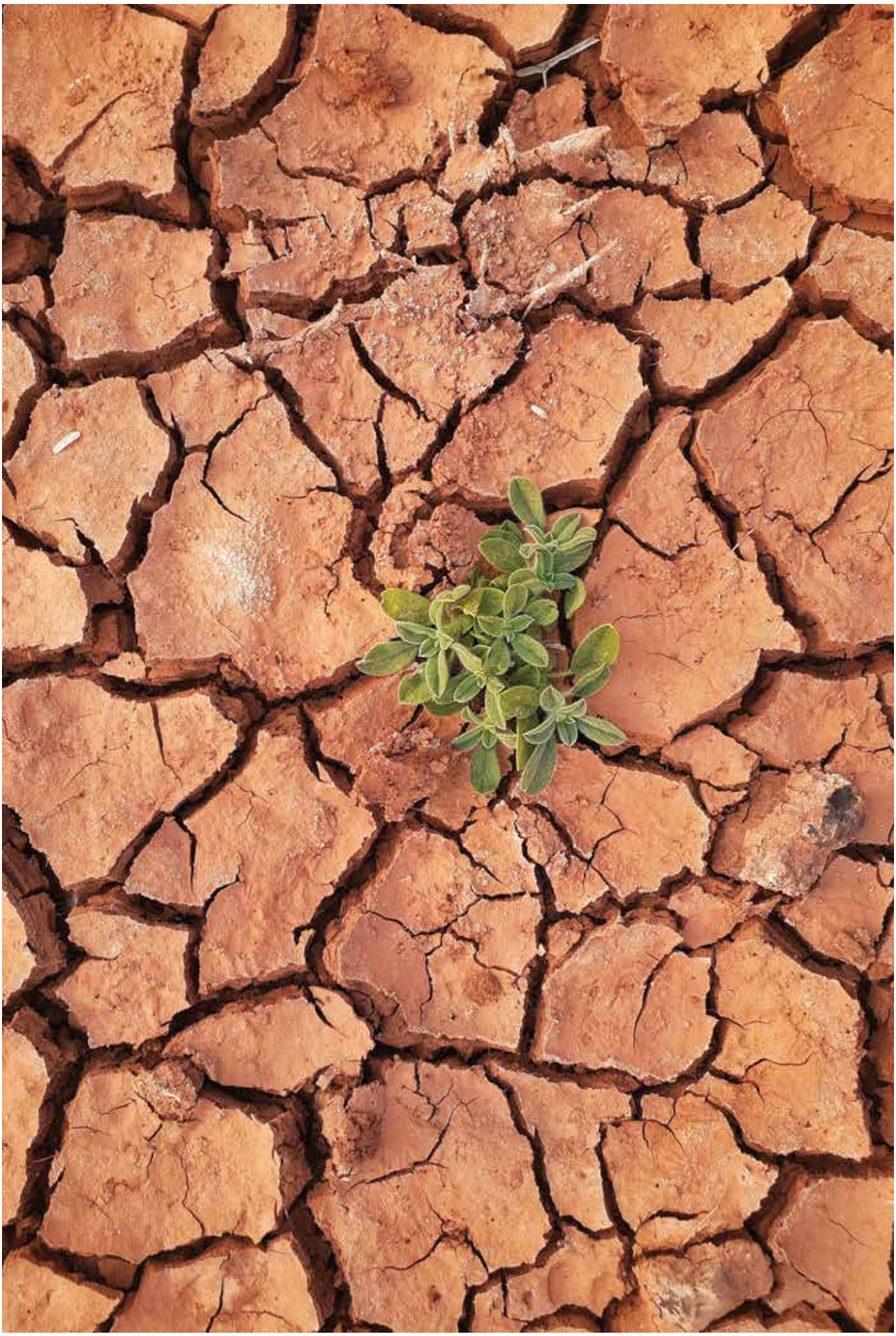


Executive Summary

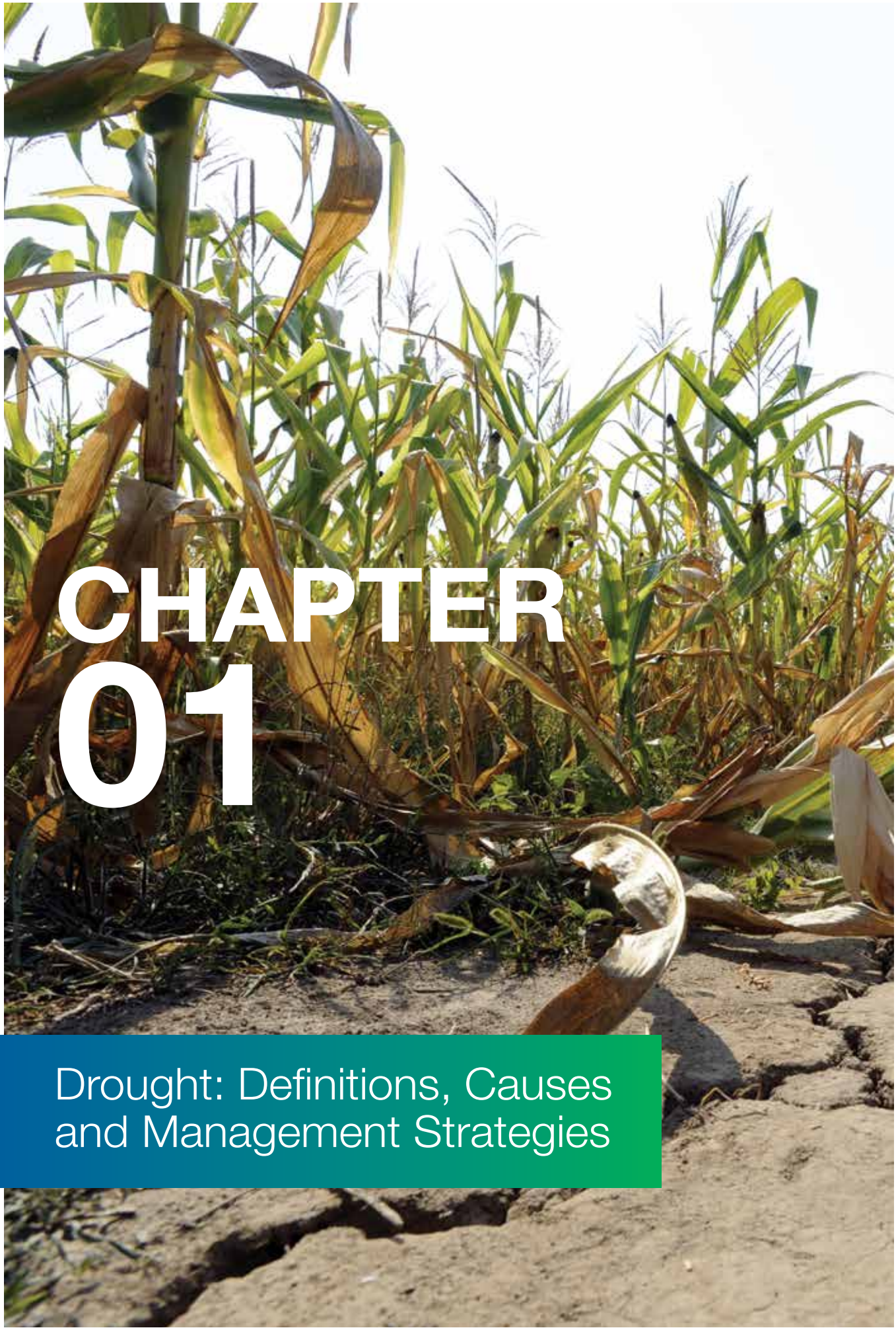
The definition of drought varies depending on the location and its symptoms. In general, droughts are classified into four types: meteorological, hydrological, agricultural, and socioeconomic. Drought is caused by reduced or low precipitation levels over an extended period which is can be triggered by different factors, including atmospheric circulation, moisture transport (oceanic temperatures and oscillations, i.e El Niño-Southern Oscillation) and thermodynamic processes. With the changing climate conditions (influenced by global warming), these factors of drought change lead to frequent and/or prolonged drought events. The IPCC Assessment Report 4 model projects that global warming will be responsible for drying that will continue from the subtropics and expand poleward. Further, soil moisture modelling indicated that greenhouse gas warming caused a worldwide agricultural drought in most parts of the world Complex maritime and terrestrial interactions produce varying climatic conditions in different regions). A limited understanding of atmospheric and oceanic dynamics has long undermined drought management strategies.

Drought policies and management frameworks have evolved from reactive to proactive management in the past several decades. International frameworks that influenced drought management include the 1994 Yokohama Strategy, The World Conference on Disaster Reduction of 2005, the Hyogo Framework for Action and the Sendai Framework of 2015. The Sendai Framework has become central to drought interventions as it comprehensively aims to prevent new disaster risks and reduce existing disaster risks through the implementation of an integrated and inclusive approach within and across all economic sectors. UNCCD's Drought Management Toolbox further nuanced drought management by emphasizing monitoring and early warning systems, vulnerability and risk assessments, and risk mitigation measures. DRAPA encourages the development

of national drought policies for drought risk management and enhances capacity at all levels of government to mitigate drought effects in Africa, influenced by these global frameworks.

Global drought severity and incidence have been assessed, and they are increasing, causing devastating effects on human, social, economic, and ecological well-being. Over the past century, drought events have consistently increased in the region, as reflected in the assessment. In most SADC countries, drought severity is increasing, albeit with varying rates of change. In particular, South Africa, Lesotho, the southern Democratic Republic of Congo (DRC) and Tanzania stand out as key hotspots. In addition to poverty, inadequate analysis and inadequate response actions, which are often poorly coordinated, and a lack of political will, this is exacerbated by poverty and faulty analysis.

There are valuable lessons to be learned from drought risk management around the world for the SADC region. Nations and regional governments must improve their drought monitoring and early warning systems. A better drought plan must consider risk assessments at all levels, from the community level to the regional level, to achieve better vulnerability and risk/impact assessments at the national and regional levels. Restoration of degraded lands, balancing land and water resources, improved conservation, sustainable utilisation and expansion of storage through dams and reservoirs are some of the mitigation measures recommended for the SADC region. It is beneficial for governments in the SADC region to establish institutions that are exclusively responsible for drought management, improving monitoring, early warning capabilities, and developing programs for preparedness, response, and recovery."



CHAPTER 01

Drought: Definitions, Causes and Management Strategies

1.1 Introduction

Drought has adversely affected societies in all regions of the world (FAO, 2019). The global concern over drought is informed by the complex, devastating impact on lives, livelihoods and economies that curtails national growth and undermines regional sustainable development (Tadesse, 2016). Global disasters, including drought, claimed over 700 000 lives between 2005 and 2015, injuring more than 1.4 million people and displacing another 23 million, with economic losses estimated at US$1.3 trillion within 10 years (Pearson and Pelling, 2015). Concerns have been raised over the increasing frequency and severity of droughts (Sivakumar et al., 2014).

The United Nations Convention to Combat Desertification (UNCCD) and its partners are paying increased attention to drought due to fears over the growing socio-economic impacts and the effects on millions of people in drought-prone regions worldwide (Sheffield and Wood, 2008). These regions suffer acute water scarcity that undermines human wellbeing, impacting negatively on agriculture and food production and leading to loss of income, unemployment, erosion of assets, malnutrition and poverty. Presently, the worst damage happens whenever drought conditions coincide with civil conflict (Anderson and Delisi, 2011) and in most cases, deadly humanitarian crises are witnessed, with hunger and thirst claiming millions of lives.

In both developing and developed countries, the direct impact of drought frequency, severity and duration on water supply is evident in all economic sectors, starting with agriculture, then energy production, tourism, transportation, urban planning, and the environment (Wilhite et al., 2014). At the local level, social impact is most severe when drought occurs in poor regions with vulnerable populations. The global priorities, in both science and practice, are focused on reducing the social, environmental and economic impacts of droughts and identifying pathways toward more drought-resilient societies (Hagenlocher et al., 2019).

Based on physical science and technology, the Intergovernmental Panel on Climate Change (IPCC) has linked the warming of the earth's climate system to dangerous anthropogenic interference, including ecosystem/water resource management and industrial emissions, which shift atmospheric equilibrium and result in long periods of drought (IPCC, 2007). (Figure1).

In many countries, droughts are not proactively managed as recurrent events but are dealt with as crises and emergency responses. Drought responses have been criticised as untimely, costly, poorly coordinated and disintegrated, delaying efforts toward the adoption of national drought policies aimed at drought risk reduction (Wilhite et al., 2014). To address these shortcomings, policy reforms in some countries focus on strengthening community and state capacity to withstand periods of drought (Easterling and Wilhite, 1987).

Drought mitigation, preparedness and response are measures and actions taken by governments to reduce the vulnerability to drought and minimise the impacts of droughts or enhance recovery.[1] In the context of natural hazards, drought mitigation refers to actions taken in advance of drought to reduce impacts in the future.[2] Based on information from UNCCD, drought risk mitigation measures are actions adopted at the national and local levels to reduce drought risks through better drought preparedness and effective response strategies.[3]

[1]UNCCD: Integrated drought management plan. Pillars section: Mitigation, preparedness and response; IDMP, https://www.droughtmanagement.info/pillars/mitigation-preparedness-response/
[2]World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2014)
[3]UNCCD: Drought tool box. Risk mitigation measures. https://knowledge.unccd.int/drought-toolbox/page/risk-mitigation-measures

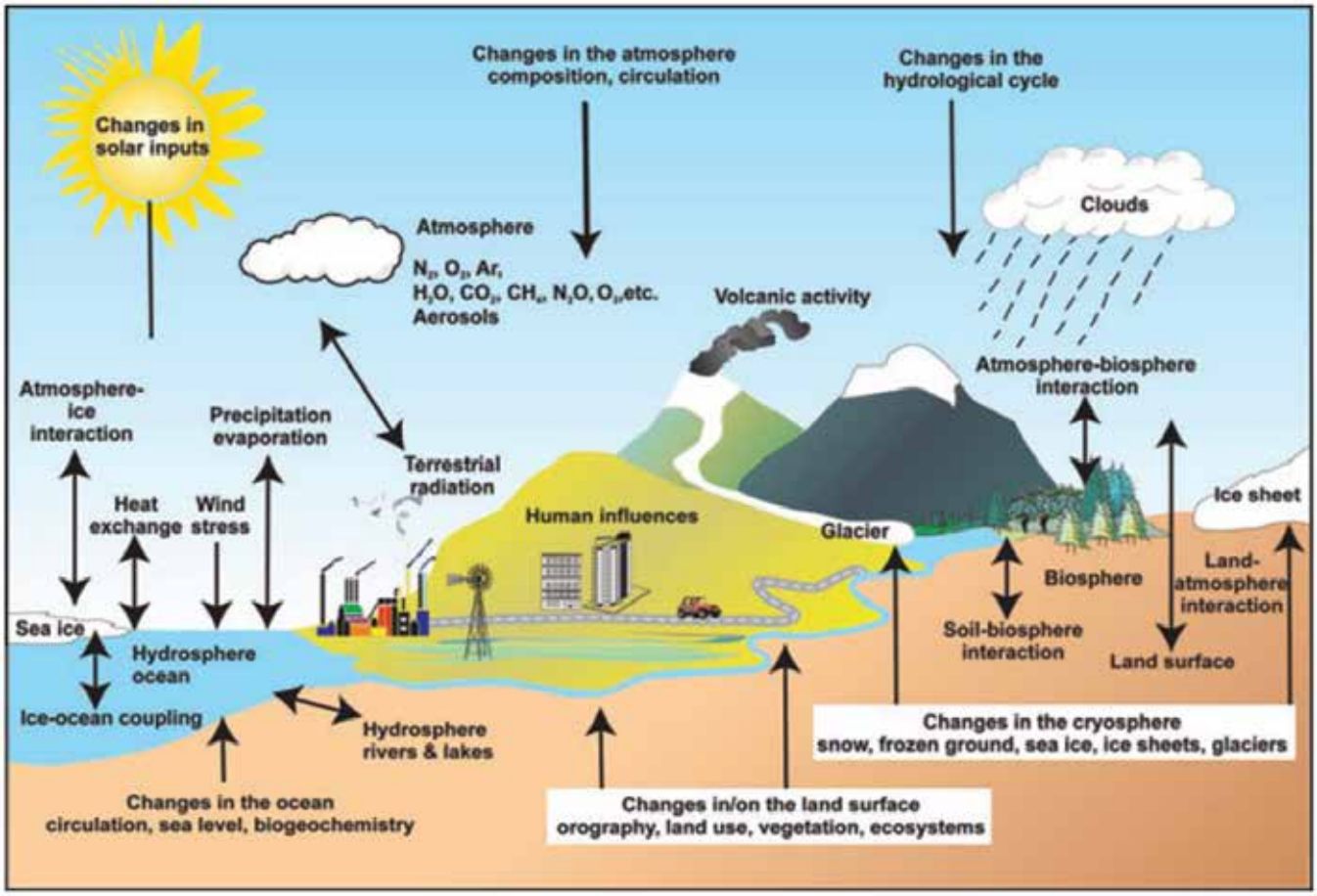


FIGURE 1: THE GLOBAL CLIMATE SYSTEM (HORTON ET AL., 2010). ORIGINALLY ADAPTED FROM IPCCWG1 2007

1.2 Definitions of Drought

To date, many definitions of drought have been developed that extend beyond meteorological aspects to address specific impacts in the agriculture, hydrological, socio-economic, and ecological sectors (UNCCD, 2019a).[4] Scholarly definitions of drought are based on variables such as inadequate precipitation or water deficits available for plant growth, hydro-power and commercial and industrial use (O'Farrell et al., 2009). When contextualising drought, agricultural drought is explained based on the reduction in soil moisture availability below the optimal level required by a crop at each different growth stage, resulting in impaired growth and reduced yields (Figure 2). This is close to the hydrological drought that is concerned with the precipitation deficiencies that are responsible for the scarcity of subsurface water resources that is detrimental to plant growth (FAO, 2020b).

Meteorological drought is related to a reduction in precipitation supply compared with a specified average condition. The UNCCD (2019b) defines meteorological drought as a precipitation deficiency, possibly combined with increased potential evapotranspiration, extending over a large area and spanning an extended period.

Hydrological drought happens when there is reduced availability of surface and subsurface water resources; that is, when there is a substantial deficit in surface runoff, or when there is a depletion of groundwater recharge. According to Van Loon and Laaha (2015), hydrological drought is a lack of water in the hydrological system, manifesting itself in abnormally low streamflow in rivers and abnormally low levels in lakes, reservoirs and groundwater.

[4]UNCCD/Science-Policy Interface (2019). Land Management and Drought Mitigation. Science-Policy Brief No: 6. September 2019. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany

Agricultural drought is defined as a reduction in soil moisture availability below the optimal level required by a crop during each different growth stage, resulting in impaired growth and reduced crop yields. Based on Wilhite (2011), the definition of agricultural drought is a critical factor in estimating crop production potential.

Socio-economic drought happens when human activities are affected by reduced precipitation and related water availability. Based on UNCCD (2019b), socio-economic drought occurs when the demand for economic goods exceeds the supply because of weather-related shortages in the water supply.

Although Figure 2 shows the relationships among the four types of drought and their physical and socio-economic impact on ecosystems, the four can also be explained separately as categories of drought (Rojas, 2020) to expand the understanding of separate impacts and propose mitigation strategies against each type of drought. The United Nations Development Programme (UNDP) considers drought the most complex and least-understood of natural hazards, affecting more people than any other hazard. Drought hazards can be characterised by multiple climatological and hydrological parameters that relate to, and shape, the development of measures for mitigation of drought impacts (Mishra and Singh, 2010).

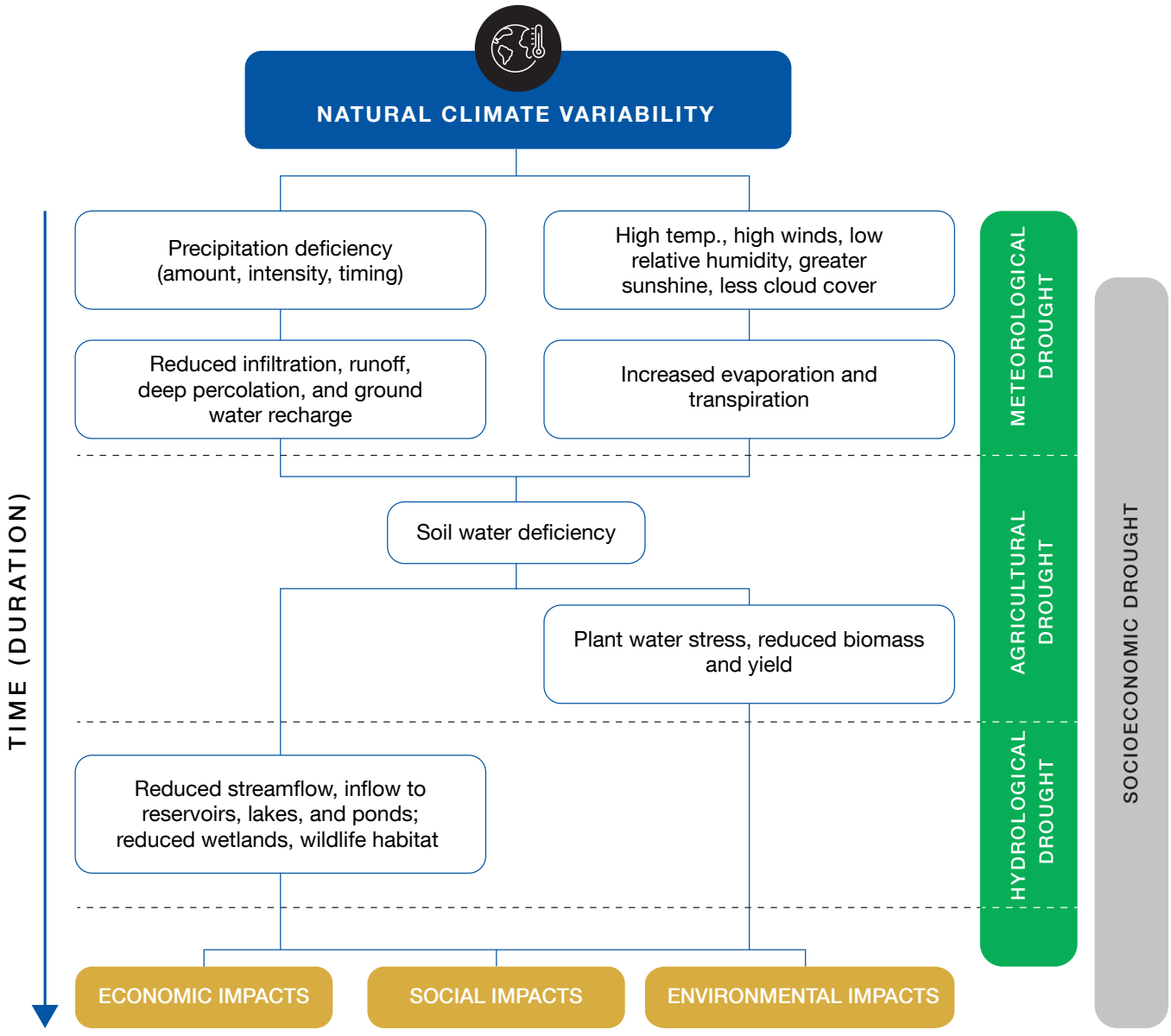


FIGURE 2: TYPOLOGIES OF DROUGHT (TADESSE, 2018)

1.3 The Causes of Drought

Droughts can be triggered by different factors, including atmospheric circulation, moisture transport and thermodynamic processes (Drumond et al., 2019). In the Amazon, IPCC models show that the subtropical high pressure in the south, combined with the north-south tropical Atlantic sea surface temperature gradient, leads to an increase in dry conditions (Zhang, 2015). The IPCC Assessment Report 4 model projects that global warming will be responsible for drying that will continue from the subtropics and expand poleward (Cook et al., 2010). Further, soil moisture modelling indicated that greenhouse gas warming caused a worldwide agricultural drought in most parts of the world (Wang, 2005).

Complex maritime and terrestrial interactions produce varying climatic conditions in different regions. In the Sahel, both drought and precipitation have been linked to the El Niño-Southern Oscillation (ENSO), the equatorial Indian Ocean sea-surface temperature (SST), the African Easterly Jet (AEJ) and the Tropical Easterly Jet (TEJ). The Gulf of Guinea is affected by SSTs, and south-west Africa by ENSO and the North Atlantic Oscillation (NAO), while drought in South Africa is exclusively linked to ENSO (Parry et al., 2007). Besides ENSO, oceanic circulation in Southern Africa is seen to influence regional climate (Lutjeharms et al., 2001), including the Indian Ocean dipole responsible for Zimbabwe's weather patterns (Manatsa et al., 2011), the quasi-biennial oscillation (QBO) influencing precipitation in Malawi (Jury, 2002), and the Antarctic Oscillation (AAO) on the winter rainfall on the west coast of Southern Africa (Reason, et al., 2002). These influences are most significant during the summers (Fauchereau et al., 2003).

A limited understanding of atmospheric and oceanic dynamics has long undermined drought management strategies. Despite progress since the release of the IPCC Fifth Assessment Report (AR5) in 2013, challenges of data quality and availability undermine the accuracy of the factors cited for causing drought (Alexander, 2016).

1.4 Levers for Improving Drought Management through International Agreements

Drought differs from one region to another in terms of its physical characteristics, impacts and coping capacity, including the level of preparedness, mitigation and response/recovery capability (Wilhite, 2014a). Driven by the severe and complex impacts of drought on various sectors of national economies, governments are developing working practices to manage drought risks that undermine national growth. Processes for developing and implementing sustainable drought management practices reveal the gap in state capacities to manage increased vulnerabilities and motivate the promotion of working drought strategies at the international level. According to the UNCCD's Integrated Drought Management Programme, drought management strategies are measures undertaken by governments around the world to minimise drought impact and build community and national resilience against drought risks.

In the 1990s, the International Decade for Natural Disaster Reduction (IDNDR, 1990-2000) focused on improved cooperation among African states to enable sharing of experiences, assisting them

to engage in disaster management policies in order to address land degradation and poor coordination at regional levels (Plate and Kron, 1994). The intention was to reduce loss of life, poverty damage and socio-economic disruptions resulting from natural disasters including drought.

In the last decade, drought policy-related discussions have focused on paradigm shifts in the pattern of global response from short-term strategies to more proactive planning and mitigation strategies (Ding et al., 2011). Such dynamics are driven by the widespread failure of previous measures that continued to allow drought to exert devastating impacts on society, the economy and the environment (Yuan and Wood, 2013). These drought impacts are more complex today as many economic sectors are affected, creating more conflicts between various water users. In Africa and elsewhere, drought responses reflect the low commitment by governments to prioritise drought risk management, leading to fragmented investment, planning, mitigation and disaster preparedness in the region (Wilhite, et al., 2005). Such limited commitment by some states has been going on since 2015 despite the renewed international commitment to the Paris Agreement (UN_Paris Agreement, 2015). For some African states that adopted the UNCCD in 1992, policy development has been slow due to limited state capacity.

Despite such limitations, the Sendai Framework demonstrates how policies with drought-related components need more global attention. As emphasised in the IPCC AR5 (2013) (Chen et al., 2018), the absence of direct observations among states and the dependency on inferred global trends on index choice has challenged the clear distinction of long-term climate change from decadal-scale drought variability.

1.5 Drought and Land Degradation

There is a strong link between drought and land degradation, as observed in the gradual impact of water scarcity on vegetation cover. Land degradation is often described as the loss of potential productivity from an agricultural perspective. Anthropogenic activities, including intensive historical land uses (e.g., livestock grazing, crop farming), in semi-arid parts of the Sahel, northern Australia and South Africa, have made ecosystems vulnerable to land degradation processes (Vicente-Serrano et al., 2015). The linkage shows the complexity of vegetation activity processes in the world's semi-arid regions and the difficulty of defining a universal response to the effect of drought as a variety of factors (natural and anthropogenic) interact in these arid regions.

Land management practices offer opportunities for mitigating the impact of drought and refocusing actions on proactive drought risk management. Sustainable land management for ecosystem resilience plays a role in reversing land degradation and discouraging the spread of desert-like conditions (Hans, 1997). The UNCCD (2019) states that sustainable land management (SLM), nature-based solutions, ecosystem-based disaster risk reduction (Eco-DRR) and ecosystem-based adaptation are proactive and effective approaches for improving long-term ecosystem and human resilience.

The Drought-Smart Land Management (D-SLM) framework illustrates land-based interventions for drought mitigation (Figure 3). The D-SLM interventions improve the capacity of soil to accept, retain, release and transmit water and increase plant water use efficiency. D-SLM interventions contribute to avoiding, reducing and reversing land degradation under the framework for land degradation neutrality (LDN). LDN is defined as a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems (Orr et al., 2019)

LDN aims to support national sustainable development aspirations by providing guidance on the policies, procedures and governance needed to regulate national land use to avoid further net loss of productive lands (Metternicht, Akhtar-Schuster and Castillo, 2019). It can be achieved by halting the ongoing loss of land using a dual-pronged approach of measures to reduce land degradation and reverse past degradation. LDN implementation is fundamental to achieving the Sustainable Development Goals (SDGs), especially Target 15.3. Achieving LDN can also support the implementation of the objectives of the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD) (Orr, Rakoto and Safriel, 2019). Many nations require an enabling policy environment (UNCCD, 2019a) and increased financing to implement LDN (Chasek et al., 2019).

Frequent droughts are considered a threat to land management; as natural (vulnerable) resources degraded during drought will have less time to recover before the next drought (Australian Government, 2019). In the long run, future productivity will decline, as will the natural capital base. Achieving LDN will help reduce drought risk and assist in effective, sustainable land management. Investing in natural resource management programmes that enhance the country's natural resource base is important, as this has a positive impact on conservation efforts, especially on degraded land resources.

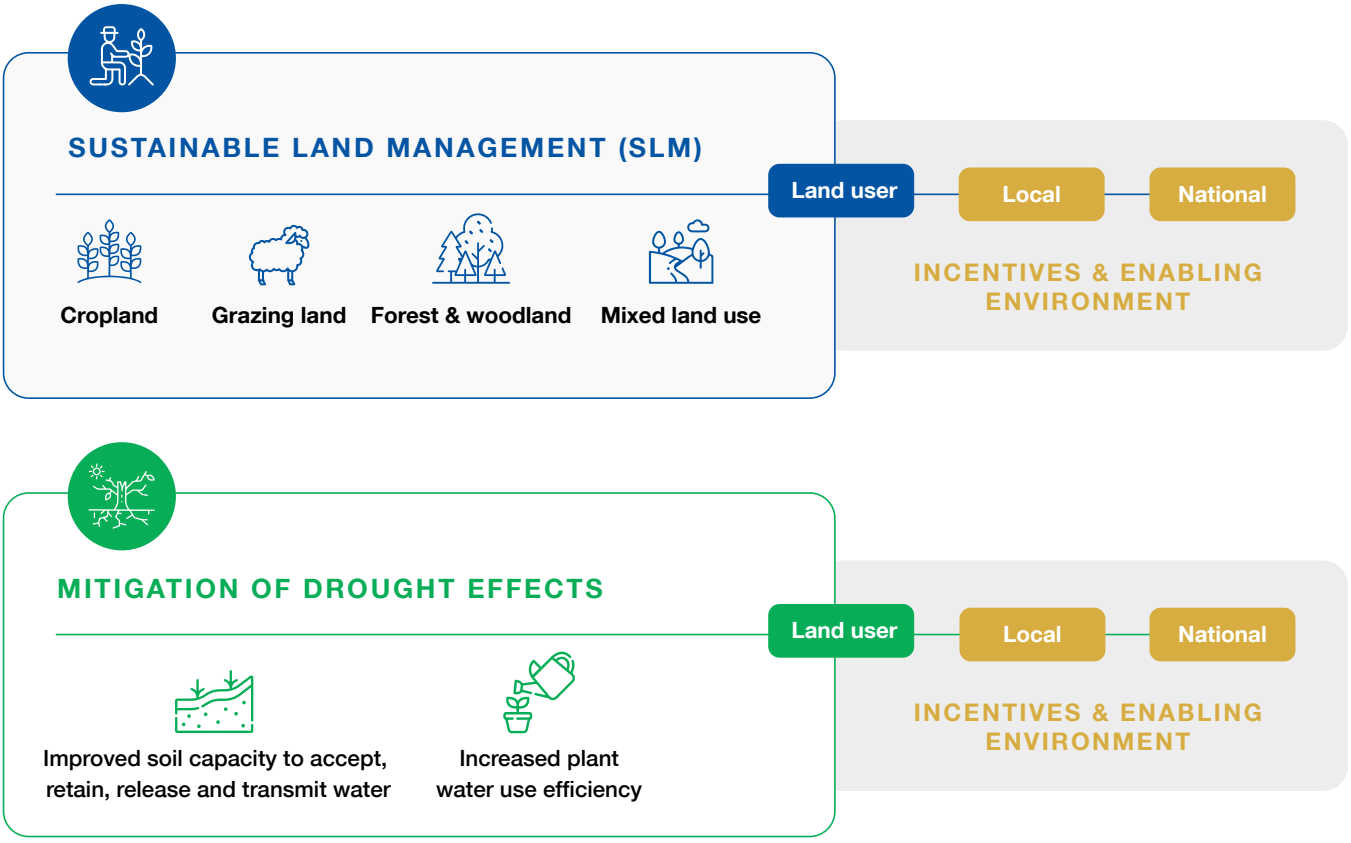


FIGURE 3: DROUGHT-SMART LAND MANAGEMENT (D-SLM) FRAMEWORK (GERBER, 2019).

CHAPTER 02

Global scope: Trends and Impact of Drought

The IPCC documented a range of observed climate trends in its 2007 Fourth Assessment Report, about global surface temperature – where an increase of about 1.3°F (0.7°C) over the past century has had implications for drought risks (Horton et al., 2010). The notable impact is that the increases in drought duration, intensity and severity in Central America, the Amazon, Southern Africa and the Mediterranean, co-relate with the extension of dry spell periods and reduced water availability in these regions, under the 1.5 and/or 2°C warming scenarios (Liu et al., 2018).

2.1 Dynamics and Trends

The Food and Agriculture Organization of the United Nations (FAO) Agricultural Stress Index System (ASIS) analysis of climate change projections foresee an increase in drought episodes based on the distribution and varying intensity of droughts at the global or continental level (Figure 4). In addition, the fifth report from the IPCC projects that drought episodes are expected to increase in frequency due to climate change impacts (Stocker, 2014).

In Europe, drought has manifested in the past three decades through increased water scarcity and affects at least 11% of the population and 17% of EU territory (Stein et al., 2016). In Russia, regional climate projections indicate that there is a continuous reduction in soil moisture in the spring and summer seasons, and increased drier conditions over most of European Russia (Krichak and Alpert, 2005).

According to the International Fund for Agricultural Development (IFAD), at least 60% of Sub-Saharan Africa is vulnerable to drought, while another 30% is highly vulnerable (Figure 5). From 1980-2000 it was noted that the SADC region experienced drought on average once every four to five years. Generally, the extreme drought in the Limpopo River Basin is a regular phenomenon and has been recorded for more than a century at intervals of 10-20 years (FAO, 2004).

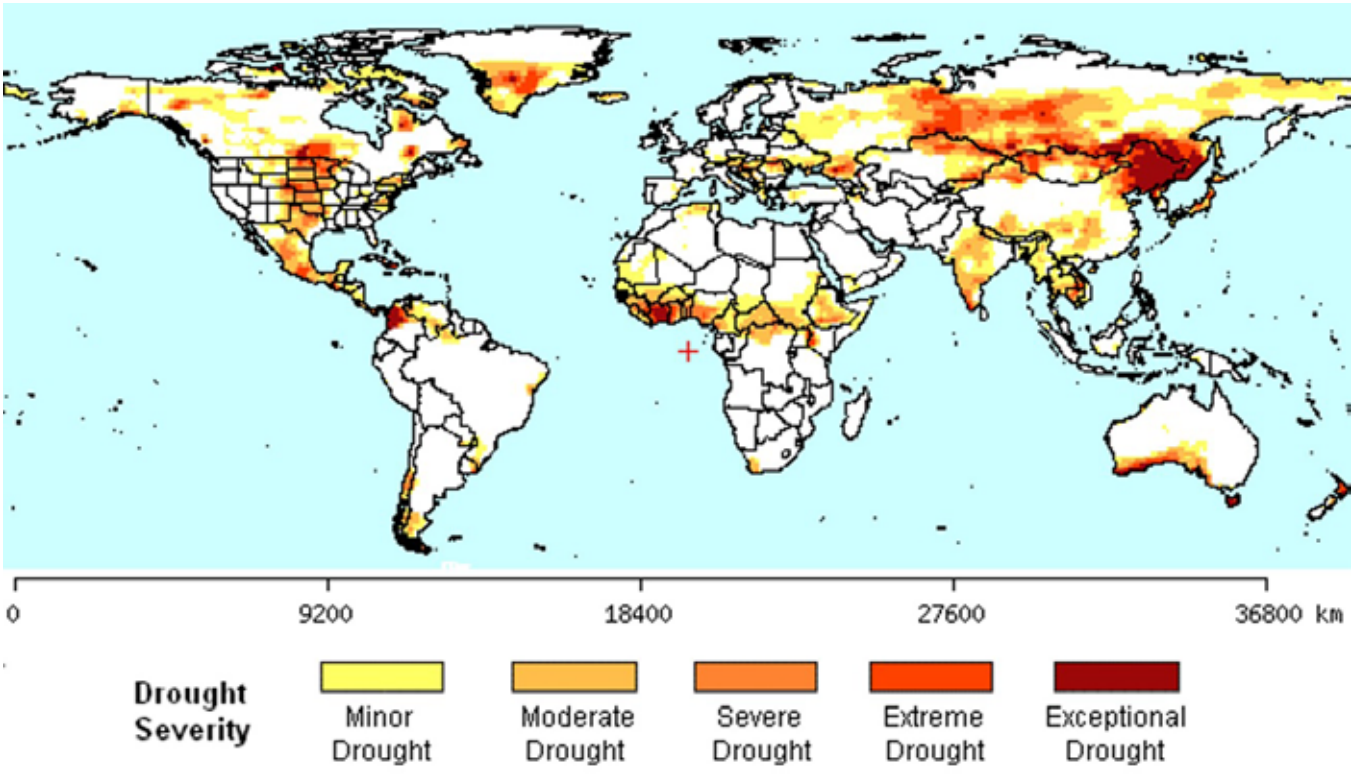


FIGURE 4: GLOBAL DROUGHT SEVERITY

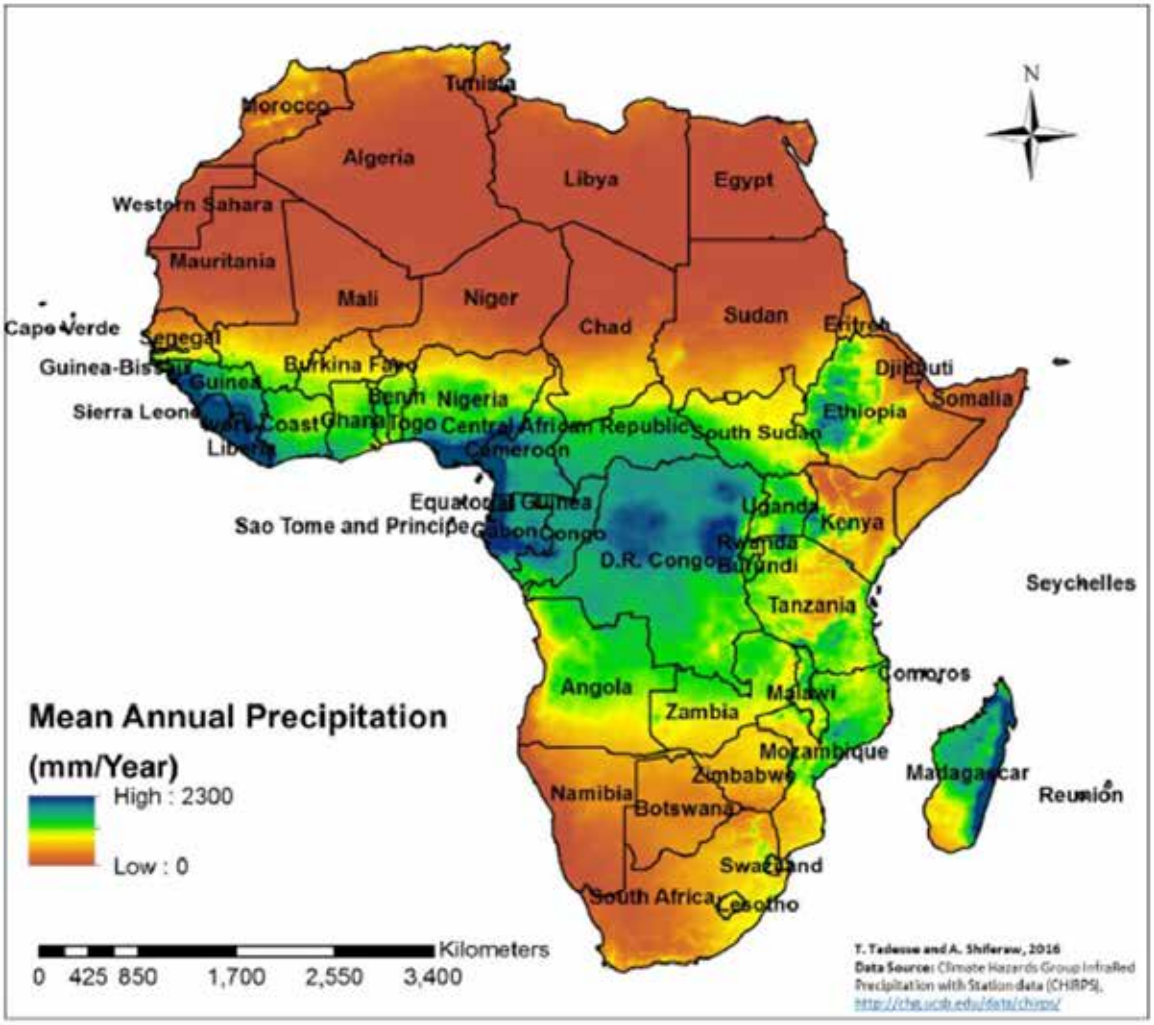


FIGURE 5: MEAN ANNUAL RAINFALL (1981-2014) PATTERNS OF THE AFRICAN CONTINENT (FAO, 2004)

2.2 The Global Impacts of Drought

The impacts of drought have influenced policy development, including financial plans to protect the welfare of affected communities, build their resilience and strengthen state institutions focused exclusively on drought management (planning, mitigation and/or adaptation). The distribution of drought-related damage indicates high losses in Sub-Saharan Africa and potential high risks in Central and South America, southern Europe, the Middle East and southern Australia (UNCCD, 2016) (Figure 6).

An estimated 1.5 billion people have been affected by disasters, with a total economic loss of over US$1.3 trillion, between 2008 and 2012, with 20% attributed to drought (UNISDR, 2015). Generally, the global cost of drought has been estimated at US$35 billion, with 83% of these losses in the agriculture sector (FAO, 2017). Drought impacts on the agriculture sector are vast and include reduced cropland and forest cover, water scarcity, biodiversity loss, land degradation and damage to aquatic habitats (FAO, 2020). While severe drought shows a significant impact on food security, there are other aspects of drought that have received less attention (Meigh, Tate and McCartney, 2002), such as reduced water security (water shortages, poor water quality) and soil/land degradation.

2.2.1 Socio-economic impacts

In the USA, the 2012 drought losses reached between US$35 billion and US$70 billion. In Russia, during the same year, the direct and indirect losses combined were estimated at RUR45bn (US$606 million) at the regional level (Ukhova, 2013). In the EU, the spatial distribution of drought impact and the economic losses reached the equivalent of US$13 billion in 2003, affecting about 100 million people. In Spain, the losses associated with water scarcity and a failure in crop farming created rifts between legislation and scientific knowledge in what was expected to inform the next layer of drought management strategies (Paneque, 2015).

In the Asia Pacific, the average annual loss has been estimated at US$675 billion, of which US$405 billion is from drought-related agricultural losses (Reliefweb, 2019). In South East Asia alone, and especially Cambodia, Myanmar, Laos, Vietnam, and the Philippines, annual losses have been estimated at US$86.5 billion, roughly 3% of regional GDP. Drought is a significant factor in the failure of agribusiness in the African region, which receive less than 500mm of rainfall annually, including Southern Africa (Rouault and Richard, 2005). Around 40% of maize production in Africa faces occasional drought stress, resulting in yield losses of 10-25% (Fisher et al., 2015). In South Africa, the 1991-1992 drought period affected an estimated 86 million people, with 25% at high risk of starvation as cereal production[5] reduced from 11.3 to 6.2 million tonnes. In Botswana, the 1981-1986 drought reduced food and water availability, while the 1991-1992 drought caused a 9.3% decline in manufacturing and a 6% drop in foreign exchange earnings in Zimbabwe (Sola, 2001).

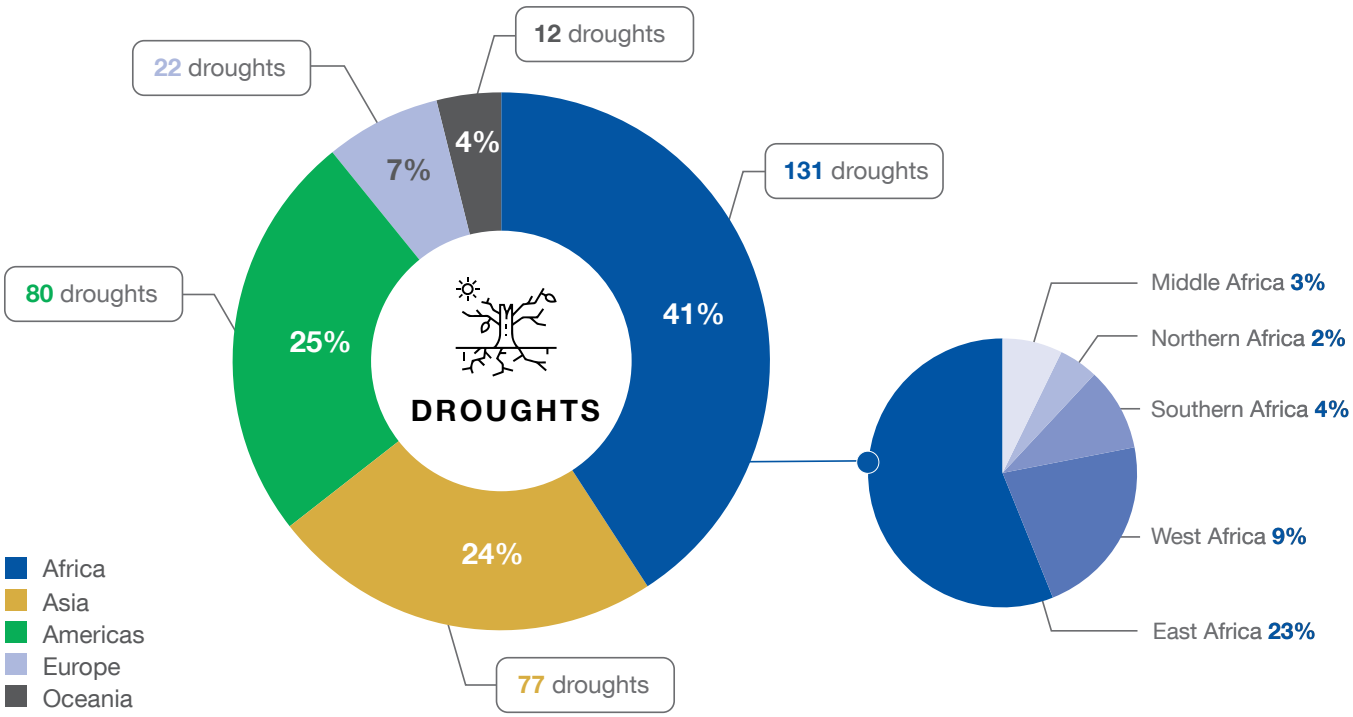
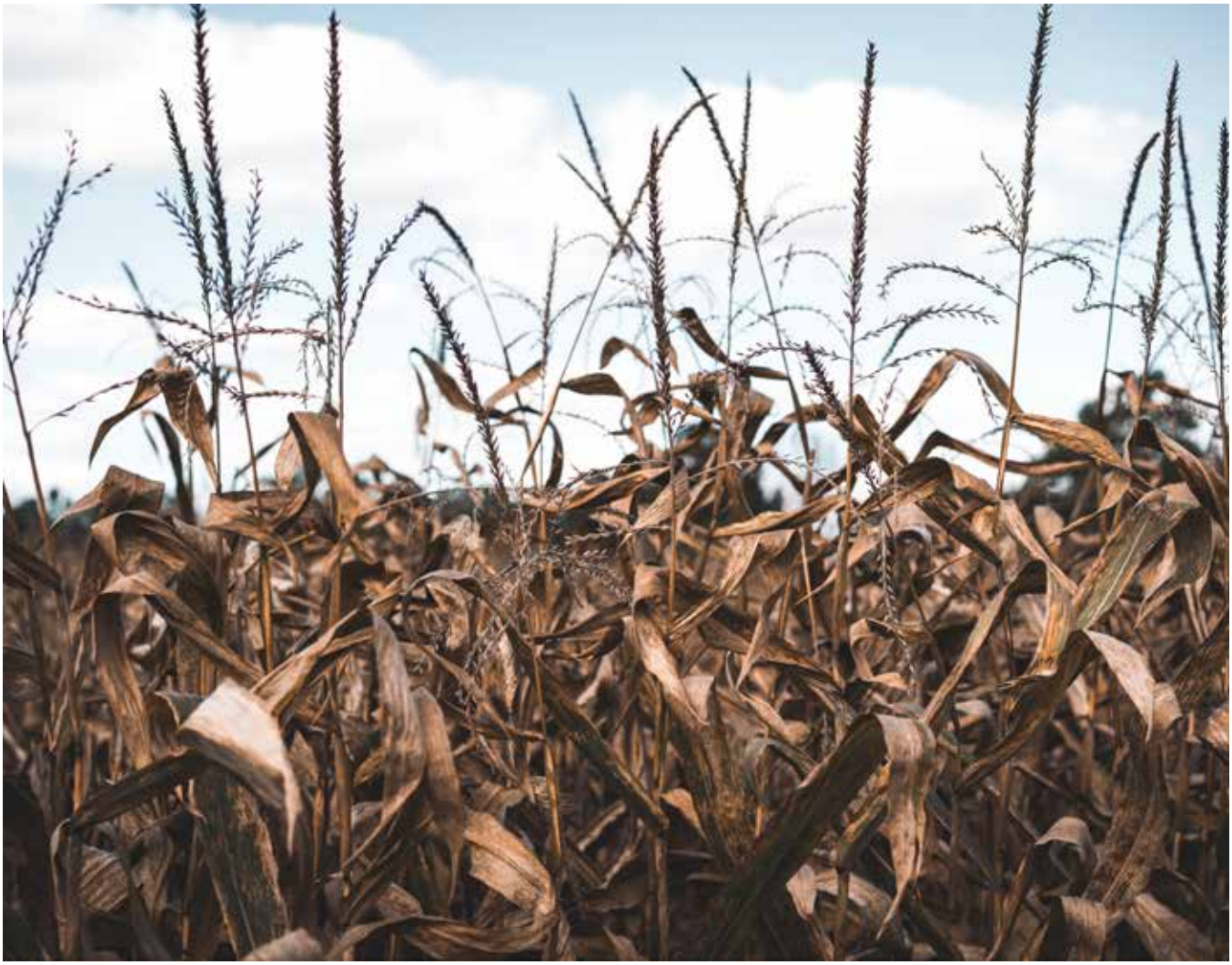


FIGURE 6: GLOBAL DISTRIBUTION OF DROUGHT OCCURRENCE (1994-2013) (CRED, 2015)

[5]Cereal production includes the production of wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains (World Bank 2022).



2.2.2 Drought Impact on Human Migrations

Human migrations due to pressure from drought events have been recorded back to the 12th and 13th centuries among the American population (Benson, Kenneth and John, 2007), and in many countries, this persist. The migration of youth, in search of socio-economic opportunities and safety nets, has characterised the drought impacts in the Caribbean and the northern Latin America region (Baez et al., 2017). In West Africa, particularly Mali, a circular pattern of migration was noted among women and children during drought events (Findley, 1994). This led to some policy reforms at the national level, which had to link the prospective development agenda to future migration patterns. In general, social protection initiatives can benefit from considering the link between migrations and climate change in order to effectively reduce drought vulnerability in local communities.

2.2.3 Drought Impact on Conflict

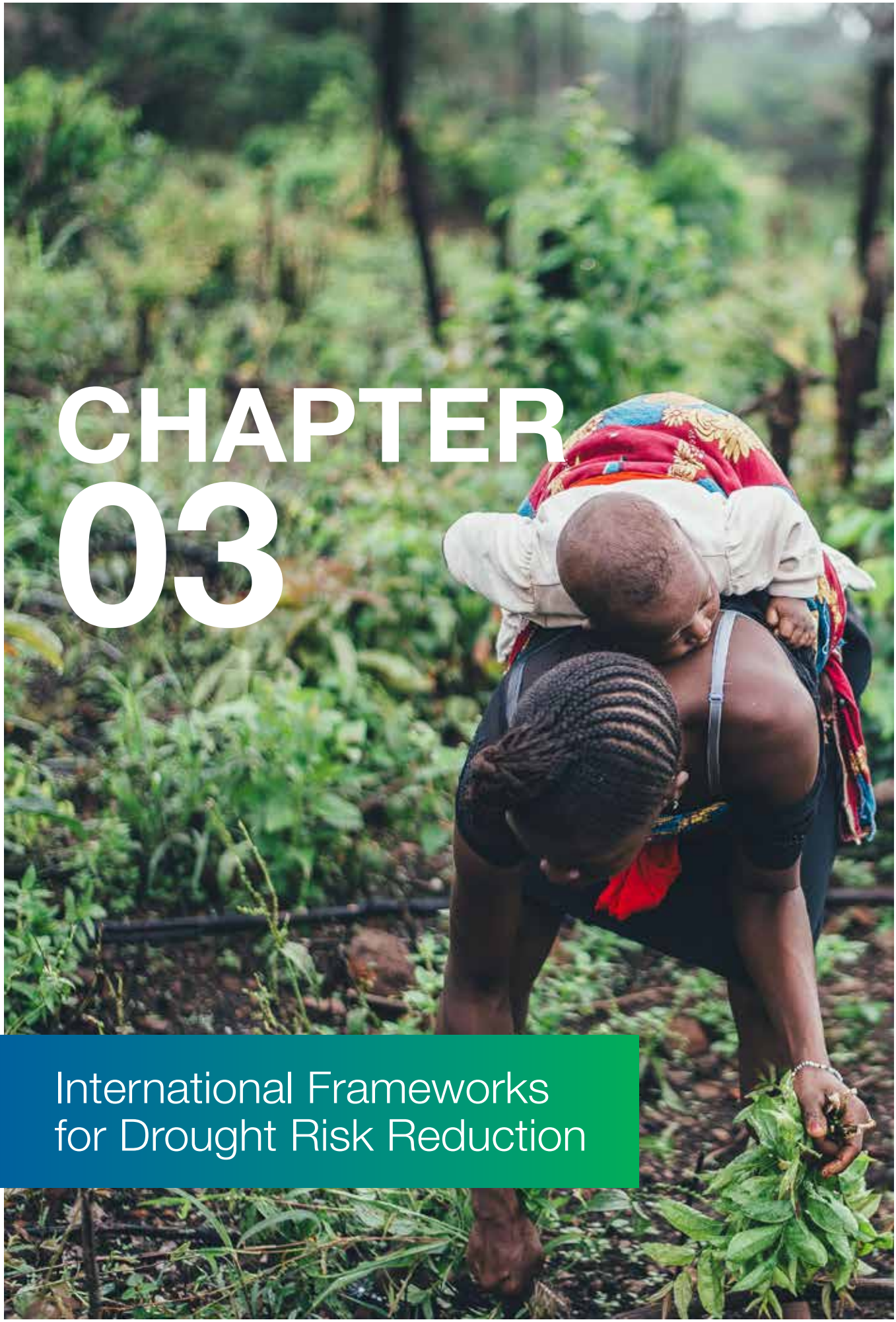
Drought increases the risk of civil war, primarily when it strikes vulnerable and politically marginalised populations in agrarian societies, although there is a combination of socio-political and geographic factors that may weigh in (Theisen, Holtermann and Buhaug, 2011). For example, water scarcity and climatic conditions, as well as increased conflicts over water resources, have played a direct role in the deterioration of Syria's economic conditions (Gleick, 2014).

2.2.4 Impact on Pastoral Economies

The impacts of drought on livestock are widespread on a global scale (UNCCD, 2019b) and Africa is not spared. Most of the African drylands are home to pastoral communities whose livelihoods depend solely on extensive livestock production. Pastoral communities play an important role in the national and regional economies of Africa. In general, pastoralism contributes 10% to 44% to the gross domestic product (GDP) of African countries (African Union , 2010). Unfortunately, in recent years, pastoral communities have been functioning within the context of growing challenges in the form of increasing vulnerability and unpredictable climate, which has significantly reduced their capacity to adapt to changes and shocks caused by droughts. Livestock in Africa has been complicated by drought, resulting in a decline in herd sizes and livestock mobility (in search of pasture). In this regard, there is a critical need to strengthen the capacity of pastoralism to operate in more sustainable pathways. Furthermore, drought management policies should consider stock movement in response to the ever-changing range of land resources, breeding seasons, disease and labour.

2.2.5 Impact on Crop-Farming Economies

Crop-farming decline due to drought has a ripple effect on socio-economic well-being, particularly in 'farming towns' and rural communities which are dependent on the sector (Boubacar, 2012). The crop-farming sector is especially an important contributor to African economies. However, this has been compromised by droughts and extreme temperatures with excessive rainfall events. This, coupled with a high demand for food and other environmental stressors, is among the challenges that farming economies face in Africa. Such challenges call for distinctive mechanisms and strategies, both in alleviating the effects of drought and dealing with its after-effects. Food security is often significantly reduced for populations of crop farmers (Thorlakson & Neufeldt, 2012), particularly, in rural (farming) communities that rely on excess productivity. Farming activities need to be adapted to cope with the changes, and early warning and response support should be provided for the farming sector, especially to improve local response in rural and remote communities.



CHAPTER 03

International Frameworks for Drought Risk Reduction

Countries have been calling for a framework to improve drought management since 2013, to curtail fragmented and uncoordinated investments in land, water and socio-economic systems (Crossman, 2018). The quest for drought risk management gained global attention in the post-2015 UN development agenda due to the huge losses associated with the socio-economic impact of droughts (UNISDR and WMO, 2012). The global framework was advanced through discussion among UNCCD members during the High-level Meeting on National Drought Policy. This was driven by the philosophy of risk reduction under the theme of 'Reducing societal vulnerability: helping society (communities and sectors)'.

3.1 International Frameworks for Disaster Risk Management

A paradigm shift from a reactive to a proactive approach has been adopted by the global community in response to the spiralling impact of drought (Wilhite, 2017). The new approach is anchored in global initiatives including the Sendai Framework, the Financing Development Agenda, the Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change (Alcántara-Ayala et al., 2017) (Figure 7).

The Yokohama Strategy, from the 1994 conference, provided guidelines for risk reduction that continue to serve as the international blueprint (Briceño, 2004). The World Conference on Disaster Reduction, which took place in Kobe in 2005, then established the Hyogo Framework for Action (ISDR-UN, 2005). Building on this, the Sendai Framework (2015) aims to prevent new disaster risks and reduce existing disaster risks through the implementation of an integrated and inclusive approach within and across all economic sectors, to increase preparedness for response and recovery and thus strengthen resilience (UNISDR, 2015).

Priorities 3 and 4 of the Sendai Framework for action recommend investing in disaster risk reduction for resilience and enhancing disaster preparedness for effective response in recovery, rehabilitation and reconstruction (Pearson and Pelling, 2015). Implementation of priority 4 at

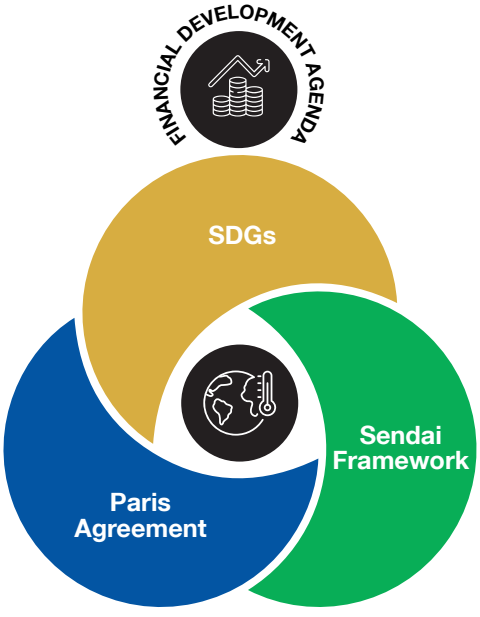


FIGURE 7: THE LINK AMONG THE KEY FOUR 2015 UNITED NATIONS LANDMARKS TO ACHIEVE DISASTER RISK MANAGEMENT AND DISASTER RISK REDUCTION (ALCÁNTARA-AYALA ET AL., 2017).

the regional level calls for cooperation to deal with disaster preparedness, support for an international recovery platform, and sharing of experience on water-related disaster risks. Drought mitigation measures are focused on establishing comprehensive early warning and delivery systems, increased water conservation, utilisation of groundwater resources, investment in water infrastructure, drought preparedness, awareness-building and education (Wilhite, 2017).

The Sendai Framework (Figure 8) emphasises the impact of slow-onset disasters, such as drought, and highlights four priority areas for disaster risk management (UNISDR, 2015), namely:

01 Understanding disaster risk

02 Strengthening disaster risk governance

03 Investing in disaster risk reduction for resilience, and

04 Enhancing disaster preparedness for effective response.

The SDGs provide a global blueprint for inclusive, equitable development that is sensitive to the planet. Goal 13 especially emphasizes the need for protection from climate-induced

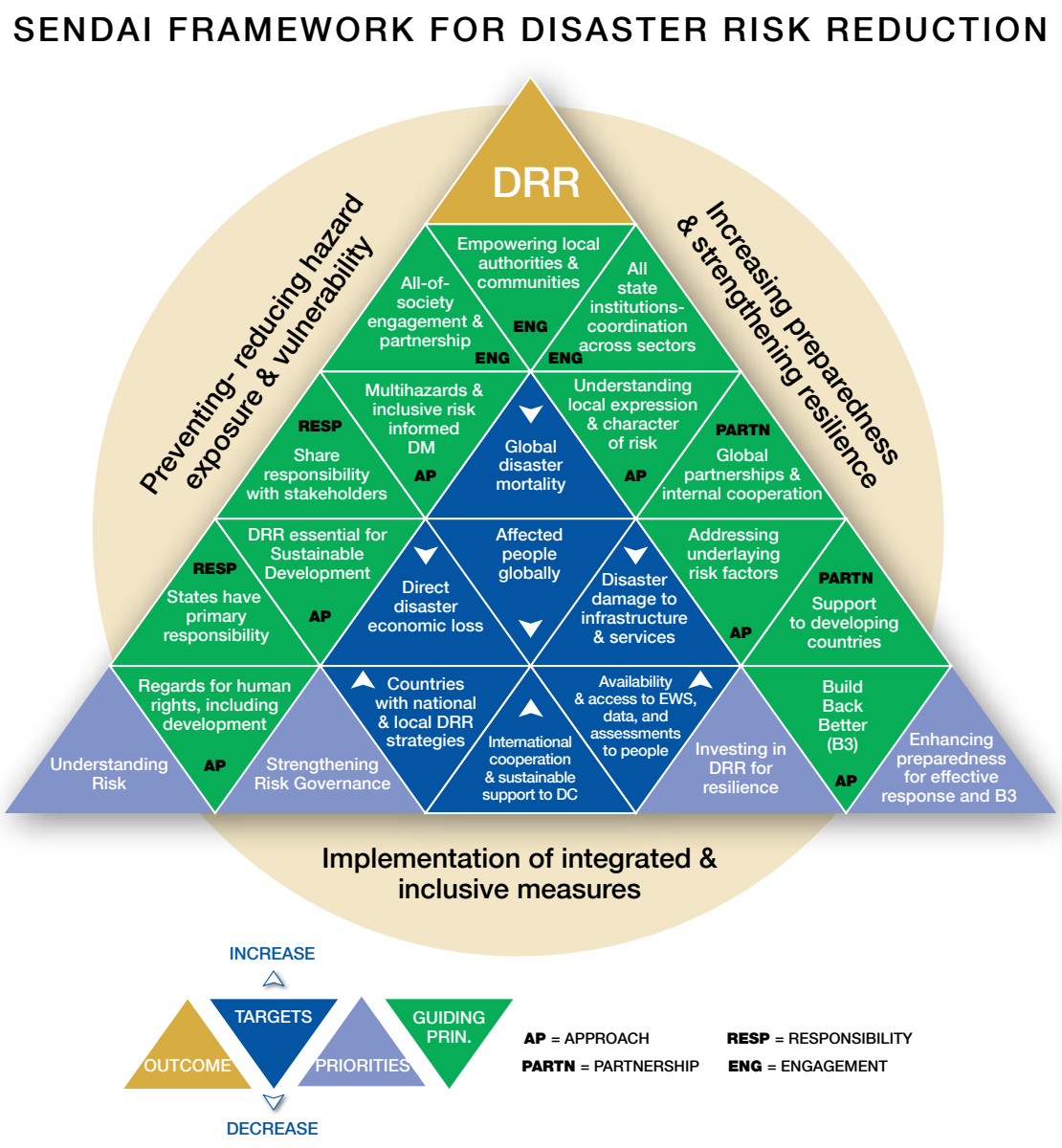


FIGURE 8: THE SENDAI FRAMEWORK FOR DISASTER RISK REDUCTION (2015–2030) REFLECTING ITS SEVEN GLOBAL TARGETS, ITS FOUR PRIORITIES FOR ACTION AND ITS 13 GUIDING PRINCIPLES

weather extremes, especially for local people including farmers, through environmentally sustainable practices.

The Paris Agreement recognises the anthropogenic effect on climate change and negotiated for commitment to an inclusive response from the 196 UNFCCC parties (Savaresi, 2016). However, progress toward the SDGs is slow, with implementation characterised by inconsistent reporting and financing, weak coordination and low accountability (Kharas, Rickels and Strauss, 2020). The above global initiatives were reinforced by the 2018/19 UNCCD Drought Initiative, which highlights several common drought management approaches for increasing drought risk assessments (Tsegai, 2019).

3.2 Pillars of Drought Risk Reduction

The guiding principles for the development of an effective drought management framework are anchored in three key pillars of drought risk reduction. As shown in the UNCCD Drought Management Toolbox (Figure 10), the pillars take into consideration monitoring and early warning, vulnerability and risk assessment, and risk mitigation measures.

These three pillars should be supported by cross-cutting policies involving, at least, the following elements: coordination and institutional development; capacity building; financing; knowledge management, science, technology and research and awareness; regional and international cooperation; stakeholder participation and inclusiveness and lastly, evaluation.

3.2.1 Pillar #1: Implementing drought monitoring and early warning systems

The international community should aim to support the establishment of drought monitoring maps and reports for all regions, sub-regions and countries. The availability of information about the probability of a wet or dry period during the coming months implies that decision-makers can better plan for the possibility of a drought. The early warning systems need to be based on better monitoring and predictive data, supported by other relevant information on regional coping and response capabilities (FAO, 2019).

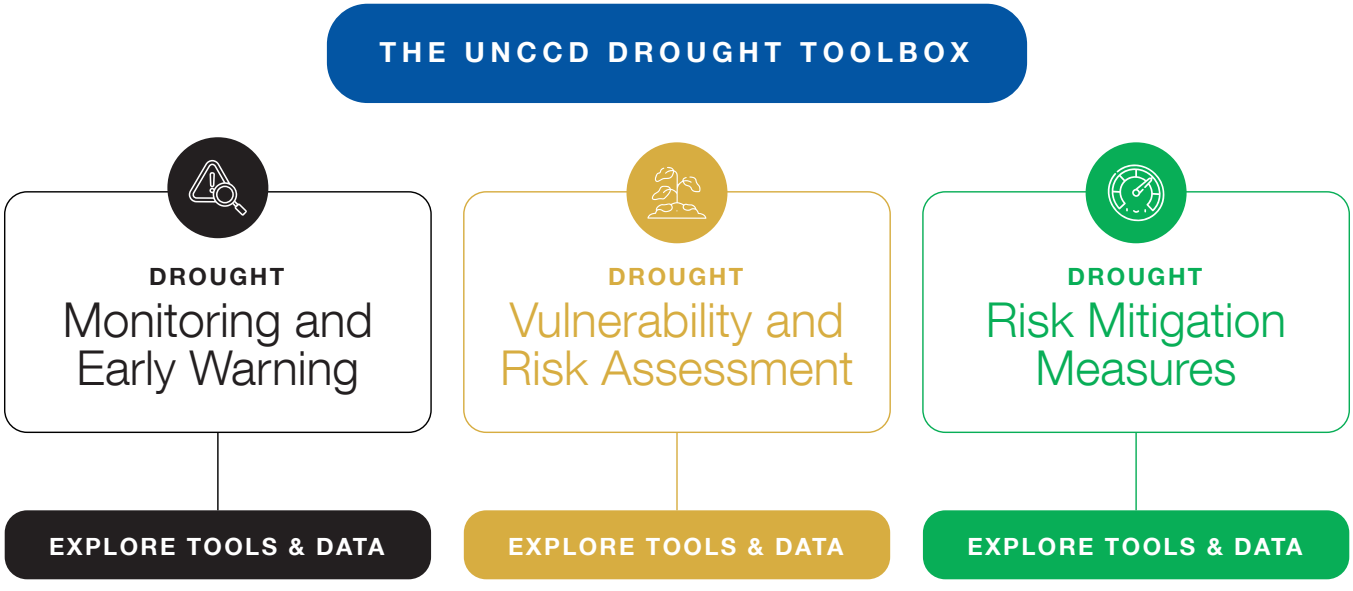


FIGURE 9: UNCCD – DROUGHT TOOLBOX KNOWLEDGE HUB (HTTPS://KNOWLEDGE.UNCCD.INT/DROUGHT-TOOLBOX)

In the USA, for example, each regional Drought Early Warning System (DEWS) focuses on improving early-warning capacity for and resilience to drought in that region, including examining the role of extreme weather events and climate variability in drought. The five key areas for drought early warning (DEWS components) include observation and monitoring, prediction and forecasting, planning and preparedness, communication and outreach, and interdisciplinary research and applications. Similarly, the Horn of Africa has an existing early warning system (Figure 11) that has been operating for 15-20 years (Tadesse et al., 2015).

The Paris Agreement recommended increased cooperation on early warning and emergency preparedness against slow-onset events such as drought and desertification. The improvement of methods for and approaches to the prediction of drought, and monitoring of desertification, can be supported by an effective exchange of information. Efficient early warnings can be achieved when the vulnerability is assessed at local, national and regional levels by means of tools/methods that analyse the links between weather, climate and disaster.

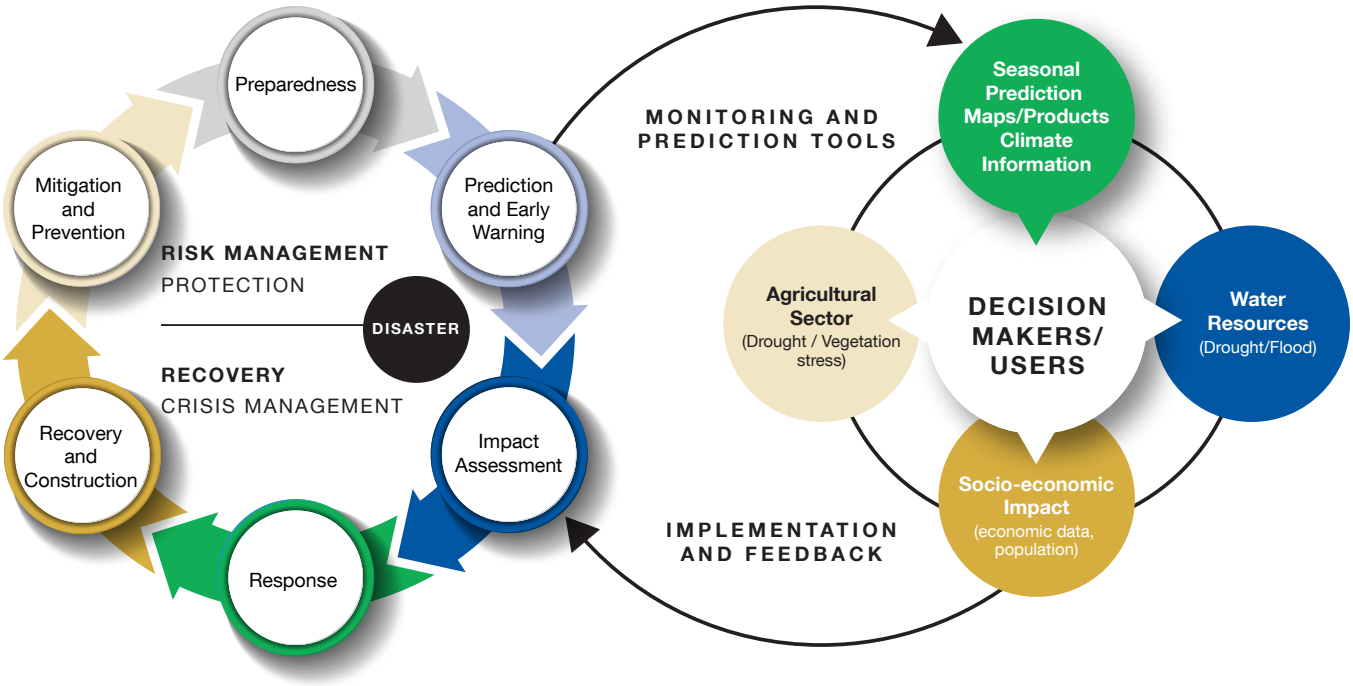


FIGURE 10: CLIMATE INFORMATION FLOWS FOR DROUGHT EARLY WARNING IN THE HORN OF AFRICA (TADESSE ET AL., 2015)

3.2.2 Pillar #2: Addressing drought vulnerability and risk

Vulnerability is a key concept for both disaster risk and climate change adaptation (Cardona et al., 2012). Vulnerability is defined in the Hyogo Framework for Action (2005)[6] as: "the conditions determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards". Hazard is defined in this framework as: "a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage,

[6]The Hyogo Framework was a global blueprint for disaster risk reduction efforts from 2005, for the next decade. Its goal was to substantially reduce disaster losses by 2015, in lives and in the social, economic and environmental assets of communities and countries.

social and economic disruption or environmental degradation". Hazards can include latent conditions that may represent future threats and can have different origins: natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards) (UNISDR, 2015). Addressing the drivers of vulnerability offers a reliable approach to reduce the current vulnerability and manage potential risk(s).

Vulnerability assessment approaches include: (i) focusing on people and their livelihoods, including the most vulnerable and marginalised groups and individuals; (ii) capturing changes in the production of ecosystem services, including from agriculture and across other sectors; and (iii) accounting for effects on the water balance at basin and sub-basin levels that further exacerbate vulnerability to drought (UNCCD, 2019b). Core elements of the risk assessment model include exposure, vulnerability and adaptive capacity (Figure 12).

The UNCCD (2019) states that addressing drought vulnerability and risk requires that the following action be taken:

01 Identify drought impacts on vulnerable economic sectors, including food and agriculture (cropping and livestock), biodiversity and ecosystems, and energy, tourism and health sectors

02 Assess physical, social, economic and environmental pressures on communities to identify who and what is at risk and why – before, during and shortly after drought

03 Assess conditions or situations that increase the resistance or susceptibility to drought and the coping capacity of communities affected by drought, and

04 Assess the extent of potential damage or loss in the event of a drought.

Collecting, applying, adapting and reviewing best practices consistently can improve the effectiveness of drought vulnerability assessments for improved drought risk management. The following recommendations can be used by policymakers to improve drought impact and vulnerability assessment:

01 Consider a proactive approach to assess vulnerability before drought crises escalate

02 Recognise that drought is often a recurrent phenomenon that interacts with other hazards and can be exacerbated by water and land resource management patterns

03 Use available assessment methods to foster inclusive, cross-sectoral and multi-scale approaches to vulnerability assessment at basin and community levels

04 Ensure that systems for action are connected to the vulnerability assessment process and that sufficient human, institutional and financial resources are available when needed

05 Learn by trial, error and review of others' experiences, and select methods best suited to encourage participation in vulnerability assessments by different groups – including women, men, the youth, the elderly, disabled people and minorities

06 Consider where and how disaggregated data should be collected, analysed and protected

07 Document assessment successes and failures, including cases where drought impacts were more or less severe than anticipated under the prevailing climatic conditions (some of these may indicate effective water and land management), and

08 Learn from others' experiences by taking part in coordinated international knowledge exchange, and advocate the use of these processes, including review, validation, documentation and dissemination.

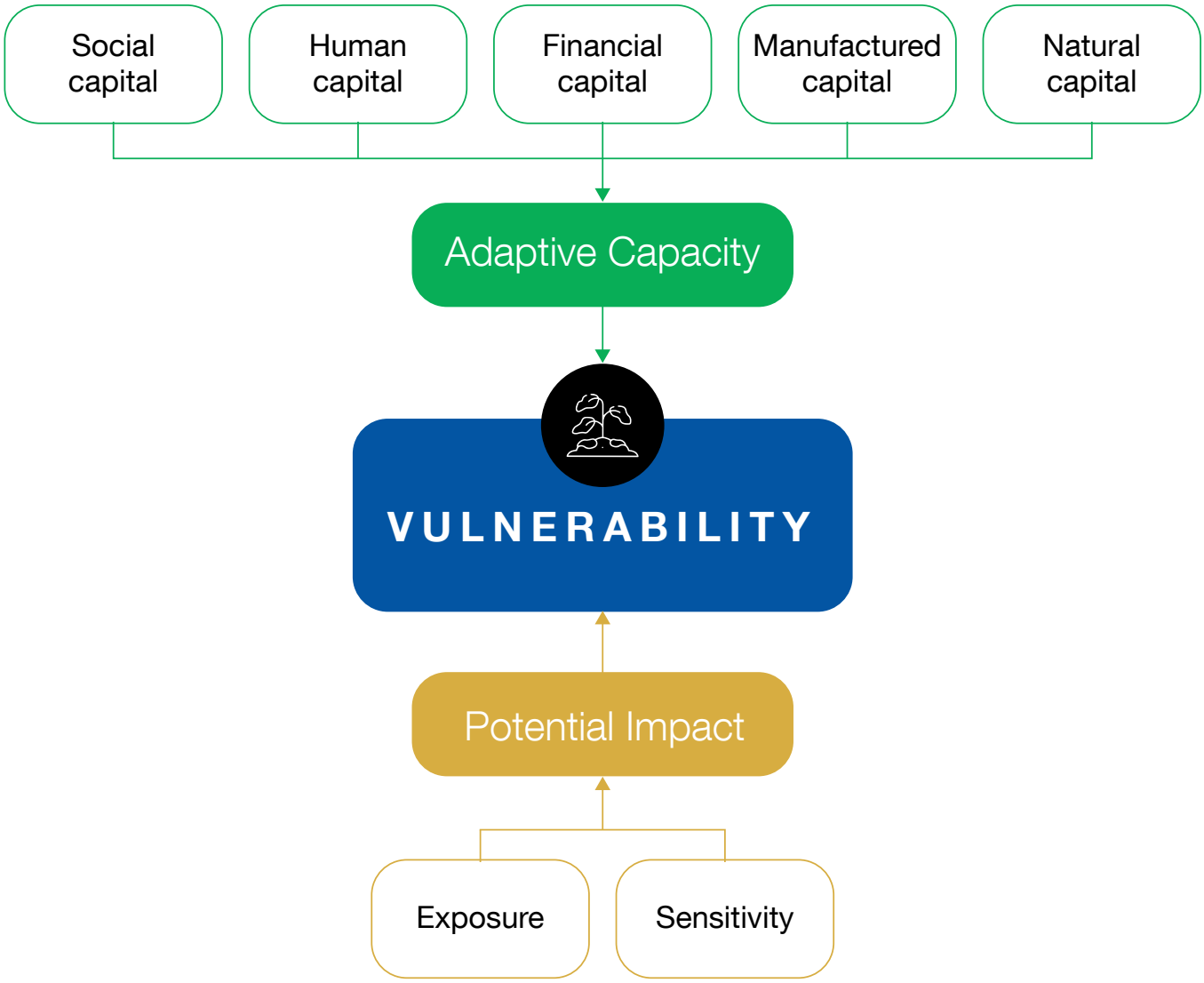


FIGURE 11: CONCEPTUAL FRAMEWORK SHOWING THE MULTIPLE DIMENSIONS TO BE INCLUDED FOR ASSESSING VULNERABILITY TO DROUGHT (UNCCD, 2019C)

3.2.3 Pillar #3: Implementing measures to limit impacts of drought and respond better to drought

Enhancing drought mitigation measures and preparedness can significantly reduce drought impacts and losses if decision-makers, communities and individuals are well prepared. Mitigation and preparedness have a greater impact on reducing the scale and effects of drought disasters. The guiding principles for drought mitigation, preparedness and response (Tadesse, 2018) include:

01 Drought mitigation and preparedness are central components of drought risk management.

02 Information coordination: dialogue, exchange of information and coordination are needed between drought risk management, development, and emergency management actors.

03 Integrated approach: the selection of appropriate drought risk management (planning, mitigation, and preparedness) measures requires many considerations, such as integrated environmental and natural resource management, social and economic development, land use planning opportunities, and climate change adaptations.

04 A combination of top-down and bottom-up approaches is required for the development and implementation of effective mitigation and preparedness measures.

05 Institutional capacity, coordinated mechanisms, identification of local needs and indigenous knowledge are required to implement effective mitigation and preparedness strategies.

06 Monitoring and early warning are key elements of drought risk management and must be closely linked to other risk reduction actions, and

07 Long-term commitment: drought risk management (planning, mitigation, and preparedness) requires a long-term commitment of resources.

3.3 Drought Cycle Management Frameworks

3.3.1 The Drought Cycle Management model (DCM model)

The DCM model conceptualises drought as a cycle of four warning phases: normal, alert, emergency and recovery (Figure 13). The DCM model is widely understood, especially within East Africa, and provides many benefits to policymakers. Users of the model recognise that representing drought (and associated responses) is convenient for practitioners.

Implementing measures to limit impacts of drought and respond better to drought requires policymakers to:

01 Implement structural measures as well as non-structural measures to limit the adverse impacts of drought.

02 Implement response efforts, assistance or intervention during or after a drought disaster to meet the life-saving and basic subsistence needs of affected communities.

03 Implement relevant measures within affected sectors (agriculture, water, environment).

04 Implement long-, medium- or short-term measures depending on time demand.

05 Consider the fact that biodiversity, land and ecosystem services play a vital role in reducing vulnerability and mitigating the impacts of drought.

Effective measures must be taken to establish proactive as well as reactive drought policies at regional, national and local levels. Addressing drought effects should not be only in reaction to drought events, as has been the case in the past.

3.3.2 The Drought Resilience, Adaptation and Management Policy (DRAMP)

The framework takes an integrated, multi-pronged approach to reduce the risks and impacts of drought (Figure 14). Organised around six cross-cutting goals (IPCC, 2012), the DRAMP framework identifies pragmatic actions for nations to adequately prepare and respond to drought.

From the graphic illustration below, the DRAMP shows a detailed breakdown of three pillars. However, the relationship between each pillar and the coloured elements is not perfect; for example, not all the green elements relate to pillar 3 on drought risk mitigation measures. The fact that the alignment between the three pillars and the DRAMP framework is not perfect is a source of confusion regarding its implementation.

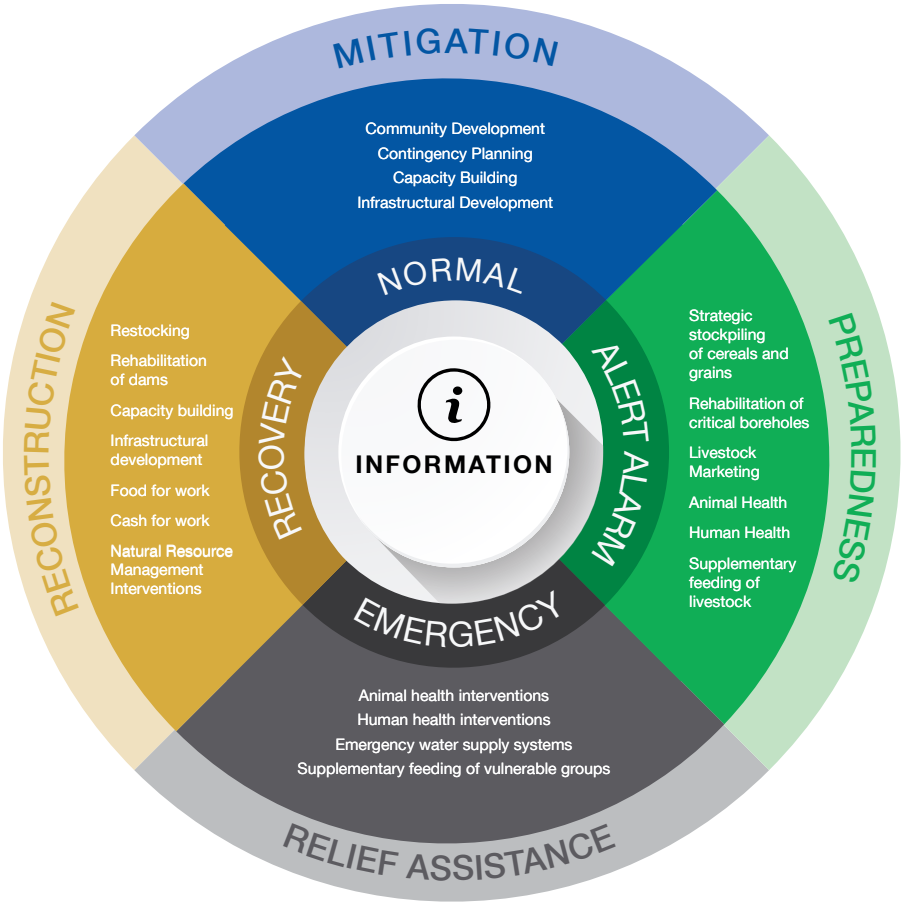


FIGURE 12: THE DROUGHT CYCLE MANAGEMENT MODEL (OXFAM GB, 2009)

The six goals of the DRAMP framework are:

01 Reduce exposure to drought: reduce the potential for loss of people, livelihoods, ecosystem services and resources, infrastructure, as well as economic, social or cultural assets in places that could be adversely affected by drought.

02 Reduce vulnerability to drought: reduce the tendency to be adversely affected by drought.

03 Increase resilience to drought risk: strengthen the ability of communities, ecosystems and economies to anticipate, absorb, accommodate or recover from the effects of drought quickly and efficiently by ensuring the preservation, restoration or improvement of natural capital.

04 Transformation: alter fundamental attributes of social, economic and ecological systems, including value systems; regulatory, legislative, or bureaucratic regimes; financial institutions; and technological or biological systems.

05 Prepare, respond to and recover from drought: the backbone of management and planning approaches to reduce drought risk, including the development of comprehensive drought monitoring and early warning systems.

06 Transfer and share drought risks: distribute risks among a wider section of society to include those who benefit directly and indirectly from robust drought risk management.

The high cost of recovery actions and the increasing concern over the frequency and severity of future drought is driving efforts for the promotion of risk management and preparedness. The new paradigm for drought management focuses on risk management rather than the previously followed crisis management approach, which contributed to increased societal vulnerability to droughts (Wipfler et al., 2009).

FIGURE 13: THE DRAMP FRAMEWORK. THE GOALS ARE MAPPED ONTO THE 'THREE KEY PILLARS' OF DROUGHT RISK REDUCTION TO DEMONSTRATE THE LINKS BETWEEN THE FRAMEWORK AND THE PILLARS (CROSSMAN, 2018)

3.3.3 Drought Resilient and Prepared Africa (DRAPA)

Leveraging past and present experiences and lessons learnt in Africa, and in line with the global disaster reduction frameworks such as the Sendai Framework and the High-level Meeting on National Drought Policy, a new strategic framework, DRAPA, was proposed (Tadesse, 2016) (Figure 9).

The DRAPA strategic framework has six main elements that are aligned with the priorities of African regional networks, such as the Intergovernmental Authority on Development (IGAD) drought disaster resilience and sustainability initiative, national action programmes, and the global disaster risk reduction frameworks, for example, the Sendai Framework. The key elements of the DRAPA framework are:

01 Drought policy and governance for drought risk management

02 Drought monitoring and early warning

03 Drought vulnerability and impact assessment

04 Drought mitigation, preparedness, and response

05 Knowledge management and drought awareness, and

06 Reducing underlying factors of drought risk.

The strategic objectives of the framework are to: (i) encourage the development of a national drought policy for drought risk management and enhance capacity at all levels of government to mitigate the effects of drought; (ii) institutionalise a systematic approach for drought monitoring and early warning systems to enhance drought resilience as well as establish best practices for drought risk management to enable the sharing of experiences among countries; (iii) identify drought vulnerability and improve risk assessment; and (iv) improve public awareness of drought risk management while focusing national, regional, continental, and international attention on the issue of enhancing resilience to drought impacts and strengthening partnerships and cooperation for enhanced drought resilience.

The focus on Africa is due to the larger vulnerable population and limited state adaptive capacities. Historically, Africa has suffered droughts more frequently than any other continent, with 131 droughts between 1994 and 2013, of which 75 occurred in East Africa. It manifests in agricultural failures, loss of livestock, scarcity/shortage of water, and outbreaks of epidemic diseases in the case of extended drought, where long-term economic impacts cause migrations and displacement (CRED, 2015). In most cases, the unaccounted costs from drought-related malnutrition, disease and displacement should be factored into future drought management frameworks and linked to early warning systems and response mechanisms, to monitor the impacts of drought more comprehensively.

Recurrent droughts in African regions (including Southern Africa) call for collaboration among governments and international communities in building and implementing the DRAPA in line with drought risk reduction. Implementation of the DRAPA (with the support of global networks) will improve drought monitoring tools and early warning systems in Africa by customising drought information to specific sectors in specific countries.

All elements in the DRAPA should be aligned properly to the three pillars of drought risk management for the development of an effective drought management framework. Cross-cutting policy issues that should support the implementation of the DRAPA and the three pillars of drought risk management include coordination and institutional development; financing; knowledge management; scientific technology and research; regional and international cooperation; stakeholder participation and inclusiveness, as well as continuous evaluation.

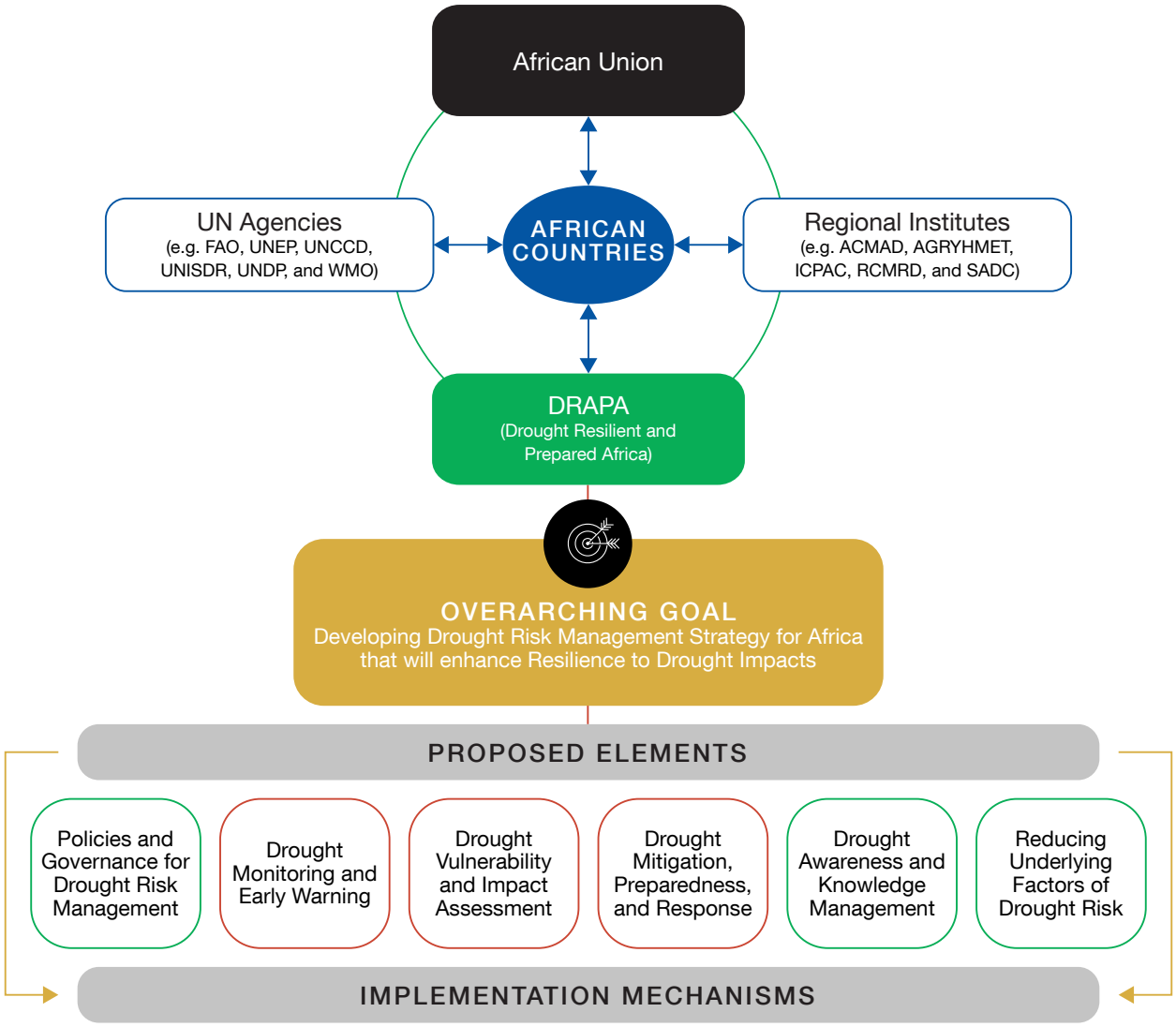
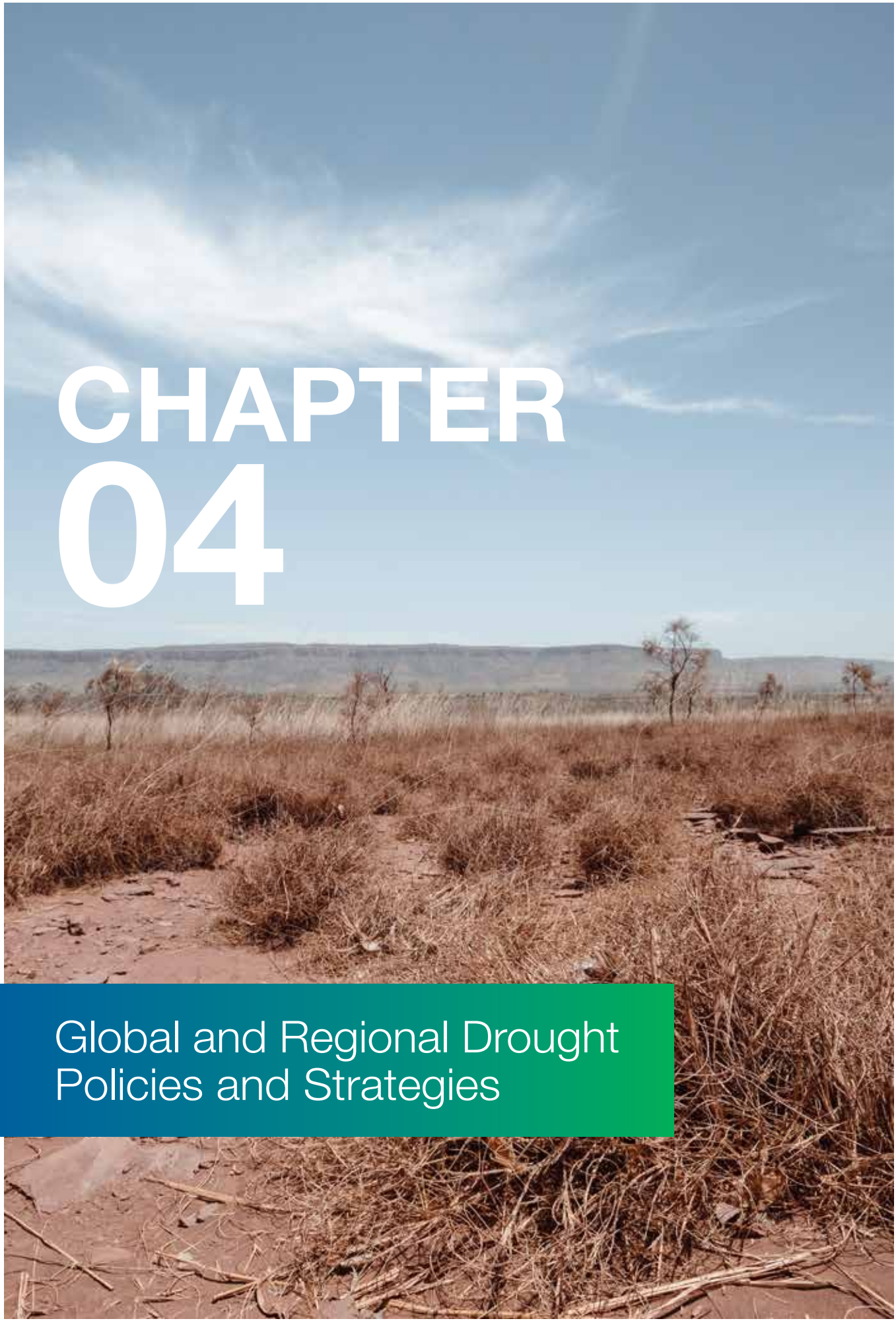


FIGURE 14: PROPOSED STRATEGIC FRAMEWORK STRUCTURE OF 'DROUGHT RESILIENT AND PREPARED AFRICA' (DRAPA) FOR DROUGHT RISK MANAGEMENT AND ENHANCING RESILIENCE IN AFRICA (TADESSE, 2018)



CHAPTER 04

Global and Regional Drought Policies and Strategies

Global policies have been influenced by several world summits towards developing a plan of action for disaster risk reduction. They include the 1994 World Conference in Yokohama, the 2005 World Conference and the Sendai Conference of 2015.

4.1 Background of Global Policy Frameworks

According to the World Meteorological Organization (WMO, 2018) and the Global Water Partnership (GWP, 2018), a national drought policy should establish a clear set of guidelines to govern the management of drought and its impacts (Wilhite, 2014b). The mitigation strategy should consider all components of the cycle of disaster management. National drought management policy is expected to provide a framework for shifting the paradigm from focusing on reactive crisis management to a proactive, risk-based approach that is intended to increase the coping capacity and build resilience against future impacts of drought.

In 2013, during the High-Level Meeting on Drought Policies, the Global Water Partnership (GWP) and WMO formed a collective Integrated Drought Management Programme (IDMP). The mission was to change from reactive approaches to a proactive drought management approach that will focus on drought prevention, mitigation, vulnerability reduction, planning and preparedness. In line with the High-level Meeting on National Drought Policy and the Sendai Framework, Africa is expected to benefit from the DRAPA framework, which is focused on building an effective drought risk management programme and enhanced resilience from the continental to the local levels for African states (Tadesse, 2016).

4.2 North America, Latin America and the Caribbean Regions

Until 2014, the USA had not developed a national drought policy despite pressure from states that had made strides in drought planning and management. Individual states made progress from a response to mitigation plan to and timely coordinated information sharing and early warning. The US organisational structure for drought planning and management incorporates:

i. Monitoring, early warning and information delivery
ii. Risk and impact assessment, and
iii. Mitigation, preparedness and response.

In California, drought impact on water scarcity has motivated state action towards managing urban water demand (Hjelmstad, Garcia and Larson, 2019). The government has passed bills that support water conservation, strengthen drought planning, improve agricultural water usage, and support adaptation to climate change. The California Drought Contingency Plan recommended the Standard Emergency Management System (SEMS), an established structure for emergency management, preparedness, response, recovery and mitigation, communication and coordination.

The strategies for preparing for the drought in the California contingency plan include:

i. Drought response workshops and planning
ii. Drought monitoring and forecasting
iii. Water conservation
iv. Promoting legislative initiatives, and
v. A water transfer programme for responding to drought impacts and improved water quality.

In Latin America, the limited institutional capacity to provide reliable early warning information and

identification of vulnerable communities affects the development of drought management policies (Verbist et al., 2016). For example, in northeast Brazil, the socio-economic impact of drought on vulnerable populations, the economy and the environment motivated the development of drought policies focused on drought preparedness and response. Key strategies included improved early warning systems and drought prediction, and more efficient communication. Brazil is taking progressive action to reform drought management strategies, especially transiting from reactive crisis management to proactive, risk-based management (Sivakumar et al., 2011).

In the Caribbean region, climate change driven by anthropogenic activities is expected to worsen in the near future (Herrera et al., 2018). FAO (2016) identifies key policy barriers that undermine the implementation of drought mitigation strategies in the Caribbean Islands, including:

i. Inadequate policy and institutional environment
ii. Limited state capacity
iii. Weak coordination in land management increases land degradation
iv. Limited transparency in addressing upstream-downstream user conflicts, and
v. A lack of finance.

In order to mitigate drought impacts, FAO is assisting nations to manage drought as a natural phenomenon by integrating preventive and curative mitigation measures in the national development plan (FAO 2020c). These include:

i. Provision of technical assistance in developing adequate strategies and implementation plans
ii. Developing technologies for drought management
iii. Fostering regional cooperation, and
iv. Supporting technology transfer through capacity building.

4.3 Europe Drought Strategies

In 2007, the EU addressed water scarcity and droughts through policy initiatives to move Europe toward a water-efficient and water-conserving economy (Table 1), through:

i. Putting the right price tag on water
ii. Allocating water and water-related funding more efficiently
iii. Improving drought risk management, and
iv. Considering additional water supply infrastructures.

Table 1: Options for addressing an integrated approach to water scarcity and drought in Europe (Bressers, Bressers and Larrue, 2016)

POLICY OPTION		ACTIONS
A	Water supply only	• Enhance development of new water supply based on existing EU legislation • Support widespread development of new water supplies, with priority to EU and national funds
B	Water pricing policies only	• Effective water pricing • Cost recovery
C	Integrated approach	• Support efficient water allocation and sustainable land use planning • Foster water efficiency technologies and practices • Foster emergence of a water-saving culture in Europe • Provide new water supply

In 2013, the Central and Eastern Europe region of the Global Water Partnership (GWP) within the framework of the joint WMO/GWP launched the Integrated Drought Management Programme (IDMP) to enhance regional drought resilience and improve state capacity. The programme facilitated partners in various sectors to provide better drought monitoring and prediction, and to use it effectively in the development of short-term and long-term drought management plans. The IDMP initiatives included:

i. Drought preparedness measures (investment and non-investment measures, such as drought insurance systems);
ii. Enhancement (and/or development) of drought monitoring and early warning systems;
iii. Development of capacity-building programmes for water managers and farmers; and
iv. Development of case studies to document good practices in the application of integrated drought management as an integral part of water and land management (including transboundary basins).

In collaboration with other parties, the IDMP focused on: investment in regional and national development, demonstration projects for innovative solutions, capacity development, and partnerships to ensure good cohesion. Drought preparedness within Central and Eastern Europe is within the objective of the EU Water Framework Directive, which includes:

01 Promoting drought risk management policies,

02 Promoting drought preparedness and mitigation and planning measures, and

03 Considering financial assistance tools.

In response to drought, the EU Climate Change Adaptation Strategy focuses on building climate-resilient state response capacity, preventing and reducing the damage from drought (GWP_CEE, 2020). The strategy improves the coordination, preparedness and capacity of regional governments to respond to the impacts of drought. The links between the preparation of drought management plans and river basin management have a synergetic effect on achieving environmental conservation. Priority Area 5 in the EU strategy deals with environmental risks, with an emphasis on improved drought risk preparedness, proactive management and cooperation of state actors. Gradually, there has been a strategic shift in the EU from crisis management to the adoption of drought prevention approaches (Stein et al., 2016).

The Central and Eastern European countries are signatories to the UNCCD, and the IDMP CEE allows for cooperation and sharing of information that leads to the establishment of structures for drought management. These create guidelines for drought preparedness and management, with principles borrowed from EU drought strategies and water policy documents – mostly based on WMO/GWP guidelines – for action:

The principles of the European Water Framework Directive are (Rossi, 2009):

(i) Water is not considered a commercial product, but rather as a heritage to be protected.

(ii) Increasing pressure from the growth in demand calls for action to protect water, from both a qualitative and a quantitative point of view.

(iii) The policy on the environment is orientated to the pursuit of the objectives of preserving, protecting and improving the quality of the environment.

(iv) Specific principles for water policy – the principle of 'subsidiarity' – is to be taken into account in the development of a legislative framework, as is the principle of 'cost recovery' of water services, including those linked to negative impacts on the environment.

(v) Decisions on the measures to ensure protection and sustainable use must be as close as possible to the locations where water is affected or used, and

(vi) Cooperation and coherent action at different levels of government are necessary, in addition

to information, consultation and involvement of the public, including users. Protection and sustainable management of water have to be integrated into other policy areas, such as energy and agriculture.

The weakness of the EU directive, however, is in its limited focus on the quantity of water within the surface water bodies. The directive also treats drought risks as a marginal issue that should be addressed with local efforts. Localised effort reduces coordinated approaches from national and regional levels that should accommodate the transboundary effect of climate impact. This ignores borders and requires a joint effort by regional states to share costs and benefits (UNESCO, 2019).

In Spain, the 2000 Water Framework Directive improved strategies by changing water management in all EU member states, putting aquatic ecology at the base of management decisions. The state demonstrated the need for adaptation strategies to drought, water scarcity and precipitation variabilities (Sivakumar et al., 2011). The strategies support drought management plans under the Spanish Constitution of 1978 and the European Union Water Framework Directive of 2000. The purpose of the directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, which:

i. Prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems;

ii. Promotes sustainable water use based on the long-term protection of available water resources;

iii. Aims at enhanced protection and improvement of the aquatic environment, inter alia, through specific measures for the progressive reduction of discharges, emissions and losses of priority substances and the cessation or phasing-out of discharges, emissions and losses of priority hazardous substances;

iv. Ensures the progressive reduction of pollution of groundwater and prevents its further pollution, and

v. Contributes to mitigating the effects of floods and droughts and thereby contributes to the provision of a sufficient supply of good-quality surface water and groundwater as needed for sustainable, balanced and equitable water use.

In the UK, agricultural drought management strategies have been evolving for decades, with some aspects improving the management of future drought risks. In a policy position statement by the Chartered Institutes of Water and Environmental Management (CIWEM), the causes of, the plans for, and the lessons learnt from drought in the UK have been the key focus for the CIWEM. These strategies include:

i. Planning for drought
ii. Sharing of information
iii. Conservation of water in preparation for future drought
iv. Integrated communication
v. Restrictions on water use for non-essential purposes
vi. State enforcement of regulations, and
vii. Improvement of the drought monitoring system for adequate preparedness and response.

The key recommendations from CIWEM include:

i. Inclusion of adaptation and resilience into investment plans
ii. Investment in infrastructure (roads)
iii. Improved emergency response
iv. Adopting multiple approaches to implementing recovery strategies, and
v. Involving drought victims in the planning process.

4.4 Africa Drought Strategies

The WMO and its partners, UNCCD, FAO, CBD, and UNW-DPC, are collaborating to establish a capacity development initiative on National Drought Management Policies (NDMP) (UN Water, 2015). The aim is to increase the capacities of developing countries in creating risk-based national drought management policies. Despite the high drought impact in Africa, many states have not prioritised drought risk management and instead rely on crisis management approaches.

The Southern African Development Community (SADC) drought strategies are concerned with the effect of drought on food security. The long-term strategies are focused on conservation, investment, research, agricultural production, institutional arrangement and physical infrastructure (SADC, 1999). Drought institutions are expected to improve coordination, planning and sharing of experiences on coping mechanisms. In order to reduce long-term vulnerability, governments engage in:

i. Promoting drought-mitigation practices

ii. Adequate planning

iii. Building human capacity

iv. Promoting drought contingency plans

v. Promoting technology transfer, and

vi.Strengthening sustainable resource management.

In Botswana, the government integrates drought management into national plans and development (Belbase and Morgan, 1994), thereby making the non-emergency aspects of drought part of the regular government programme to benefit from existing projects and budgets. The strategies are focused on facilitating recovery and post-drought rehabilitation in rural areas. In Mozambique, the government considers drought a national disaster and provides humanitarian assistance and coordination in disaster response (FAO, 2004). In South Africa, a grouped drought response strategy was used in the 1990s, drawing efforts from all agencies to ensure (i) effective disaster management, (ii) promote coordination, (iii) ensure adequate financial arrangements, and (iv) improve the proactive risk reduction programme (FAO, 2004).

In Zimbabwe, the state in 1998 reviewed institutional capacities and structures to deal with drought preparedness, mitigation and response, with much of the focus going on improving sustainable livelihoods, water conservation and natural resource management. The model focused on planning, preparedness, prevention, mitigation response, recovery and rehabilitation, with key strategies being awareness, research, controlled grazing, reforestation, water conservation, rural industrialisation and mechanised agriculture (FAO, 2004).

The IGAD inter-regional platform provides mechanisms for coordination among development partners and governments to enhance disaster resilience of vulnerable communities within the pastoral and agro-pastoral areas in the Horn of Africa (FAO, 2020a). The first IGAD Priority Intervention Area (IGAD, 2020) enhances access and use of sustainable natural resources and environmental services among drought-prone communities. The key strategies in the IGAD contingency plan are to develop regional capacity and strengthen regional cooperation on climate adaptation. To enhance community resilience, early warning systems need to be harmonised (preferably regionally). In addition, the capacity of ICPAC to forecast weather/climate precisely should be enhanced and the negotiation capacity of member states strengthened.

The outcome of the 8th IGAD-IDDRSI Steering Committee Meeting in Entebbe (IGAD, 2017), recommended for building regional resilience, understanding the impact of consecutive droughts on agriculture and ecosystems, and strengthening monitoring and evaluation and reporting systems. In 2018, FAO focused on

building resilience in the East and North Africa regions by providing technical, administrative and financial capacities and drought management structures to protect farmers (Bazza, Kay and Knutson, 2018). The FAO helps build the capacity of drought-prone countries and reduce the impacts of future drought. In addition, it helps develop guidelines for specific drought-prone regions, provide support for the implementation of drought policies, build partnerships (WMO, UN-Water, UNCCD, CBD, NDMC-USA) with institutions and research centres, and encourage regional networking (Rojas, 2020).

In response to drought, FAO used cash transfer programmes (in the Horn of Africa), water trucking (in East Africa) and restocking herds (in the Sahel) as short-term strategies. It considered road improvement, irrigation, water conservation and disease management as long-term strategies to help build the resilience of vulnerable pastoralist communities. In 2017, FAO-Ethiopia scaled up drought response to recover broken social safety nets (FAO, 2017) by using emergency livestock support targeting vulnerable refugees and host communities, supporting crop production and improved coordination.

In the Kenyan Vision 2030, the Medium Term Plan II for Drought Risk Management and Ending Drought Emergencies (Figure 15) was part of the Common Programme Framework for national transformation toward reducing vulnerability to drought (NDMA, 2015). After devolution, the responsibilities for drought management were shared between the national government and the county governments.

The framework addresses structural causes of vulnerability by harmonising inequalities in power and resources sharing, and integrating measures for programmes to scale up and down in response to drought conditions. The first four pillars of the EDE framework focus on building resilience to drought risk and the last two on improving risk management (Obrecht, 2019). The framework also recognises the water stress in the Arid and Semi-Arid Lands (ASALs) regions and calls for a coordinated approach that guides water service providers to improve water access for the rural population. The framework proposes to integrate disaster risk management into critical economic sectors.

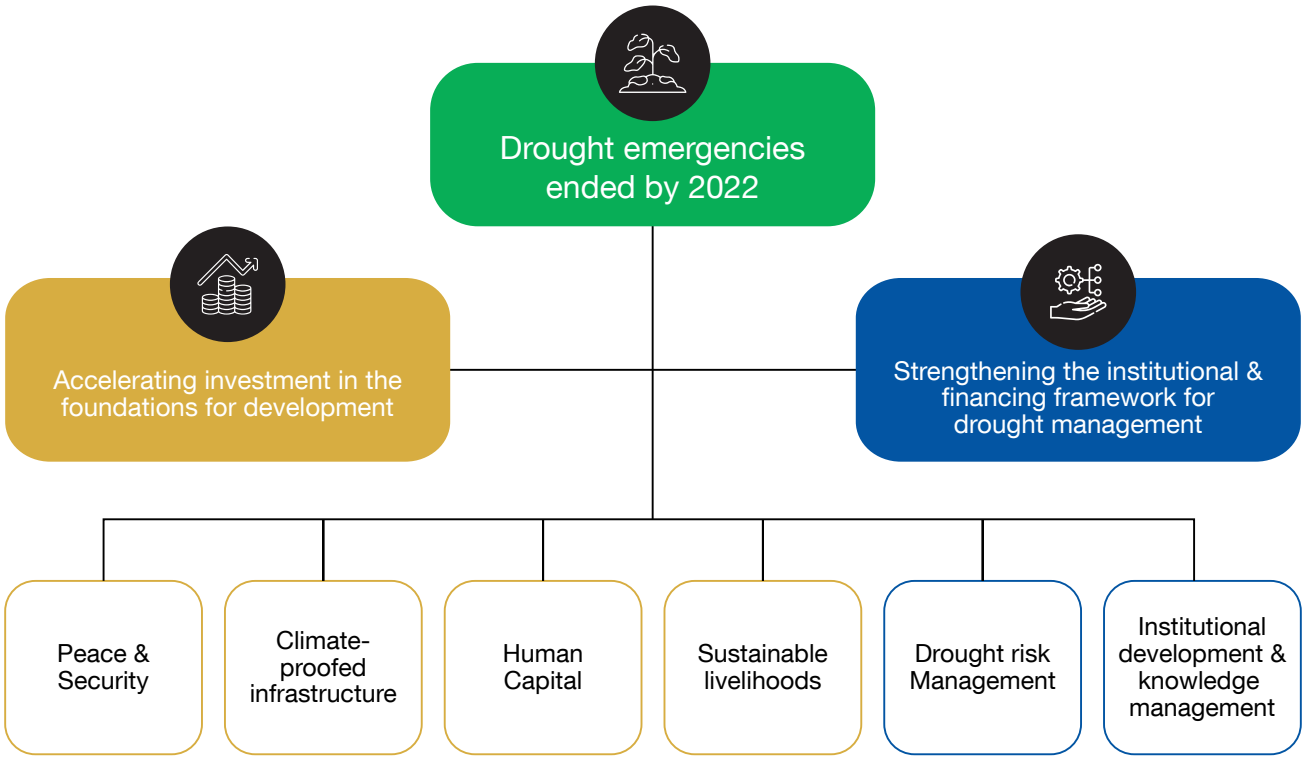


FIGURE 15: ENDING DROUGHT EMERGENCY (EDE) FRAMEWORK, KENYA

In 2011, the Kenyan government converted the Department for Arid Lands into a new National Drought Management Authority (NDMA), mandated to coordinate drought response in Kenya. The government focused on planning and coordination of emergency response while international partners take on advisory roles and implementation of project activities. The County Steering Group reviews development and implementation at the county level.

In West Africa, and specifically Morocco, past drought events led to the establishment of an Integrated Drought Management System to do:

i. Monitoring and introducing an early warning system
ii. Remote sensing and forecasting
iii. Implement emergency operational plans (water supply, job creation, forest conservation), and
iv. Reduce vulnerability to drought.

A key pillar is an integrated approach to water conservation and sustainable use for domestic and agricultural production, using public-private partnerships.

4.5 Asian Drought Policies

The geo-climatic conditions of South Asian and South East Asian countries are diverse and vulnerable to multiple natural hazards, such as drought (Indrajit and Bhatt, 2020). Drought risk management in South Asia and South East Asia provides a valuable reference point on general perspectives on drought risk mitigation and management. Other Pacific states focus on improving adaptive capacity instead of prevention as a strategy to deal with existing drought effects. Member states of the Association of Southeast Asian Nations (ASEAN) have taken measures against drought (Reliefweb, 2019) by declaring they will integrate drought-related activities into the association's future action plan. The target is to improve drought risk assessment and early warning services by:

i. Sharing data from space-based technologies
ii. Capacity building, and
iii. Risk financing instruments.

Regional cooperation is fostered among states that share the Mekong River (GDO_ERCC, 2019). In policy dialogue (10 December 2019) on 'Building Resilience to Drought in South-East Asia', current initiatives and future strategies on strengthening drought resilience supported prevention, protection and assisting vulnerable communities (ASEAN, 2019). Sectoral resources were mobilised for inclusive cooperation, political commitments, capacity building and disaster monitoring geared towards improved drought response strategies. In the short term, farmers were supported with crop farming structures, irrigation, and information on water storage and use for agriculture and domestic purposes. In the long term, ASEAN states agreed to:

(i) Transform crop and aquaculture structures to fit drought-resistant varieties
(ii) Adjust cropping seasons according to suitable ecological conditions
(iii) Improve water storage and supply strategies
(iv) Create awareness and invest in drought prevention, and
(v) Ensure proactive response to drought. ASEAN regional states collaborate on risk financing, drought risk assessment, and supporting multi-sectoral approaches to drought management.

During the Asia-Pacific Conference on Early Warning, Prevention, Preparedness and Management of Disasters in Food and Agriculture (FAO, 2001), Agenda 5 of the conference highlighted river basin management strategies for flood and drought mitigation, which covered current strategies, experiences, trends in approaches, techniques and practices, and lessons learnt. However, there has been limited documentation among ASEAN states (IGES, 2017).

4.6 China's Drought Policy

China introduced its National Climate Change Programme to cope with frequent drought through investment in water infrastructure, implementing water laws, improving technology, promoting agriculture, improving seeds and reducing losses from drought. The focus at the national level is on long-term climate change mitigation and adaptation policies, drought relief policies and policy formulation to improve the adaptive capacity of local people (Li, et al., 2013).

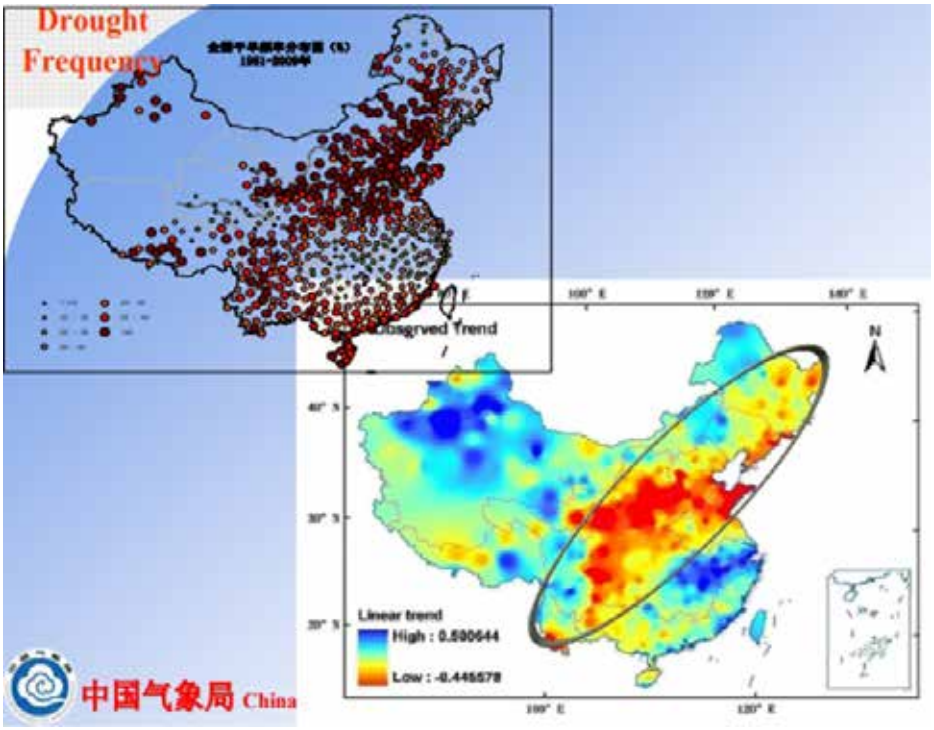
China has invested about US$608 billion into the water sector over the past several years, focused toward disaster risk management, optimal infrastructure and ecosystem-based management (Zhang et al., 2012). The investment was motivated by socio-economic challenges linked to a water shortage resulting from severe hydrological drought (Yang et al., 2015). The Yangtze drought of 2019 is remembered for limited water access to 3.5 million people and undermining river transport and cargo shipping. The state plans to build resilience by improving infrastructure through the South-North Water Diversion Project and addressing risk management and ecosystem-based management.

The WMO expert meeting on the National Drought Policy, held in 2011 in Washington, rates drought impact in China at 55%, among other disasters. This serves to motivate drought management planning and policy reforms (Zhang, 2011). The four figures in Figure 16 below (a, b, c, d) show the structure of drought policies in China.

16A

Documents of the Central or local governments on Drought preparedness and reduction

16B



16C

16D

FIGURE 16: DROUGHT POLICIES OF THE PEOPLE'S REPUBLIC OF CHINA (ZHANG, 2011).

4.7 Australian Drought Policy

The Australian government drought response, resilience and preparedness plan shows stakeholder engagement in drought management is important, ranging from state and territorial governments to industry, individual farmers and business communities (Australian Government, 2019a). In 2018, the state and territorial governments signed a National Drought Agreement (NDA), to guide in the development of policies that position farmers to plan for and manage risk, and prepare for and recover from drought. The agreement provides a framework for a collaborative effort in drought preparedness, response and recovery, adoption of risk management practices, providing services for mitigation, and improving access to information.

The role of the state is to:

i. Fund and deliver household support payment
ii. Establish an operational future drought fund
iii. Provide access to farmers' incentives (loans), and
iv. Improve weather prediction and communication.

Key areas include supporting victims during drought, supporting farmers, and ensuring long-term resilience and preparedness.

The shared responsibilities among Commonwealth territories are:

(i) Developing and implementing drought preparedness, response and recovery programmes

(ii) Developing capacity-building programmes and promoting resilience

(iii) Mitigating the effects of drought on human wellbeing

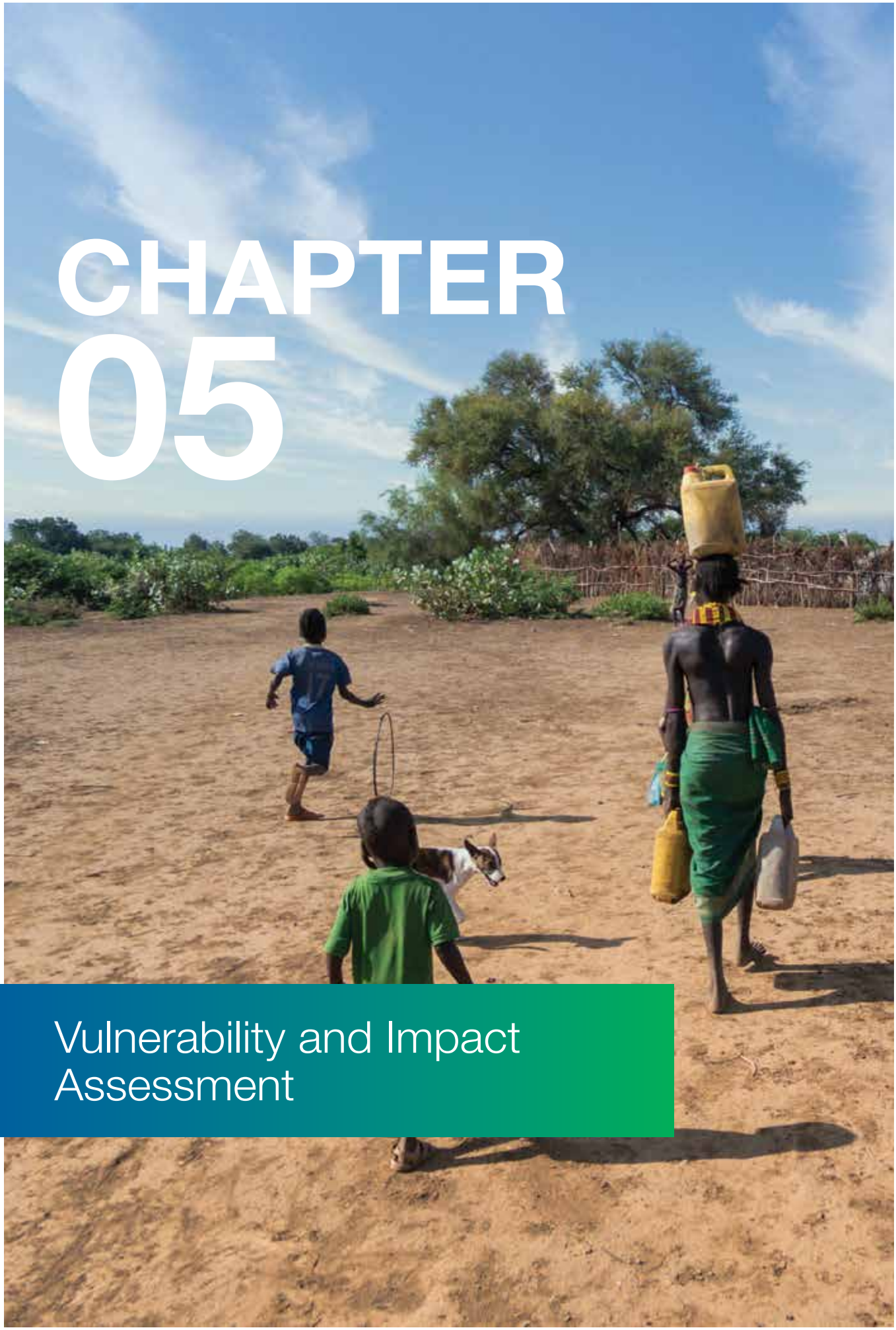
(iv) Coordinating and communicating reliable information on drought management policies

(v) Ensuring information on assistance for drought preparedness, response and recovery is accessible

(vi) Ensuring consistency of drought policies, and

(vii) Developing quality data on weather, EWS, fodder and information.

The Inter-Governmental Agreement (IGA) supports producers to adapt and prepare for drought (Australian Government, 2019b) and subsequent water trading (Kiem, 2013), as well as maintenance of the natural resource base. The IGA review working group suggests policy approaches in preparedness and risk management for drought and rural support, including investment in monitoring tools for forecasting drought. The existing National Drought Policy in Australia was agreed upon by all levels of government to encourage producers to adopt self-reliant approaches to protect agricultural and environmental resources during drought (White and Karssies, 1999) and invest in research, extension and education services to support farmers in coping with drought.



CHAPTER 05

Vulnerability and Impact Assessment

In this section, the report focuses on globally recommended models, most of which have been applied in IPCC in the assessment of climate change variabilities and the drought distribution, severity and duration. In the last two decades, the IPCC's Special Report on Emissions Scenarios (SRES) has been used in the southern European drought risk assessment (Parry et al., 2007). These models showed similar results when computed by both ECHAM4 and HadCM3 GCMs, i.e. that a drought occurrence frequency of less than every 10 years should be expected by the 2070s.

In Latin America, specifically Brazil, the government adopted the Municipality Watch Index (IMA), which is composed of IPECE and the State Research Institute, to streamline relief services as part of improving drought preparedness and response strategies. During its application, the IMA measured the vulnerability of 184 municipalities to climatic change and its effects on agriculture.

5.1 Drought vulnerabilities and responses

In China, the data for vulnerability assessment is based on the national meteorology service, the Arid Climate Observation System (ACOS, Lanzhou), China Climate Observation System (CCOS, Beijing) and the National Centre for Arid Climate Monitoring and Warning (NCACMW). These models allow for an integrated, responsive and efficient drought warning system, which includes:

i. Numerical weather prediction models
ii. Drought warning models, and
iii. Disaster assessment criteria and decision management.

The key variable for assessment and ranking vulnerability of the socio-economic sectors in China include:

iv. Clean drinkable water, hydro-power, water security
v. Forestry food production
vi. Grassland production, and
vii. Industry, service and environment.

China Meteorological Administration has developed the national drought grading indices, early warning and assessment systems.

See the below two figures (Figure 17) where (a) shows drought-covered, affected and destroyed crop areas, and grain losses and (b) shows population and livestock in drinking water access difficulty.

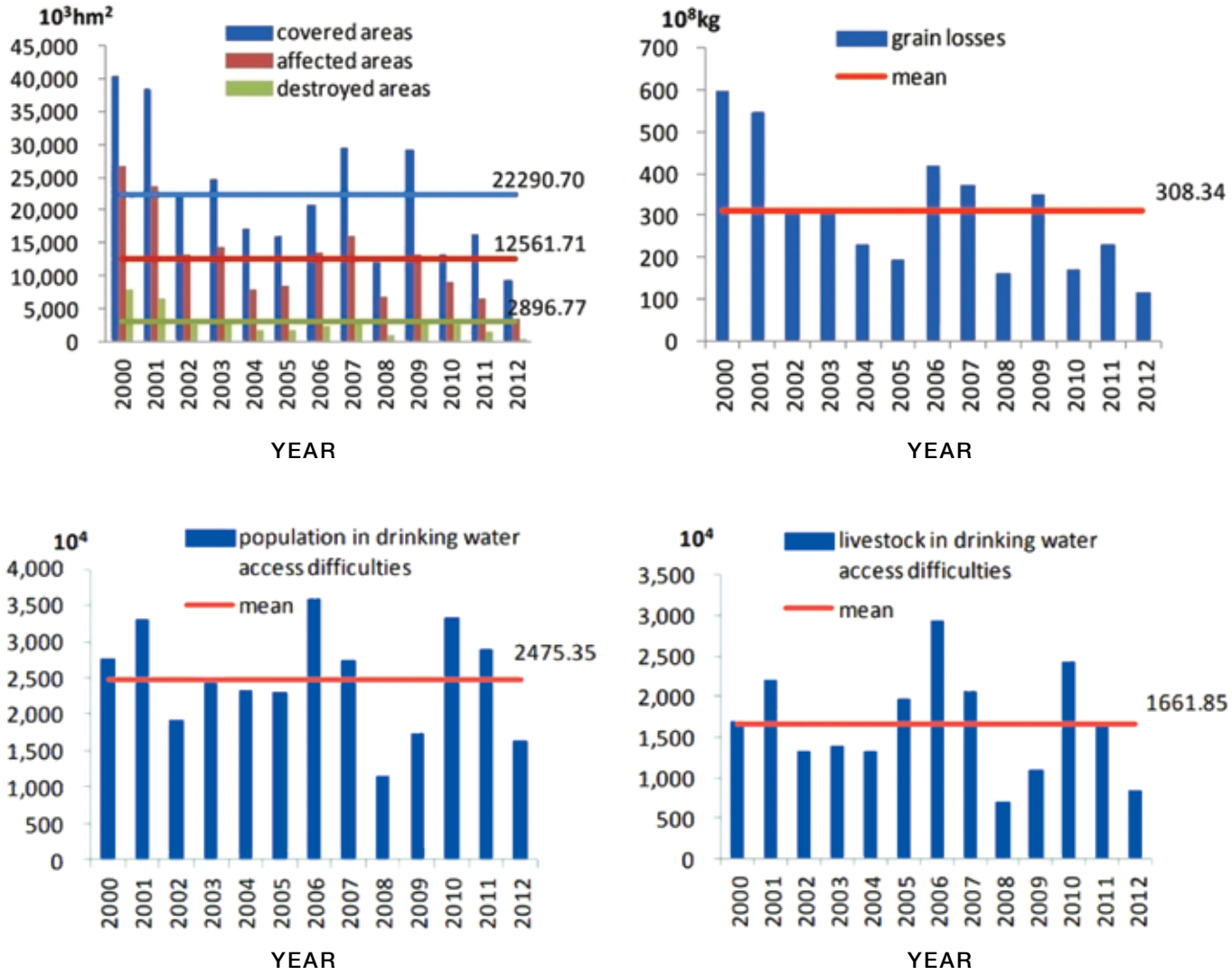


FIGURE 17: THE DROUGHT IMPACT ON PASTURE AND LIVESTOCK NUMBERS (XURONG AND XIAOHUI, 2010)

Analysis of the river flow during drought(s) in Southern Africa was used to determine the severity and provide effective means of monitoring as droughts develop (Meigh, Tate and McCartney, 2002). Due to the complexities of drought behaviour over large regions, four techniques were combined in a software package to provide rapid assessments, namely:

i. Low-flow frequency analysis based on annual minimum discharge
ii. The run-sum analysis suitable for tropical and ASALs climates
iii. Run-off accumulation analysis based on comparing current river flows and historical quantities, and
iv. Ranking of flows and comparison with extremes based on statistical comparison of monthly flows to historic minima, maxima and means of river flows.

Based on studies that link ENSO to the cause and severity of drought in the southern region of Africa, the utilisation of multiple sea surface temperature patterns (Gore, Abiodun and Kucharski, 2020) and correlation, uses the SPEEDY software to study historical simulations (1979-2008) against current observations and the impact on the Standardized Precipitation Evapotranspiration Index. Although the approach captures regional, temporal and spatial distribution of climate variables, it has a warm and wet bias, hence the need to compare its outcome with other complex drought models.

Models reviewed by the Intergovernmental Panel on Climate Change consistently predict an increased incidence of drought in the future (Li et al., 2009), which highlights the danger of outstripping the local efforts of adaptation and mitigation to drought (IPCC, 2014). Adverse impact is expected in the large public and private investments to meet the food needs of the growing human population, through:

i. Crop breeding
ii. Irrigation infrastructure
iii. Safety nets
iv. Processing/marketing infrastructure, and
v. Storage facilities.

In an attempt to characterise the spatial and temporal structures of drought regimes in Southern Africa, 10 global climate models utilised the Standardized Precipitation Evapotranspiration Index spanning three and 12 months. Here, the spatial variability used rotated principal component analysis while the temporal variability relied on wavelet analysis. The results showed that all the models simulate the drought better at three months, but with high variation in strength and duration. In another study (Lyon, 2009), scholars use the weighted anomaly Standardized Precipitation Index (SPI), where they correlated Weighted Anomaly Standardized Precipitation Index (WASP) and SPI based on the GPCC data, the area average temporal correlation for the Southern Africa land area grid.

During the Asia-Pacific Conference in June 2001, Global Information and Early Warning System (GIEWS) methodologies, tools and technologies integrated the following elements into the GIEWS workstation:

i. The country cereal balance sheet
ii. The rapid assessment mission
iii. The geographic information system
iv. Satellite imagery, and
v. The electronic news service.

With the use of such methodology, which is linked to a unique reference database, analysts can assess rainfall and vegetation, supply and utilisation and other indicators to provide warnings of an impending disaster. Participating states suggested that such methodologies for assessing food availability and accessibility at the local level should be improved. The contribution of FAO in national early warning systems was realised in the development of an interactive website known as GeoWeb, which gives users access to GIEWS databases and tools. The role of agrometeorological models and remote sensing for crop monitoring and forecasting in Asia and the Pacific is very important.

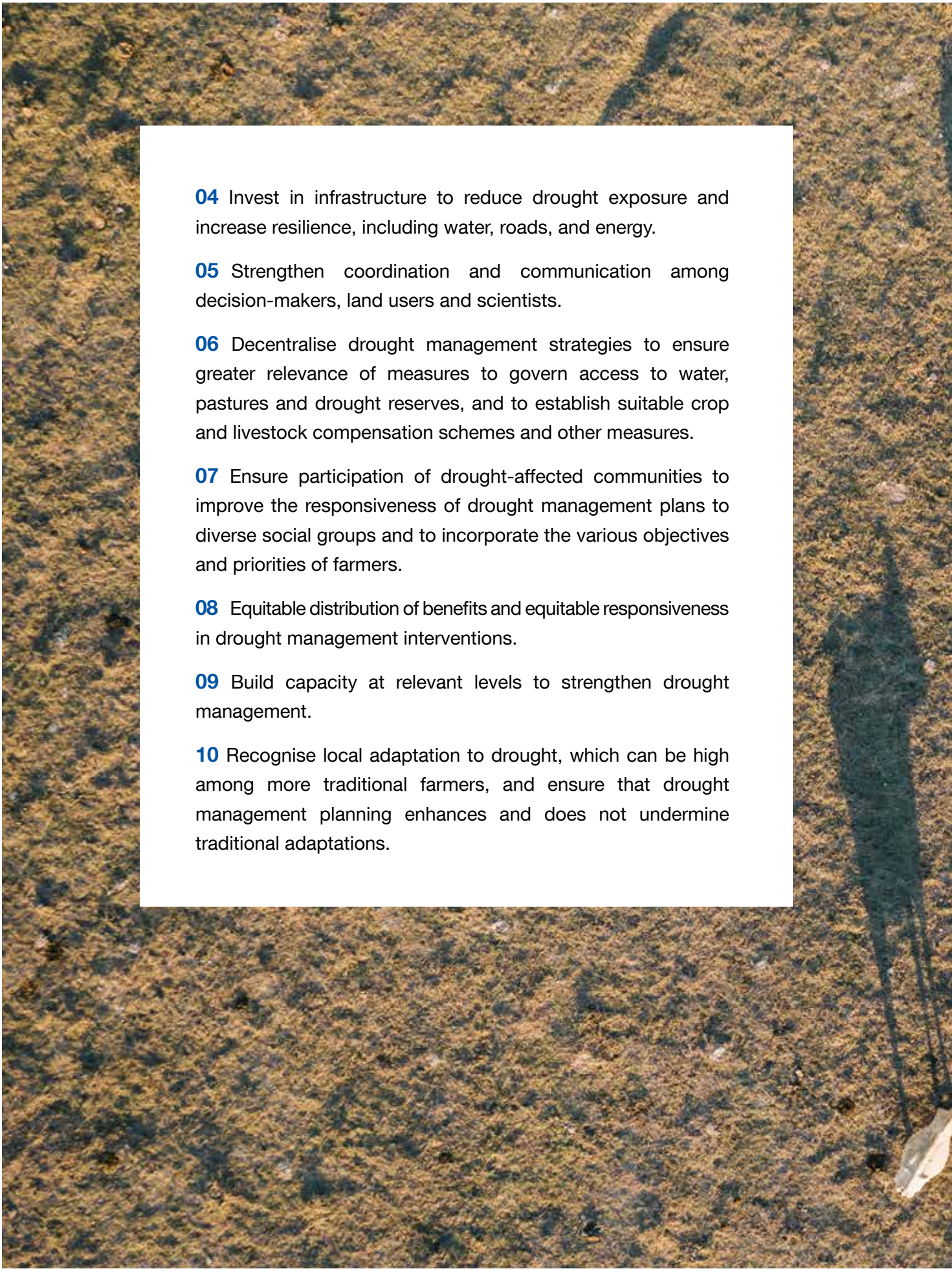
5.2 Lessons on Drought Mitigation Strategies

Based on the policies and strategies reviewed in the preceding section, several lessons emerge that can inform further efforts to develop drought management strategies.

01 Promote sustainable management of natural resources, ensure environmental protection, and ensure agricultural development is consistent with drought risk management.

02 Prioritise drought mitigation and response measures, including measures to rehabilitate degraded ecosystems, and ensure drought management planning is informed by climate change scenarios to improve adaptation and resilience building.

03 Maintain a strong focus, particularly in developing economies, on the vulnerabilities of the poorest sectors of society, whose capacity to manage drought may be particularly weak.



04 Invest in infrastructure to reduce drought exposure and increase resilience, including water, roads, and energy.

05 Strengthen coordination and communication among decision-makers, land users and scientists.

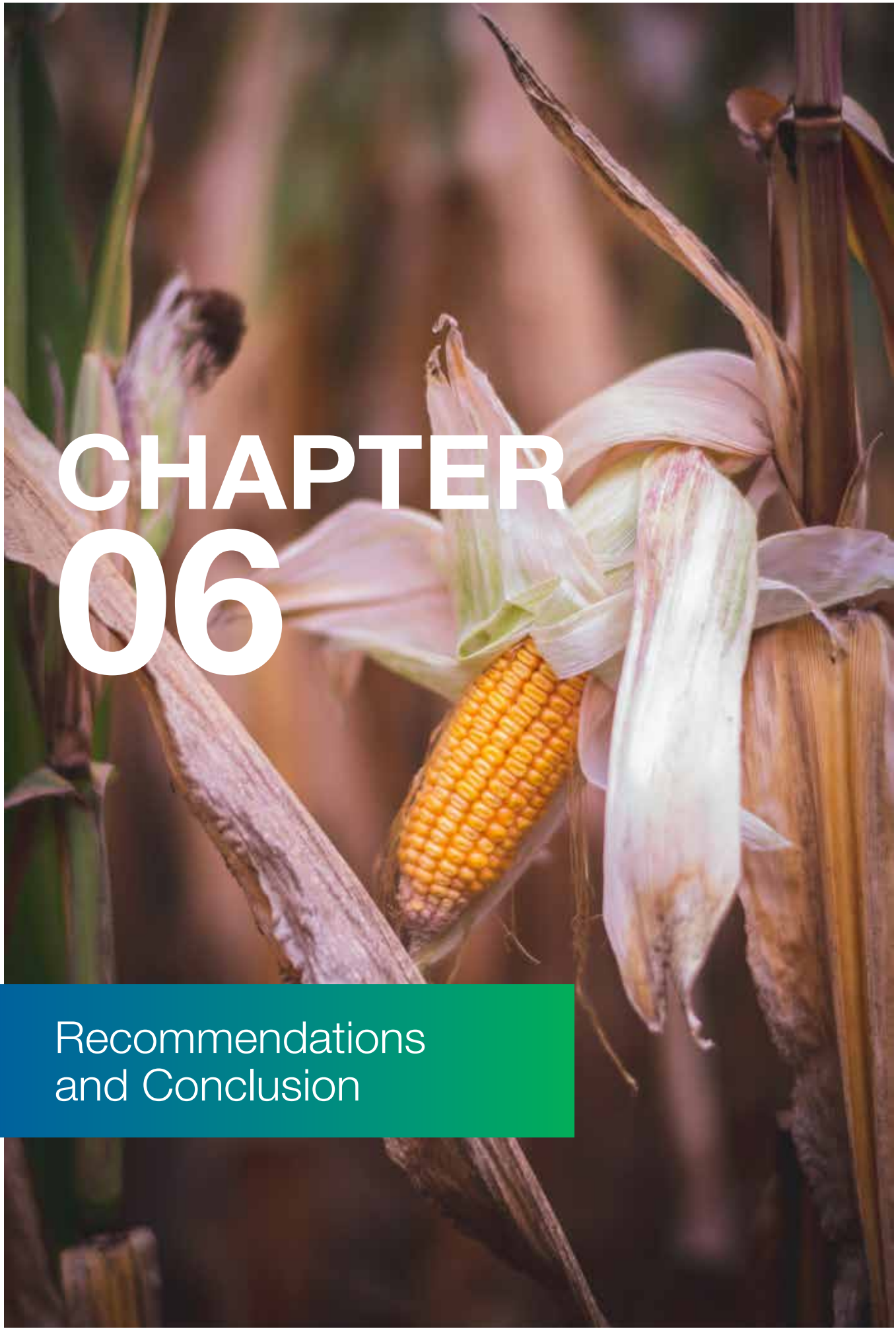
06 Decentralise drought management strategies to ensure greater relevance of measures to govern access to water, pastures and drought reserves, and to establish suitable crop and livestock compensation schemes and other measures.

07 Ensure participation of drought-affected communities to improve the responsiveness of drought management plans to diverse social groups and to incorporate the various objectives and priorities of farmers.

08 Equitable distribution of benefits and equitable responsiveness in drought management interventions.

09 Build capacity at relevant levels to strengthen drought management.

10 Recognise local adaptation to drought, which can be high among more traditional farmers, and ensure that drought management planning enhances and does not undermine traditional adaptations.



CHAPTER 06

Recommendations and Conclusion

Several of the recommendations highlighted are based on common strategies suitable for implementing sustainable drought management strategies at regional levels. While the majority of the recommendations can be applied globally, some of the elements may be specific to Africa due to the complex nature of the African climate system and drought variabilities. The elements are grouped under the three global pillars of drought risk management.

6.1 Monitoring and Early Warning Systems

Nations and regional governments should improve drought monitoring and early warning systems through:

i. Adequate assessment of drought situations from inception to the end of the drought event
ii. Improved national and regional drought forecast by using advanced models and tools suitable to a specific place, and weather parameters
iii. Ensuring timely and reliable data is available to inform decisions and policy reforms, and
iv. Increased capacity building and awareness, especially at the local level, and for farmers and other producers.

The future early warning systems in the SADC region should:

i. Use research to understand strategies for reducing hunger and distressed or migrating population as a result of drought through research activity
ii. Provide timely and effective information to facilitate action to avoid or reduce the risk of droughts and prepare for an effective response
iii. Provide increased monitoring of drought indicators to determine the inception and when the drought ends, including the timely and spatial distribution, and
iv. Go beyond the generalised precipitation deficiency and adopt indicators relevant to the different types of drought discussed in this report, including evidence of land degradation and changing water demands.

6.2 Vulnerability and Risk/Impact Assessment

In order to achieve better vulnerability and risk/impact assessment at the national and regional level, governments and partners concerned with drought should focus on:

i. Assessing risks at all levels, community and regional, to develop better drought plans
ii. Identify different forms of vulnerability and analyse the reasons for each
iii. Governments should assess the severity of droughts and estimate the expected damage, and
iv. All governments should map drought hotspots and focus resources to manage drought risks in drought-prone areas.

The vulnerability assessment features in the SADC region should consider the following:

i. Assess the vulnerability of economic sectors, especially those that deal with extracting from the natural systems, including rain-fed agriculture, livestock, environment, energy, tourism and health sectors
ii. Assess the degree of potential damage and losses in the event of a drought
iii. Assess and improve the coping capacity of communities and nations prone to drought
iv. Identify reasonable mitigation measures to address risks with state sectors, population groups, and ecosystems, and

v. Assess to what extent production systems are vulnerable, and the conditions that impact a system's resistance to drought.

6.3 Improved Drought Risk Mitigation Measures

To achieve drought risk mitigation measures:

i. Increase water infrastructure for conservation and sustainable use
ii. Invest in land restoration to improve soil moisture and groundwater recharge and reduce evaporative losses
iii. Integrate precipitation and other climatic parameters with water information, such as; stream flow (tropical regions), the snowpack (polar regions), groundwater levels, lakes, and soil moisture
iv. Increase water supply to manage increasing demand and respond to increasing population
v. Increase insurance cover on producers, especially crop and livestock farmers/traders, and
vi. Build farmers' capacity on how to mitigate drought impact.

Some of the key recommended mitigation measures for the SADC region include:

i. Restore degraded lands and balance land and water resources
ii. Improve water conservation and sustainable utilisation, protection of water sources against contamination and expand storage through dams and reservoirs; foster controlled water extraction and usage
iii. Improve irrigated agriculture for subsistence livelihoods
vii. Investing in social protection and cash-transfer programmes and improving access to markets and rural services can create alternative non-farm employment that could reduce the impacts of droughts
viii. Increase crop insurance to protect crop farming and further invest in drought-tolerant crops
ix. Address upstream-downstream water users' conflicts to encourage integrated water resource management for sustainable conservation of water resources
x. Analyse documents against normative and existing standards based on the WMO and the GWO drought management policy guidelines
xi. Identify capacity gaps in the implementation of drought policies, and
xii. Identify best drought management practices at regional, national and basin levels for targeted measures in addressing drought risks.

6.4 Establish Drought Institutions and Drought Contingency Planning

Governments in the SADC region can establish institutions that deal exclusively with drought management for improved coordination, enhancing monitoring and early warning capabilities, water shortage impact assessments and preparedness, response, and recovery programmes. Drought contingency plans at the regional level will allow for integrated approaches, enabling states to pool resources to assess droughts, drought action levels and institutional responses, and strive for effective preparedness, response and recovery from droughts, and further, improve water resource management. The contingency plan should focus on:

i. Improving access to information, investment in technologies and empowering working practices
ii. Establishment or implementation of frameworks for national planning and coordination to facilitate drought response and management
iii. Specifying activities that should be implemented before, during and after a drought to minimise drought impacts at the sectoral, national and regional level, with respect to coordination, monitoring, mobilising resources and local wisdom
iv. Identifying and mapping supportive stakeholders at the local and regional levels, with a vision to participate in the drought response activities, and
v. Considering the role of local experiences in drought response strategies and sharing success stories in the region to support the next layer of drought mitigation efforts.

6.5 Conclusion

As the climate drastically changes, the world is realising how essential it is to plan and have systems and plans in place for natural disasters, particularly drought. The concern is not only for environmental impacts due to drought seasons, but nations also recognise the importance of taking into consideration the socio-economic impacts and effects of drought. Certain factors are most affected by drought and require specialised planning and conceptualisation of implementable strategies and frameworks to ensure that the vulnerability to prolonged drought seasons is reduced. This includes subsistence farmers and rural communities in less-developed countries that are water-scarce.

As the world prepares for the predicted prolonged periods of dry weather, the policies and frameworks, as well as the various tools of early warning systems, will prove to be crucial. There should be particular attention given to regional coordination of these tools, policies and frameworks, particularly for areas most vulnerable to the occurrence of crops, such as the southern parts of Africa. In these areas, frameworks and tools should be realistic, holistic and harmonised to ensure they are implementable and relevant.

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