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Proceedings of the Regional Workshops on

Capacity Development to Support National Drought Management Policies

for Eastern and Southern Africa and the Near East and North Africa Regions

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A UN-Water Initiative

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ACRONYMS AND ABBREVIATIONS

AGRITEX	Agriculture Research and Extension Services
AMESD	African Monitoring of the Environment for Sustainable Development
APF	Advocacy Policy Framework
AREA	Agricultural Research and Extension Authority
ASALs	Arid and Semi-arid Lands
ASIS	Agriculture Stress Index System
BVAC	Botswana Vulnerability Assessment Committee
CAMA	Civil Aviation and Meteorological Authority
CBD	Convention on Biological Diversity
CEPA	Centre for Environmental Policy and Advocacy
CILSS	Club of Sahel and the Permanent Inter-State Committee to Fight against Drought in the Sahel
COP	Conference of Parties
CRTS	Royal Center of Spatial Teledetection
CSA	Office of Food Safety
DCCMS	Department of Climate Change and Meteorological Services
DMCN	Drought Monitoring Centre, headquartered in Nairobi
DMN	Direction de la Météorologie Nationale
DRM	Drought Risk Management
EBI	Ethiopian Biodiversity Institute
ECA	Economic Commission for Africa
EDE	Ending Drought Emergencies
ESA	Eastern and Southern African
ETP	Evapo-transpiration
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
FRWO	Range and Watershed Management Organization
GDP	Gross Domestic Product
GFCS	Global Framework for Climate Services
GHA	Greater Horn of Africa
GHACOF	Greater Horn of Africa Climate Outlook Forums
GMB	Grain Marketing Board
GWP	Global Water Partnership
HCEFLCD	High Commission for Water and Forests and the Fight against Desertification
HMNDP	High-level Meeting on National Drought Policy
HOA	Horn of Africa
ICPAC	IGAD Climate Prediction and Applications Center
IDDRSI	Drought Disaster Resiliance and Sustainability Initiative
IDMP	Integrated Drought Management Programme
IGAD	Intergovernmental Authority on Development
IMDC	Inter-Ministerial Drought Committee
INRA	National Institute of Agronomic Research
ISA	Iranian Space Agency
IWRM	Integrated Water Resources Management
KMS	Kenya Meteorological Service

MEDD	Ministry of the Environment and Sustainable Development
MESA	Monitoring for Environment and Security in Africa
MIN	Minimum on record
MOCIT	Ministry of Communication and Information Technology
MSD	Meteorological Services Department
NAP	National Action Programmes
NAPA	National Adaptation Programme of Action
NBSAP	National Biodiversity Strategy and Action Plan
NCAD	National Committee on Agricultural Drought
NCP	National Contingency Plan
NDCF	National Drought Contingency Fund
NDDPCU	National Drought and Desertification Programs Coordinating Unit
NDMA	National Drought Management Authority
NDMC	National Drought Mitigation Center
NDMO	National Disaster Management Office
NDMP	National Drought Management Policies
NDO	National Drought Observatory
NDVI	Normalized Difference Vegetation Index
NDWMC	National Drought Warning and Monitoring Center
NEMA	National Environment Management Authority
NENA	Near East and North Africa
NIP	National Irrigation Programme
NMHS	National Meteorological and Hydrological Services
NWRA	National Water Resources Authority
NWSA	National Water and Sewage Authority
ONM	National Office of Meteorology
PDI	Palmer Drought Index
PDNA	Post-disaster Needs Assessment
RCOF	Regional Climate Outlook Forums
RDC	Rural District Council
SADC	Southern African Development Community
SPEI	Standardized Precipitation Evapotranspiration Index
SPI	Standardized Precipitation Index
SRBMP	Shire River Basin Management Project
SSEP	Sudanese Society for Environmental Protection
SST	Sea Surface Temperature
TDA	Tiham Development Authority
UNEP	United Nations Environment Programme
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNW-DPC	UN-Water Decade Programme on Capacity Development
USDM	United States Drought Monitor
WFP	World Food Programme
WHADP	Wadi Hadramout Agricultural Development Project
WMO	World Meteorological Organization
WRD	Water Resources Department
WRSI	Water Requirement Satisfaction Index
WSTF	Water Scarcity Task Force
ZIMVAC	Zimbabwe Vulnerability Assessment

FOREWORD

Launched in March 2013 on the margins of the High-level Meeting on National Drought Policy (HMNDP) in Geneva, Switzerland, the UN-Water initiative on Capacity Development to Support National Drought Management Policies (NDMP) is a collaborative effort of several entities of the UN-Water inter-agency mechanism: the World Meteorological Organization (WMO), the United Nations Convention to Combat Desertification (UNCCD), the Food and Agriculture Organization of the United Nations (FAO), the Convention on Biological Diversity (CBD) and the UN-Water Decade Programme on Capacity Development (UNW-DPC).

Together these partners aim to help drought-prone countries formulate and adopt effective, risk-based national drought management policies through the targeted development of capacities among the various stakeholders dealing with drought at all levels, including ministries, relevant institutions, practitioners and the society at large. It is clear that responding to drought proactively, before it actually happens, can reduce the often disastrous impacts on livelihoods and economies. So far regional workshops have been held for Eastern Europe, Latin America and the Caribbean, Asia-Pacific, Eastern and Southern Africa, as well as the Near East and North Africa regions. A final regional workshop for West and Central African countries will take place in Accra, Ghana from 4 to 7 May 2015.

The topic of the present proceedings covers the outcomes of the regional workshop for Eastern and Southern Africa which took place in Addis Ababa, Ethiopia from 5 to 8 August 2014, and the regional workshop for the Near East and North Africa which took place in Cairo, Egypt from 17 to 20 November 2014.

The level of cooperation required to execute an initiative like NDMP is considerable, not only among the partners involved at the United Nations level but also among partners at the national and regional level. Therefore, the initiative's success is based in large part on the willingness of the collaborating organizations to contribute their competences and experiences in order to enter into an intense dialogue with countries from all over the world.

As coordinator of this UN-Water initiative, therefore, I warmly thank our partner institutions, local hosts for the regional workshops as well as, of course, all of the engaged participants who have made this initiative a success. We hope that by helping countries develop and implement national drought management policies based on the philosophy of risk reduction, we can alter approaches to drought management at the country level and significantly help to reduce the associated impacts. On an international level, 2015 will be an important year for setting the development goals under the post-2015 development agenda and we hope that this initiative has made a significant contribution to the discussion by raising awareness on the importance of national drought policy and preparedness planning.

Further information on the initiative is available from:
www.ais.unwater.org/droughtmanagement

Reza Ardakanian
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The UN-Water Decade Programme on Capacity Development (UNW-DPC)
on behalf of the partners of the UN-Water initiative on
"Capacity Development to Support National Drought Management Policies"

SETTING THE SCENE

Donald Wilhite, University of Nebraska, USA

The implementation of national drought policy based on the philosophy of risk reduction can alter a nation's approach to drought management by reducing the associated impacts (risk). This was a motivating factor that led to the "High-level Meeting on National Drought Policy (HMNDP)" [1] which took place in Geneva from 11 to 15 March 2013. Accordingly, the World Meteorological Organization (WMO) Secretariat, the Secretariat of the United Nations Convention to Combat Desertification (UNCCD) and the Food and Agriculture Organization of the United Nations (FAO), in collaboration with a number of UN agencies including the UN-Water interagency mechanism, international and regional organizations and key national agencies organized the HMNDP. The theme of HMNDP was "Reducing Societal Vulnerability – Helping Society (Communities and Sectors)."

Concerns about the spiraling impacts of drought on a growing number of sectors, the current and projected increase in the incidence of drought frequency and severity and the outcomes and recommendations emanating from the HMNDP, is drawing increased attention from governments, international and regional organizations, and non-governmental organizations on drought policy and preparedness planning. Simply stated, a national drought policy should establish a clear set of principles or operating guidelines to govern the management of drought and its impacts. The overriding principle of drought policy should be an emphasis on risk management through the application of preparedness and mitigation measures. This policy should be directed toward reducing risk by developing better awareness and understanding of the drought hazard and the underlying causes of societal vulnerability. The principles of risk management can be promoted by encouraging the improvement and application of seasonal and shorter-term forecasts, developing integrated monitoring and drought early warning systems and associated information delivery systems, developing preparedness plans at various levels of government, adopting mitigation actions and programs, creating a safety net of emergency response programs that ensure timely and targeted relief, and providing an organizational structure that enhances coordination within and between levels of government and with stakeholders. The policy should be consistent and equitable for all regions, population groups, and economic sectors and consistent with the goals of sustainable development.

[1] High-level Meeting on National Drought Policy, organized by WMO, FAO and UNCCD, 11-15 March 2013, Geneva, Switzerland (http://www.wmo.int/pages/prog/wcp/drought/hmndp/index.php).

As vulnerability to and the incidence of drought has increased globally, greater attention has been directed to reducing risks associated with its occurrence through the introduction of planning to improve operational capabilities (i.e., climate and water supply monitoring, building institutional capacity) and mitigation measures that are aimed at reducing drought impacts. This change in emphasis is long overdue. Mitigating the effects of drought requires the use of all components of the cycle of disaster management, rather than only the crisis management portion of this cycle. Typically, when drought occurs, governments and donors have followed with impact assessment, response, recovery, and reconstruction activities to return the region or locality to a pre-disaster state. Historically, little attention has been given to preparedness, mitigation, and prediction/early warning actions (i.e., risk management) and the development of risk-based national drought management policies that could reduce future impacts and lessen the need for government and donor interventions in the future. Crisis management only addresses the symptoms of drought, as they manifest themselves in the impacts that occur as a direct or indirect cause of drought. Risk-based management, on the other hand, is focused on identifying where vulnerabilities exist (particular sectors, regions, communities, or population groups) and addresses these vulnerabilities through systematically implementing mitigation and adaptation measures that will lessen the risk to future drought events. Because societies have emphasized crisis management in past attempts at drought management, countries have generally moved from one drought event to another with little, if any, reduction in risk. In addition, in many drought-prone regions, another drought event is likely to occur before the region fully recovers from the last event.

Progress on drought preparedness and policy development has been slow for a number of reasons. It is certainly related to the slow-onset characteristics of drought and the lack of a universal definition. These characteristics make early warning, impact assessment, and response difficult for scientists, natural resource managers, and policy makers. The lack of a universal definition often leads to confusion and inaction on the part of decision makers since scientists may disagree on the existence of drought conditions and its severity. Severity is also difficult to characterize since it is best evaluated on the basis of multiple indicators and indices, rather than on the basis of a single variable. The impacts of drought are also largely non-structural and spatially pervasive. These features make it difficult to assess the effects of drought and to respond in a timely and effective manner. Drought impacts are not as visual as other natural hazards, making it difficult for the media to communicate the significance of the event and its impacts to the public. Public sentiment to respond is often lacking in comparison to other natural hazards that result in loss of life and property.

Associated with the crisis management approach is the lack of recognition that drought is a normal part of the climate. Climate change and associated projected changes in climate variability will likely increase the frequency and severity of drought and other extreme climatic events. In the case of drought, the duration of these events may also increase. Therefore, it is imperative for all drought-prone nations to adopt a more risk-based approach to drought management in order to increase resilience to future episodes of drought.

To provide guidance in the preparation of national drought policies and planning techniques, it is important to define the key components of drought policy, its objectives, and steps in the implementation process. An important component of national drought policy is increased attention to drought preparedness in order to build institutional capacity to deal more effectively with this pervasive natural hazard. The lessons learned by a few countries that have been experimenting with this approach will be helpful in identifying pathways to achieve more drought-resilient societies.

The challenge that nations face in the development of a risk-based, national drought management policy is complex and requires political will and a coordinated approach within and between levels of government and with the diversity of stakeholders that must be engaged in the policy development process. A national drought policy that is centered on the principles of risk-based management will provide a framework for shifting the paradigm from one traditionally focused on a reactive, crisis management approach to one that is focused on a proactive, risk-based approach that is intended to increase the coping capacity of the country and thus create greater resilience to future episodes of drought. In essence, the paradigm shift will result is an approach that is focused on managing risk rather than managing disasters.

The formulation of a national drought management policy, while providing the framework for a paradigm shift, is only the first step in vulnerability reduction. The development of a national drought policy must be intrinsically linked to the development and implementation of preparedness and mitigation plans at the provincial/state and local levels. These plans will be the instruments through which a national drought policy is executed. The guidelines for preparing a national drought policy and preparedness plans, which are the instruments for implementing a drought policy at the sub-national level, have been developed for publication through the Integrated Drought Management Programme of the Global Water Partnership and the World Meteorological Organization. These guidelines are available on the IDMP website (**http://www.droughtmanagement.info/)** in English, Arabic, Russian, Chinese, French and Spanish.

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Chapter 1

BACKGROUND AND RATIONALE

Drought is major cause of concern for many countries across the globe. The frequency, severity, duration and spatial extent of drought is expected to even further intensify in the coming decades because of climate change and associated risks. Drought has disastrous impacts on food security, social stability, livelihoods, the environment and the economy. Thanks to the latest science and technology, impacts and associated risks of drought can be significantly reduced through improved preparedness, policies and practices that support early warning systems, vulnerability assessments and strengthening the emergency and recovery strategies. Proactive and risk-based national drought management practices can greatly assist countries to build societal resilience to drought. Unfortunately, the approach that most countries are pursuing to date is to react after drought strikes, which are referred to as "crisis management" approaches. This approach, often uncoordinated, proved to be ineffective calling for a paradigm shift from 'crisis' and 'reactive' drought management approaches to 'risk-based' and 'proactive' approaches.

A UN-Water initiative was launched on the occasion of the HMNDP with the aim of supporting countries towards building their capacities for developing the risk-based and proactive national drought management policies. The capacity building initiative is organized by the following UN-Water entities: FAO, UNCCD, WMO, CBD and UNW-DPC. The objectives and implementation mechanisms are explained in the below sub-sections.

1.1 Objectives of the Initiative

The overall goal of initative is to enhance capacities in drought-prone developing countries and transition economies in order to generate more drought resilient societies by reducing the risk associated with the incidence of drought.

Within the framework of the above stated broader goal, the key targets included:

- Improving the awareness of drought management issues and the needs and strategies for national drought policies based on the principles of 'risk reduction';
- Equipping key government stakeholders concerned with drought with tools and strategies for improved decision support, risk assessments of vulnerable sectors, population groups and regions;
- Furnishing these stakeholders with up-to-date methodologies to develop and improve drought monitoring, seasonal forecasts, early warning and information delivery systems; to conduct vulnerability and impact assessments of the vulnerable sectors and layers of the society; as well as to elaborate and implement drought preparedness, mitigation and response strategies and plans;
- Advancing national drought management policies taking into account long-term benefits of risk-based, proactive national drought policies to address drought and water scarcity problems at large, moving beyond short-term planning which addresses drought as 'crisis'; and
- Promoting collaboration between sectors at country and regional levels. In general, there is poor coordination among drought-relevant institutions within a country and among drought-prone countries in the regions. Strong coordination is a prerequisite if implementation on the ground is to succeed. Thus, preparing for drought and drought-related actions needs effective collaboration at different levels of planning, preparedness and response.

1.2 Implementation Mechanism

To be able to achieve the above-mentioned goals and targets, the partners of the UN-Water initiative organised a series of regional training workshops to support the development of national drought management policies with the following sequence of events:

- International Kick-off Workshop at the HMNDP, Geneva, Switzerland (12 March 2013);

- Regional Workshop for Eastern European countries (9-11 July 2013);
- Regional Workshop for Latin America and the Caribbean countries (4-6 December 2013);
- Regional Workshop for Asia-Pacific countries (6-9 May 2014);
- Regional Workshop for Eastern and Southern African countries (5-8 August 2014);
- Regional Workshop for Near East and North Africa countries (17-20 November 2014); and
- Regional Workshop for West and Central Africa countries (4-7 May 2015)

Based on the proposed elements in the Compendium of National Drought Policy (Sivakumar et al., 2011), the regional workshops are structured to include different sessions, which include mainly the three key pillars of national drought policy:

- Drought Monitoring and Early Warning Systems;
- Vulnerability and Risk Assessment; and
- Drought Preparedness, Mitigation and Response.

It is also worth noting that "Biodiversity and drought" was an integral part of the sessions which added value to the contents of the regional workshops by bringing the 'ecosystem and biodiversity' aspects into the drought management issues.

Each session in the regional workshops included a thematic presentation, which was followed by extended roundtable discussions in breakout groups. As situations vary from country to country, and region to region, no dogmatic or rigid set of elements of a national drought policy was defined, instead a suite of strategies guiding the policy development in each country's specific situation were presented. Participants were also introduced to a generic 10-Step process for formulating national drought policies (World Meteorological Organisation and Global Water Partnership, 2014).

The purpose of the workshop proceedings is to elaborate and document the workshop presentations and the discussions in breakout groups in the two regional workshops: (i) Eastern and Southern African (ESA) regional workshop which took place from 5 to 8 August 2014 in Addis Ababa, Ethiopia; and (ii) the Near East and North Africa (NENA) regional workshop which took place in Cairo, Egypt from 17 to 20 November 2014.

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Chapter 2

OVERVIEW OF THE REGIONAL WORKSHOPS

2.1 Introduction

Being the seat and regional hub for many regional and international offices on the African continent, Ethiopia was an ideal host country for ESA regional workshop. The workshop was hosted by the Economic Commission for Africa (ECA) and the Ethiopian Ministry of Environment and Forest. The workshop, held from 5-8 August 2014, was attended by 29 participants from 12 countries in the Eastern and Southern Africa region: Botswana, Djibouti, Ethiopia, Kenya, Malawi, Mozambique, Namibia, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe. In addition, based on request, drought experts from the Oxfam and the World Food Programme (WFP) offices in Ethiopia also attended the workshop.

For the NENA regional workshop, the Arab Republic of Egypt was selected as a host country. The FAO regional office for the NENA region together with the Ministry of Agriculture and Land Reclamation of the Arab Republic of Egypt served as active local partners. The workshop, held from 17-20 November 2014 at the Sofitel Hotel in Cairo, was attended by 31 representatives from 12 countries in the NENA region: Algeria, Egypt, Eritrea, Iran (Islamic republic of), Jordan, Mauritania, Morocco, Oman, Palestine, Sudan, Tunisia, and Yemen.

Participants in both workshops represented a wide range of ministries including agriculture, environment, meteorology and water, reflecting the interdisciplinary nature of drought. The ministries in the above-mentioned countries were requested to nominate participants based on the following criteria:

- Willingness and ability to produce, collectively with other country representatives, a preliminary synopsis on the status of drought and drought management in their respective countries, including existing capacities and perceived capacity needs (to be submitted ahead of the workshop);
- Ability to work jointly in multi-agency and interdisciplinary teams for organizing and coordinating a network of stakeholders at country level;
- Ability to influence policy development and contribute to subsequent activities at country level.

As part of the series of regional workshops, the ESA and NENA regional workshops had similar arrangements. Each regional workshop was conducted for three and half days. Following the opening session by high-level government officials in each of the workshops, Dr. Donald Wilhite, Professor at the University of Nebraska gave a keynote speech on 'Managing drought risk in a changing climate: the role of national drought policy'. A step-by-step process towards developing drought management policies was presented, highlighting the examples of the countries in the ESA and NENA regions. Then, participants were introduced into the ecosystems and biodiversity aspects of drought and the impact of drought on ecosystem services. The rest of the session was dedicated to presentations and discussions of country reports by the participants from the countries. The country reports – prepared by the participants and submitted ahead of the workshops - mainly assessed the state of the national drought management practices of the respective countries. Preparing the country reports in advance provided participants from the same country an opportunity to work together ahead of the workshop, creating a network among different ministries and sectors.

The sessions that followed focused on a set of key elements of national drought policy which fall under the following three areas: (i) Drought Monitoring and Early Warning Systems; (ii) Vulnerability Assessment and Impacts and (iii) Mitigation and Response. As situations vary significantly from country to country, no prescriptive or stringent set of elements of a national drought policy was defined, but participants were exposed to a suite of strategies guiding the drought policy development in each country's individual and specific situation. The workshops' thematic presentations were streamlined to fol-

low the above-mentioned three key areas. Each thematic presentation was followed by extended round-table discussions in breakout groups (See annex 2 for the detailed workshop agenda).

2.2 Major Outcomes

The thematic presentations and the breakout group discussions covered several key areas and exposed the participants to a wide spectrum of drought management policies and their context-specific relevance. Issues discussed in depth ranged from drought monitoring and early warning systems to various drought indices and data issues in drought monitoring systems. The major components of drought monitoring systems were emphasized, namely timely data and acquisition, impact data and synthesis/analysis of data used to 'trigger' actions and the need for efficient dissemination networks (web, media, extension, etc). Approaches of drought monitoring were clarified, ranging from single index/parameter, to multiple indices/parameters and composite index.

The steps on drought vulnerability and risk assessment and the typologies of different drought risk management measures were also discussed, including drought preparedness, mitigation, response and recovery. A range of risk management options were underlined in order to build societal resilience through national drought policies and preparedness plans, which comprise short and long-term measures. Most notably, the steps toward drought plans were discussed: (i) drought characterization; (ii) monitoring and early warning; (iii) vulnerability and impact assessment and iv) mitigation and response options. The generic 10-step process of formulating drought policies formed the backbone of the entire discussion during the four-day workshop. The cost of inaction on drought and the long-term cost effectiveness of risk-based drought management strategies when compared with the cost of disaster response and crisis management were highlighted.

During the workshop in Ethiopia, a field visit organized by the Ethiopian Biodiversity Institute (EBI) was conducted to Debre Zeit town, 63 Kilometers from Addis Ababa. The field visit highlighted the importance of coordinated, grassroots level community-based afforestation activities as a way of tackling drought.

In general, the achievements of the two workshops can be summarized as follows:

- The workshops improved the awareness of participants in drought manage-

ment issues, and specifically the needs and strategies for national drought policies based on the principles of 'risk reduction';

- The workshops equipped participants with tools and strategies for improved decision support, risk assessments of vulnerable sectors, population groups, regions and, most importantly, mitigating drought effects;
- The workshops furnished participants with up-to-date methodologies to develop/improve drought monitoring, seasonal forecasts, and early warning and information delivery systems; and
- The workshops improved participants' understanding and the long-term benefits of risk-based drought management policies versus crisis-based policies.

The workshops were able to promote national and regional networks of stakeholders in various ministries including water, agriculture, environment and meteorology. The workshops also strengthened mutual learning, which can help ensure the effectiveness of measures to address drought impacts and pave the way for formulating comprehensive national drought policies in their countries.

Photos from the regional workshops

SEA Workshop in progress

NENA workshop in progress

NENA workshop: handing over certificates to participants

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Chapter 3

THEMATIC SESSIONS

3.1 Biodiversity and Drought

David Coates, CBD

A brief introduction was given to decisions of the Conference of the Parties (COP) to the CBD that relate to drought, its management and the role of biodiversity. Environmental degradation and biodiversity loss can lead to droughts and aggravate the impacts of droughts. Droughts can also cause environmental damage, including biodiversity loss, which can have serious impacts on those communities depending on the biodiversity affected. However, healthy ecosystems play an important role in preventing, mitigating and regulating droughts, reducing peoples' exposure and vulnerability to droughts. Ecosystem conservation and restoration, therefore, should be an integral part of any drought management policy.

Ecosystems play an important role in regulating the water cycle and therefore influencing the availability of water, particularly under conditions of water stress. This includes at the landscape scale, for example forests contribute to maintaining local and regional climates and rainfall, and locally, for example, healthy soils help maintain soil moisture in farmer fields. Examples of how ecosystems can contribute to drought management include: diverse agricultural systems are more likely to be able to cope with the effects of drought; farmers have bred drought resistant crops and livestock over decades; soils which are healthy ecosystems and rich in organic matter can better retain soil moisture and are therefore able to better cope with periods of drought; and, more diverse ecosystems tend to be more resilient to climate change.

Ecosystems provide a range of services that directly and indirectly affect human well-being. During times of drought these services become particularly important as people, particularly in developing countries, tend to depend on them for their survival. Elements of ecosystem based approaches to drought management in existing national strategies include: conservation and management of natural resources; reducing the vulnerability of dry lands; integrated land and water management which includes ecosystem management; conserving and using traditional knowledge, innovations and practices regarding biodiversity; widespread use of agricultural biodiversity to develop drought resistant crops and livestock; and, in particular, restoring degraded ecosystems.

The ecosystem services, underpinned by biodiversity, that are relevant to drought management provide important cross-linkages between the objectives of the CBD, UNCCD and the United Nations Framework Convention on Climate Change (UNFCCC).

The Strategic Plan for Biodiversity 2011-2020, and the Aichi Biodiversity Targets, represents the agreed framework for action regarding biodiversity among the various biodiversity-related Multi-Lateral Environment Agreements, national governments and by the UN General Assembly. A key approach to implementation of this strategy is through the National Biodiversity Strategy and Action Plan (NBSAP). Elements of NBSAPs of countries participating in the workshops that are very relevant to drought management were provided as examples in each region.

Generally, integrating the role of biodiversity and ecosystems in all stages of developing drought management plans can lead to more sustainable, efficient and effective disaster risk reduction. Existing tools, guidance and plans under the Convention on Biological Diversity can be used to develop or further enhance drought monitoring and early warning systems, vulnerability and risk assessments, and drought preparedness, mitigation and response measures.

Further guidance and assistance is available from the CBD website **(www.cbd.int)**.

3.2 Drought Monitoring and Early Warning Systems

Robert Stefanski, WMO

The thematic session on the topic of "Drought monitoring and early warning systems" in the ESA and NENA regional workshops discussed the different drought indices and data issues and provided a number of successful examples of drought monitoring and early warning systems as well as a summary of ongoing WMO drought initiatives. During the NENA workshop in Cairo, for example, several statistics on drought were noted from the WMO publication "The Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes 1970-2012". During this time period, droughts accounted for 6% of the total number of disasters, 8% of the economic losses but 35% of the total number of deaths. This highlighted the importance of countries developing drought preparedness plans and proactive drought policies. The session then highlighted the outcomes of HMNDP. The basis for this initiative was the outcomes of the HMNDP, which produced the Science and Policy Documents.

The Science Document noted that NDMP has several key elements:

- Promoting standard approaches to vulnerability and impact assessment ;
- Implementing effective drought monitoring and early warning systems;
- Enhancing preparedness and mitigation actions;
- Implementing emergency response and recovery measures that reinforce national drought management policy goals; and
- Understanding the cost of inaction.

The sessions of the regional workshop are organized along the above five elements. HMNDP documents and other materials can be found at: www.hmndp.org.

It was noted that the HMNDP and the regional workshops are contributions to the Global Framework for Climate Services (GFCS-**http://gfcs.wmo.int)**, a UN-led initiative spearheaded by WMO to guide the development and application of science-based climate information and services in support of decision-making. The vision of the GFCS is to enable society to better manage the risks and opportunities arising from climate variability and change, especially for those who are most vulnerable to such risks. This will be done through development and incorporation of science-based climate information and prediction into planning, policy and practice.

With regard to drought monitoring and early warning systems, it was stated that scientists monitor drought for various reasons: it is a normal part of the climatic cycle; drought impacts are significant and widespread; many socio-economic sectors are affected; and drought is expensive. One important point is that droughts cause more deaths and displace more people than any other kind of natural disaster. A drought monitoring system is important since it allows for early drought detection, improves response, can provide information to activate or "trigger" actions within a drought plan, is a critical mitigation action and it is a foundation of a drought plan. These monitoring and early warning systems are essential for drought plans becoming proactive, but must be used with the key elements listed above and discussed in the other workshop sessions.

It was noted that potential drought monitoring system products and reports can include Historical analysis (climatology, impacts, magnitude, frequency), operational assessment (cooperative data, SPI and other indices, automated networks, satellite and soil moisture data, media and official requests); and also predictions/ projections (SPI and other indices, soil moisture, stream flow). Components of a drought early warning and information system involve monitoring and forecasting, tools for decision makers, drought risk assessment and planning and education and awareness.

Next, the presentation focused on drought indices used for drought monitoring which could involve a single index or parameter; multiple indices or parameters or a composite index. Many examples of drought indices were shown including mean rainfall compared with a 30 year period of record, number of days since a significant rain, snow water content, the Standardized Precipitation Index (SPI), the Palmer Drought Index (PDI), stream flow indices, composite indices and indices based on remotely sensed data.

The presentation also elaborated on the concept of indicators and triggers of drought. An indicator is a variable or variables used to describe drought conditions with examples such as precipitation, stream flow, groundwater, reservoir levels, soil moisture, snow pack, vegetation health/stress, fire danger ratings and PDI. A trigger is defined as specific values of the indicator that initiate and terminate each level of a drought plan, and associated management responses. An example of a trigger would be precipitation below the 5th percentile for two consecutive months.

There are several considerations in choosing indicators and triggers which include the following; proper and timely detection of drought; spatial and temporal sensitivity, sup-

plies and demands, start of drought / end of drought, composite and multiple indicators, data availability, validity, and clarity and ease of implementation. In addition to these indicators other information such as short-, medium-, and long-range weather and climate forecasts and drought impacts are useful for drought monitoring. Drought indices are important since they simplify complex relationships and provide a good communication tool for diverse users and audiences. They also provide a quantitative assessment of anomalous climatic conditions such as intensity, duration, and spatial extent and a historical reference (probability of recurrence) that can be used for planning and design applications. It was stressed that drought monitoring must be used in conjunction with the key elements of a drought plan. A slide from the FAO presentation on drought preparedness, mitigation and response was shown to illustrate how drought triggers are used in a drought plan. This showed that how a drought indicator and related triggers are related to an action. In the example, the SPI was the indicator and once the SPI is less than or equal to -1.25 (trigger level) possible actions could be ban watering lawns, dig extra wells for livestock and wildlife in area and / or reduce irrigation of annual crops by 50%.

The session also reflected on the efforts of WMO and other partners in trying to determine if a consensus could be reached on a drought index for the three types of drought: meteorological, agricultural, and hydrological. This involved reviewing the background and outcomes of the "Inter-Regional Workshop on Indices and Early Warning Systems for Drought" that was held in Lincoln, Nebraska, USA from December 2009.

The major outcome of the Lincoln workshop was that drought indices should be used that are based on a sound statistical and historical perspectives such as the SPI and percentiles. The workshop recommended that the SPI be used as a meteorological drought index. The breakout groups on agricultural and hydrological drought could not reach a consensus. The workshop adopted the "Lincoln Declaration" which stated that the National Meteorological and Hydrological Services (NMHSs) are encouraged to use SPI to characterize meteorological droughts and provide this information in addition to indices currently in use. The workshop also recommended that a comprehensive user manual for the SPI should be developed that describes the index, computation methods, specific examples of current use, the strengths and limitations, mapping capabilities, and how it can be used. The "Manual on the Standardized Precipitation Index is available at: **http://www.wmo.int/pages/prog/wcp/agm/publications/agm_proceedings.php**

A recent variation of the SPI index, called the Standardized Precipitation Evapotranspiration Index (SPEI) by Vicente-Serrano et al. (2010) which includes a temperature component. The required inputs to run the program are precipitation, mean temperature, and latitude of the site(s). More information is available at http://sac.csic.es/spei/index.html.

Important data issues with drought indices and monitoring were also highlighted. It was stressed that accurate and long-term weather data is needed. For the SPI, at least 30 years of rainfall data are needed. With less than 30 years of data, the SPI might become unreliable. For agricultural and hydrological drought indices, other data is needed such as potential evapo-transpiration (ETP), departure of ETP from normal, information on affected crops (crop conditions, growth stages) and soil moisture (measurement/simulation/departure from normal). Also, gridded datasets can be used (i.e. GPCC-Global Precipitation Climatology Centre: **http://gpcc.dwd.de)** along with remotely sensed data, and reanalysis of weather model data. It was noted that vulnerability and impact data are limited in area and length of record and this needs to be significantly improved.

The example of the US Drought Monitor (USDM) was used to show how an indicator and a trigger can be applied. The USDM has different levels that can be used as trigger and is applied by several US states. It was stressed that the main innovation of the USDM is that about 300 local experts provide feedback and updates on the process each week which makes it a very robust product.

The FAO Agriculture Stress Index System (ASIS) was presented as an example of a remotely sensed drought index. The ASIS is based on the Vegetation Health Index of Kogan et al. (1995). A historical overview of the ASIS for South America was presented from 1984 to 2013.

During the workshop in Ethiopia, there was a presentation from the Regional Project Manager of the Integrated Drought Management Programme (IDMP) in the Horn of Africa (HOA). The IDMP was established at the HMNDP and is co-sponsored by the Global Water Partnership (GWP) and WMO (www.droughtmanagement.info). The goal of the regional HOA project is to promote increased drought resilience of countries, communities and ecosystems in the HOA region. The countries involved in this project include Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, and Uganda. The components of the HOA project include knowledge, awareness and capacity development; innovative approaches and practices; influencing national policies and strategies and partnership and collaboration. The contribution of IDMP to the region would be to apply the prin-

ciples of integrated water resource and risk management, involving the GWP network at the country level. It would also be a facility in partnership with other drought initiatives in the region to support countries practically with the help of Country Water Partnerships. The project would support action and implementation on the ground, adding to existing efforts strength of IDMP and its partners and would help countries in the follow up of this workshop with practical development and implementation of national drought policies. Inadequate technical capacity in drought management in the region is a key hindrance and therefore capacity is required at all levels, that is, policy and decision makers, researchers, civil society and communities to effectively handle the drought challenges.

Group discussion: ESA regional workshop

Group A: Procedures and challenges on early warning systems

The first group tackled the question "What are the current procedures and challenges on Early warning systems?" Participants from the following countries gave a brief overview of their drought early warning system (EWS) which was also presented during their country reports: Ethiopia, Kenya, Malawi, Mozambique and Zambia. In Malawi, EWS was in place for floods, drought, pest and disease and there is a vulnerability assessment committee on the drought situation based on information from meteorological service. The committee focuses on food security for the more vulnerable populations. The meteorological service provides seasonal forecasts (3 months) prior to main growing season in December. In Kenya, there is a multi-hazard EWS which includes droughts and floods. The main institution for EWS is the Kenyan Meteorological Department which also collaborates with the regional IGAD Climate Prediction and Applications Center (ICPAC) in producing seasonal climate outlook. These outlooks are used for planning in agriculture / food security, availability of water supply, generating power plants, the livestock sector, the National Disaster Operation Sector and the National Drought Authority.

In Ethiopia, there is an EWS in place in the Ministry of Agriculture under the Prime Ministers' office and members in the EWS also include the Ministry of Water and other different line ministries. The EWS follows the regular government structures including the Federal states, Bureaus and local communities. It includes seasonal forecast assessments for the two rainfall seasons. The National Meteorological Agency provides forecasts and information including drought indicators. In case of a drought crisis, there is government food reserve and some financial resources to support drought stricken areas. In Zambia, an EWS exists with three units: weather information from the National Meteorological

Service; crop monitoring and forecasting from the Ministry of Agriculture and the Disaster Management Unit. The information is used to identify affected areas for short-term distribution of food, water, drilling and long-term measures such as irrigation policy, promotion of drought resistant crops, and conservation farming. In Mozambique, there is an EWS in place with three government institutions involved: National Meteorological Service; Ministry of Agriculture; and Water Department. The Disaster Management Institute only coordinates any disasters during the rainy seasons. The National Meteorological Service provides a seasonal outlook and uses it for the Water Requirement Satisfaction Index (WRSI) for estimating maize crop production. They also produce agro-meteorological bulletins during the growing season. Much of the information goes to the Prime Minister's Office and a technical package is prepared focusing on agriculture and irrigation that is distributed to provincial regions. There is a contingency plan where funds are available for droughts or floods. At the end of the season a food balance sheet is developed to identify the production shortfalls.

The following challenges were summarized across the five countries: inadequate early warning system structures; no specific drought policy; inadequate technical personnel and staffing; the need of interpretation of information; lack of coverage of and inadequate monitoring systems; modernisation, dissemination of warnings, credibility of data and early warnings; information sharing with the information users, harmonizing tools used in EWS, microclimates not easy to capture and implications of the information to the users; the need for more languages to interpret for communities; inadequate radios and extension workers; no proper coordination among stakeholders and inadequate commitment on policy makers and finally mainstreaming and integrating drought / climate in various plans.

Group B: Meteorological and hydrological networks, data quality and sustainability needs

The second breakout group dealt with the question "What are the meteorological and hydrological networks, data quality, sustainability needs?" The group highlighted the following issues for the meteorological and hydrological Network in drought Management: low data coverage due to lack of sustainability; observed weather data is readily available to end users as compared with hydrological data; challenges in data acquisition; and the coordination is not effective between the hydrological and meteorological institutions. There are also data quality issues with regards to a poor quality of historical data due to gaps and the observing stations do not measure all drought parameters. The group identified the following challenges for the observation network: expensive automatic stations, cost of maintenance for observing stations, vandalism, sustainability, payment

for data, and lack of resources. The group recommended the use of available observation data in drought monitoring, the involvement of end users such as .g. commercial farmers, local communities in observing data, and the sharing of drought monitoring information among partners and users.

Group C: Communicating and liaising drought monitoring and early warning between national institutions

The third group discussed the question "What mechanisms are in place for communicating and liaising drought monitoring and early warning information between national institutions?" This group included participants from Djibouti, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Uganda, and Zambia. The group noted that a management structure should be put in place with the overall responsibility for the mechanism to be the Office of the Vice President/Prime Minister or Government Ministry. This mechanism should have a coordination/Implementation unit and a Technical Committee composed of line ministries, community partners, civil society organizations, sector working groups and local administration units. The group identified the following challenges: inadequate government funding; gaps in the existing policy frameworks; information gathering and dissemination; coordination/collaboration among institutions generating data; creating synergies; and better regional coordination with national institutions.

Group discussion: NENA regional workshop

Group A: Procedures and challenges on early warning systems

The participants in this group highlighted the current procedures and challenges on early warning systems and stressed the need of baseline surveys, enhancing information quality and the distribution of data, improving technical knowhow and the institutional arrangements needed to improve coordination. They also noted the following challenges of early warning systems with regards to poor technical and financial support, integration among concerned institutions and the modernization of the existing weather and climate stations.

Group B: Meteorological and hydrological networks, data quality and sustainability needs

The second group dealt with the question "What are the meteorological and hydrological networks, data quality, sustainability needed?" The group highlighted that networking is either absent or very ineffective and that countries have shown very limited cooperation. There is an increasing lack of data due to the different interest and measurement scales. Also, data accessibility is not free in some countries while others have online access. Sustainability is not secured mainly due to budget issues and secondarily due to security concerns.

Group C: Communicating and liaising drought monitoring and early warning between national institutions

The third group discussed the mechanisms in place for communicating and liaising drought monitoring and early warning information between national institutions. The group noted that there is no real coordination among the agencies responsible for the information and data related to drought. In addition, data collection and information in most countries is still not collected in a timely manner. The declaration of drought still depends on the collection of rainfall data before the end of the rainy season. Also, in most countries, there is no existing systematic delivery system for the dissemination of information related to drought. On the positive side, databases are available in most countries and within their agencies and most countries have high commission to declare drought.

3.3 Vulnerability and Risk Assessment

Sergio A. Zelaya-Bonilla, UNCCD
Boubacar Cisse, UNCCD

The thematic session addressed drought vulnerability and risk assessment including the main concepts and methodological aspects related to the topic. The discussions were focused on the environmental and socio-economic impacts of drought, possible response measures as well as relevant policies based on the definition of drought provided by the UNCCD. According to article 1 of the Convention, drought is the naturally occurring phenomenon that exists when precipitation is significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems.

Types of drought

In order to implement effective monitoring and to respond to drought impacts, a proper classification system must be included in national policies accounting for the different types of droughts, i.e., meteorological, agricultural, hydrological, and socio-economic droughts. For the purpose of enabling action towards national policies on drought, in addition to meteorological droughts, analyzed in previous sections, the following views on the different types of drought are described based on physical and social conditions and impacts:

- Agricultural droughts affect food production and farming via soil / water deficits and reduced ground water or reservoir levels. Furthermore, deficient topsoil moisture at planting may stop germination, leading to low plant populations.
- Hydrological droughts are associated with impacts on water supply during periods of precipitation shortages (below the expected average in a given area). Water stored in reservoirs and rivers is used for multiple purposes such as for drinking, flood control, irrigation, recreation, navigation, hydro power and wildlife habitat. Competition for water use in these storage systems escalates during the presence of drought scenarios, thereby increasing the risk of water use conflicts.
- Socio-economic droughts which occur when the demand for an economic good (e.g., water, forage, food grains, fish, and hydroelectric power) exceeds supply as a result of a weather-related shortfall in water supply.

Impacts of drought

These are related with the specific impacts of drought, a combination of these impacts with other bio-physical or socio-economic phenomena and may refer to the level of resilience (or vulnerability) to such impacts. For purposes of an initial training on drought we may include the following dimensions of such impacts:

- Environmental: such as water scarcity, wind and water soil erosion, desertification biodiversity loss, forest fires as well as dust and sandstorms.
- Economic: such as the resulting price increase (of food products and other goods and services) because of relatively lower supply or increased demand of such goods and services caused by such aspect as loss of agricultural / livestock production, loss of hydroelectric power, and lower revenues on specific economic activities (tourism and river transport, for example).

- Social: such as increased poverty and reduced quality of life, overall health degradation, mental and physical stress, forced human migration, social unrest and political conflicts over scarce natural resources, especially water availability.

The impacts of climate change

Furthermore, large scale humanitarian crises are expected to increase in the presence of climate change. The IPCC's Working Group II, Assessment Report 5 (http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap12_FGDall.pdf) state that there is evidence of a climate change – conflict connection, albeit in an indirect relationship. The connection is more closely related with poverty, economic performance, and policy failures. These anthropogenic factors include poor or lack of design of the proper policies on climate change and variability, thus increasing the risk of conflicts.

The overall risk of droughts

In any case, drought is considered in the international sustainable development agenda as a global issue, currently affecting large parts of Africa, South and Central America, Asia and Oceania and in the North the USA, and some parts of Europe such, it has been recognized in the forthcoming SDGs: as an issue of global nature. The report of the Open Working Group of the UN (see: http://sustainabledevelopment.un.org/focussdgs.html) has recommended the sustainable development goal 2: "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture" including a specific target on drought: "2.4. By 2030 ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters, and that progressively improve land and soil quality". The OWG report also includes drought under SDG 15 described as "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" by including another target: "15.3. By 2020, combat desertification, and restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land-degradation neutral world".

This widespread awareness on the risks of drought refers directly to the environmental, social and economic impacts which hinder society's ability to function on its own. Drought risk disasters" (UN-ISDR, 2009) refer to the combination of the probability of a drought event and its negative consequences. Moreover, in vulnerable areas in developing countries there is a pressing need to focus drought management policies on rain-fed

smallholder farmers, for the building-up of drought resilience and guarantee increased food security. This is so when considering that:

- 70% of the World's 1.1 billion farmers are poor small-holder farmers;
- 80% of the world's agricultural land is rain-fed;
- Between 1900 and 2004, droughts caused more than 50% of all deaths from natural disasters and represented 35% of the population affected by disasters; and
- 7% of economic losses are caused by floods and earthquakes, but the (unaccounted) economic costs of droughts could be higher.

According to the national reports of parties to the UNCCD, drought policies are still almost non-existent at the national level, although drought-related projects are in place in many countries.

Combating drought

Key solutions discussed during this session urged countries to develop and adopt both national and regional policies including the following elements:

- Creation, increase, and strengthening of capacities on drought risk management (DRM) at the national and local as well as at the international level, by identifying and assessing impacts through early warning mechanisms and tools;
- Participatory approach which means full involvement of affected communities, men and women and all users of land resources when designing drought policies and measures to increases resilience; and
- Financial predictability: budget at local, national or international level for cooperation at all levels must be addressed and action on drought must be accounted for.

The session proposed that an integrated national drought policy that aims at building more drought resilient societies should be based on the sustainable use and management of natural resources (land, soil, forest, biodiversity, water, energy, etc.) in all socio-economic sectors (agriculture, industry, etc). However, reality indicates that only few developing countries have formulated (and some are under implementation) national drought preparedness and mitigation policies that are mainstreamed into national development strategies and plans. Progress on drought preparedness also has been slow at the national level.

Therefore, to achieve effective results, countries need to set up as priority options for addressing the absence of an integrated institutional authority on drought management at the national level while also, from a local perspective, identifying differentiated responsibility levels among different government jurisdictions. Gap analyses and similar tools can be used to identify the existing policies and institutional capacities. Other options discussed also include:

1. Development of drought management policies and their governance (national perspective) by:

- Establishment of National Coordinating Mechanisms as institutional tools for improving efficiency of decision-making (national authority, budget, etc.);
- Establishment of a preparedness system to cope with the effects of drought as it is done with other natural disasters; and
- Incentives for increased investments, innovation and technology transfer which may consist of incentives for investments on drought-related infrastructure and other innovative ways for economic development (for example, China and Israel experiences, among others) as well as capacity building and inclusion of drought priorities in the national financial cooperation frameworks.

2. Setting up policies and measures on drought management at the local level in rural and urban areas, such as:

- Strengthening local and farm level infrastructure (communication, hydrological infrastructure, access to local markets);
- Advocacy for diversifying and improving productive activities to reduce risk and increase resilience; and
- Adoption of traditional and new technologies (irrigation, rainwater harvesting) and innovation schemes for dry land development.

The role of UNCCD and partners

- The UNCCD National Action Programme (NAP) is a tool for national policies that combat desertification and also mitigate the effects of drought;
- The UNCCD legal framework on drought: COP 11 adopted an Advocacy Policy Framework (APF) on drought (including water scarcity) through decision 9/COP 11, which benefitted extensively from two documents, prepared for the

High Level Meeting on National Drought Police (HMNDP) namely the (a) Policy Document: National Drought Management Policy and (b) Science Document: Best Practices on National Drought Management Policy as well as from the Proceedings of the expert meeting of 14-15 July 2011 – Towards A Compendium on National Drought Policy.

A note on the UNCCD APF on drought (including water scarcity)

The APF on drought aims at advocating for the development of drought management policies at the national level by enhancing the capacities of local communities in efficiently and effectively addressing drought events, to increase the coping capacities of affected populations and to enable them to make use of the available opportunities for livelihood improvement and resilience. The APF advocates for long term solutions leading to increased population resilience and reduced need for interventions in the form of drought disaster assistance by governments, donors and other stakeholders. The APF contents were discussed in the session and below there is a summary of main features and concerns of participants:

- The APF has a mix of strategies for different economic sectors: bottom-up approach for agriculture; different approaches for other sectors (industry, urban areas) as different impacts and responses are found in different sectors. How is the scenario in specific countries?
- Data on socio-economic vulnerabilities: the APF is based on data on poverty, poor populations and their access to resources. Is there such data in the countries? What is the understanding of vulnerability and resilience? Coping capacities? Drivers? What is the role of NAPs and national reporting?
- Fostering consistency of national policies (i.e., drought and agriculture) and emerging external drivers (markets and trade, fiscal, financial, constraints). What are the areas to be addressed by a policy on drought?
- Innovative approach. Is a new policy framework on drought needed at the national level? (Some policies, measures and tools are already in place, perhaps – it was mentioned- we only need to adopt them to drought impacts). The main recommendation on this issue was to start with a preliminary assessment of existing relevant national policies and assess whether new policies are needed;
- Stakeholder participation: For policy relevance there is the need to identify the priority capacity needs for addressing drought policies, their implementation and the accountability at the community / regional and national levels, aiming at improving the ability to deliver; and

- The session concluded with a round table of discussions in which participants reflected on drought cases in their countries taking place which took place in their respective countries and feed production reduction, livestock productivity loss and power generation reduction.

3.4 Drought Preparedness, Mitigation and Response

Mohamed Bazza, FAO

Drought is widespread in most parts of Africa with drastic impacts on human life and the environment. Desertification which constitutes the ultimate stage of drought, is encroaching massive areas of lands in different regions of the continent, at a speed never witnessed before. The mitigation of these impacts, as part of other drivers for overall economic development, is necessary in order to halt or at least slow down this phenomenon. The knowledge and tools for managing drought are readily available today thanks to new advances in science, technology and research.

"Drought Preparedness, Mitigation and Response" constitutes the third pillar of drought risk management, besides "Monitoring and Early Warning" and "Vulnerability and Risk Assessment". The three pillars are closely interlinked as explained in the presentation.

This session starts by recalling the following definitions, along the lines of the HMNDP Compendium on National Drought Policy and the National Drought Mitigation Center (NDMC) of the University of Lincoln-Nebraska:

Drought Preparedness: established policies and specified plans and activities taken before drought to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective response in a drought situation (contingency planning).

Drought Planning: actions taken by individual citizens, industry, government, and others before drought occurs to mitigate impacts and conflicts arising from drought.

Response to Drought: efforts such as the provision of assistance or intervention during or immediately after a drought disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Recovery from Drought: decisions and actions taken after a drought with a view to restoring or improving the pre-drought living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce drought risk.

Drought Mitigation: any structural/physical measures (e.g., appropriate crops, dams, engineering projects) or non-structural measures (e.g., policies, awareness, knowledge development, public commitment, and operating practices) undertaken to limit the adverse impacts of drought.

Traditionally, response to drought - and at times recovery from it - constitutes the main action that countries take, as an emergency measure after drought has been declared. Such response is unplanned and hastily applied after drought has taken its toll of damages and scourges. It is often less effective in reaching its goals and conducive to greater societal vulnerability to subsequent droughts.

Response to drought, including recovery, remains an important component of pro-active drought risk management; however it needs to be planned before drought occurs and should be fully integrated into a comprehensive drought plan so that response measures contribute also to building long-term resilience to drought. Numerous advantages and synergies resulting from the integration of response and recovery measures into a drought plan have been explained during the session.

The output of "Vulnerability and Risk Assessment" is a list of who (e.g. groups of practitioners or layers of the society) or what (e.g. economic sectors, such as agriculture, water, etc.) is vulnerable to drought, arranged in the order of priority from highest to lowest priority. The ordering is done on the basis of agreed criteria, such as economic loss stemming from drought impacts. For each element of this list starting from highest priority, the measures and actions that are needed in view of eliminating or reducing those impacts, and thus increasing the coping capacity of who/what is vulnerable to them, is established. These measures and actions are called "Risk Management Options". It concerns all main sectors which are impacted by drought, particularly agriculture, water and environment, but also tourism, transport, energy, health, etc., depending on the context.

Drought risk management options included in a drought plan should address the root causes of vulnerability, so that their implementation results in increasing capacities to cope with drought and reducing impacts. The set of risk management options that can

potentially be included in a drought plan can be split into three categories, based on the time it takes for their implementation: long, medium, and short terms, as indicated in the table below.

The short-term measures are implemented before, during and after drought in a timely manner, based on indices or triggers liked to drought indicators determined by "Monitoring and Early Warning". The three categories complement each other and constitute an integral drought risk management plan.

Table 1: Short and long term drought management plans

CATEGORY	LONG-TERM	SHORT-TERM	RESPONSE AND RECOVERY
Objective	Resilience building	Impacts mitigation	Emergency response, recovery
Implementation framework	Develop programs regularly	Drought plan	Response within drought plan
Implementation time	Continuous	Before, during, after drought	During and after drought

A long but non-exhaustive list of typical measures for all three categories was given in the presentation. The latter also explains the procedure for linking actions to indices and drought indicators and provides examples for doing so. Long-term measures and actions are fundamental for building resilience to drought. They are normally included in the strategies and action plans of the main sectors affected by drought, such as water, agriculture, environment, etc. These measures constitute a fundamental component of national drought risk management. For this reason, revisiting the strategies of these sectors to ensure the inclusion of priority drought risk management options is an important step for developing national drought management policies and action plans. It should be noted, however, that despite their utmost importance in building resilience to drought, long-term measures do not shield completely against drought impacts. They need to be supplemented by well-planned medium-term mitigation measures as well as by response and recovery measures.

After the thematic presentation, the participants were split into three groups to practice applying the approach and process introduced by the session. The three groups focused on water, agriculture and other sectors, respectively, and proposed drought

risk management measures of medium- and long-term dimensions, relevant for their countries and regions.

The group discussions revealed that most countries have some experience in proactive risk management; however, drought is only rarely part of the framework and even when it is included in the framework it is still managed reactively on emergency basis. This is not appropriate because the slow onset and long duration of drought, along with the creeping impacts over time, in comparison with other natural hazards, such as floods or earthquakes, makes drought completely different from other hazards. Because of its nature and special characteristics, drought should not be managed the same way as other hazards.

The sample priority impacts and corresponding measures identified by the working groups as valid for their countries and regions are indicated in the tables below. These impacts and measures have been edited for harmony but their substance has not been reviewed. They are only indicative and their lists are incomplete given the time limit allocated to the exercise. Some measures or actions are valid only within the perspectives considered by the participants and should not be transposed to other situations. In some cases, the groups found difficulties in agreeing on the difference between long-term and medium-term measures as illustrated in the tables. The agencies responsible for the development and implementation of these measures are also indicative as these vary from one to another. However the groups acknowledged having learned the basic principles and the process for identifying primary impacts and the corresponding mitigation measures.

Question covered by Working Groups: Using the results of the Impact and Vulnerability Assessment, develop long- and medium-term drought risk management measures and specify for each measure the responsible agencies.

Group discussion: ESA regional workshop

Group A: Drought risk management strategy: the water sector

The group composed of participants from Malawi (2), Kenya (2), Zambia (1), Ethiopia (4) and Mozambique (2) were asked to develop long- and medium-term drought risk management measures and to specify for each measure the responsible agency (ies) with a focus on the water sector.

Table 2: Short and long term risk management measures – the water sector

	ACTIONS	TRIGGERS	AGENCIES
1. WATER SUPPLY MANAGEMENT			
Long term	**Structural** • Water transfers (e.g. canals) • Drilling boreholes • Desalination • Building dams • Catchment conservation/Ground water recharge • Recycling waste water • Enhancing EWSs **Non-structural** • Development of master plan • Regulatory framework • Improve water efficiency • Weather modification (enhancing water supply e.g . Snow packing, cloud seeding enhancing ppt)	Hydrologic/ Meteorologic/ Agricultural	Water/Forestry/ Ministry of Agriculture/ Irrigation/ Environment
Short term	• Water harvesting (ground / roof) • Weather modification • Water use efficiency • Shallow wells and springs	Hydrologic/ Meteorologic/ Agricultural	
2. WATER DEMAND MANAGEMENT			
Long term	• Drip irrigation • Education & awareness • Regulatory framework	Hydrologic/ Meteorologic/ Agricultural	Irrigation/Water
Short term	• Drip irrigation • Water rationing • Water tariffs • Water permits	Hydrologic/ Meteorologic/ Agricultural	Irrigation/Water

Group B: Drought risk management strategy: agriculture sector

The second group was given the task of developing short- and long-term drought risk management measures with a focus on the agriculture sector.

Table 3: Short and long term risk management measures – agriculture sector

	IMPACTS	ACTIONS	AGENCIES
1. CROPS			
Long-Term	• Food insecurity • Loss of income • Loss of jobs • Migration • Malnutrition	• Dams • Boreholes • Irrigation expansion • Crop insurance • Diversification of economic activities • Water harvesting/ recycling • Early warning system • Awareness/ Education	**Agriculture** • Hydrology/Water Ministry • Ministry of Finance • Research institutions • Meteorological Services
Short/ Medium Term		• Drought resistant Crops / early maturing • Crop rotation • Crop thinning • Crop insurance • Proper fertilization • Mulching • Weeding	
2. LIVESTOCK			
Long-Term	• Food insecurity • Loss of income • Loss of jobs • Migration • Malnutrition	• Review of policy • Boreholes • Forage reserves • Livestock insurance • Diversification of economic activities • Early warning system • Awareness / Education	• Agriculture • Ministry of Lands • Hydrology / Water Ministry • Ministry of Finance • Research institutions • Meteorological Services
Short/ Medium Term		• Managing livestock capacity • Early info for pastoralists • Livestock Insurance • Use of indigenous breeds • Provision of water and forage • Re-allocation of grazing area	
3. FORESTRY			
Long-Term	• Loss of biodiversity • Loss of income • Loss of jobs • Soil degradation • Reduction in timber	• Afforestation • Reforestation • Forest Conservation Policy • Awareness/Education	• Forestry • Agriculture • Ministry of Land • Hydrology/Water Ministry • Ministry of Finance • Communities

Group C: Drought risk management strategy: other sectors (ealth, energy, education)

The group composed of participants from Djibouti, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Uganda and Zambia were asked to develop the long- and medium-term drought risk management measures with a focus on other sectors.

Table 4: Short and long term risk management measures – other sectors

SECTORS	IMPACTS	ACTIONS	TRIGGERS	AGENCY
1. Health Sector	Reduced access to safe drinking water	• Provision of safe drinking water • Promotion of water harvesting technologies • Awareness raising • Strengthen community participation in good hygiene practices	• Falling levels of water sources	• Min. of Health • Min. of Agriculture • Min. of Environment
	Increased disease incidences	• Vaccination/ immunization campaigns • Mass treatments • Surveillance for noticeable diseases	% of population affected	• Ministry of Health • Ministry of Agriculture • Ministry of Environment • International Agencies • CSO/NGO • Community
	Reduced productivity	• Increased access to health facilities • Disease prevention measures & improved hygiene • Supply of high nutritional food kits	Reduced man-hours for productive activities	• Ministry of Health • Ministry of Agriculture • Ministry of Environment • International Agencies • NGO • Community
	• Increased expenditure on health services • Increased malnutrition in children • Reduced water levels in reservoirs	• Power rationing • Increasing use of renewable energy	• Falling levels of water • Increased demand for power	• Ministry of Energy • Ministry of Finance • Power utility companies • Private sector
2. Energy Sector	Increased energy prices with increased reliance on expensive power sources	Availing alternative sources of renewable energy: solar, wind		

SECTORS	IMPACTS	ACTIONS	TRIGGERS	AGENCY
3. Education Sector	Increased school drop-outs	• Awareness raising • Expansion of school feeding programmes • Increased access to education	% of school attendance	• Ministry of Education • Ministry of Agriculture • Ministry of Health • International Agencies • CSO/NGO • Local Authorities

Group discussion: NENA workshop

Table 5: Group A – Short and long term risk management meaures: water sector

IMPACTS	ACTIONS	TRIGGERS	AGENCIES
Low water Supply	**Short-term** • Public awareness • Reduce water losses • Increase use efficiency • Water recycling • Artificial rainfall • Make use of all available water (quality wise) • Reuse of nonconventional water • Drilling new deep wells		• Gov, SCOs, NGOs, • Local communities • Water users
	Long-term • Building dams/reservoirs • Water harvesting(macro and micro) • Water transfer between catchment areas(national and regional) • Improving infrastructures • Improvement of legal framework • Update the legislation • Establishment of water user community associations • Upgrade water fees at all levels		• Government • CSOs, NGOs • Local communities • Water users

Table 6: Group B – Short, medium and long term risk management meaures: agriculture sector

MEASURES	
Short term	• Water reuse for agriculture • Conservation agriculture • Small-scale water harvesting • Crop thinning (small farms) • Over-cutting trees • Artificial rainfall • Supporting small farmers (subsidies, creating jobs, etc.) • Agriculture pest control • Agriculture debt postponement /levying
Medium and long term	• Reuse of treated wastewater • Addition of organic matter • Changing cropping pattern to adapt to water scarcity • Using stress resistant crop varieties • Adopting best agricultural practices and conservation agriculture • Water collection and storage (large scale: dams, groundwater,) • Reforestation • Range reserves • Capacity development • Review of education curricula • Developing adapted laws and plans • Sensitizing policy makers • Promoting coordination between sectors/institution

Table 7: Group C – Risks and mitigation measures in other sectors

SECTORS	RISKS	MEASURES
1. Environment	• Biodiversity loss • Reduced benefits from ecosystems service	• Approach PAS • Improve effectiveness of PAS • Control IAS
2. Health	• Epidemics/infectious diseases • General public health (hygiene) • Overburdened health system • High economic costs	• Contingency plans • Strengthening health care services to address drought costs • Advocacy • Public awareness
3. Education	• Reduced attendance and achievement • Reduced access to education • Limited knowledge about drought management • Early marriage	• Awareness raising (through media) • Exemptions from fees • Provision of food in schools

3.5 The 10-Step Process

Daniel Tsegai, UNW-DPC

Although drought affects almost all climatic regions, its impacts vary from region to region. Africa and the Near East are some of the most affected regions with drought. ESA and the NENA region countries have been hit with drought as recently as 2011. Most of the governments in these countries respond to the impacts of drought after the incidence and do so without a coordinated effort between various relevant actors. This approach is not only ineffective but also unsustainable. The time is ripe for countries to seek changes in their approaches for drought management from a 'crisis' based and 'reactive' approach toward a 'risk' based and 'proactive' approach. The latter include effective monitoring and early warning systems, coordinated vulnerability assessment and significant response and mitigation measures. Countries have to move forward with formulating policies which allow cooperation at all levels of government with the aim of creating more drought resilient societies.

The session on "Developing Drought Management Policy: The 10-Step Process" introduced broadly the step-by-step procedures necessary in the development of national drought policies to mitigate the risks of drought and enhance effective response to drought. The objectives of such policies include creating more drought resilient societies as well as highlighting the challenges that can occur when developing drought policies. Broadly speaking, the objectives of risk based national drought policy include supporting vulnerable economic sectors and population groups to adopt 'self-reliant' measures which promote effective risk management strategies; to promote sustainable use of the agricultural and other natural resource base; and to facilitate early recovery from drought through actions consistent with national drought policy objectives.

The generic 10-Step planning process to formulate national drought policies – revised several times, the latest of which was published in 2014 (WMO and GWP, 2014) – was presented in some detail during the session. The 10-steps include:

1. Appoint a national drought management policy commission;
2. Define the goals of a risk-based national drought management policy;
3. Seek stakeholder participation;
4. Collect inventory data and financial resources, and identify groups at risk;
5. Prepare/write the key tenets of a national drought management policy;

6. Identify research needs and fill institutional gaps;
7. Integrate science and policy aspects of drought management;
8. Publicize the drought management policy and build public awareness;
9. Develop educational programmes for all age groups and stakeholders; and
10. Evaluate and revise national drought management policy.

Drought policies should be broadly stated to accommodate changes in time and space and context/country specific conditions. The 10-Step Process should be modified to incorporate specific national context. Implementation of the policies requires political will and a coordinated approach among diverse stakeholders at all levels engaged in the process. A country's drought policy should not only be consistent and equitable for all regions, reflecting regional differences in drought characteristics, vulnerability and impacts, it should also be equitable with regard to all groups and economic sectors. Furthermore, it should be in line with the country's goals as regard to sustainable development.

The importance of relevant institutional arrangements for a drought policy was also elaborated during the session. Building strong institutions and appropriate governance, and cultivating stakeholder participation with special emphasis on a "bottom-up" approach including the communities (both in decision-making and implementation) are some of the institutional arrangements that could strengthen the process of developing a national drought policy. Furthermore, preparedness at all levels of government (individuals, communities, decision makers and local as well as regional authorities) and having a legal or institutional framework with defined responsibilities and cross-sectoral collaboration are preconditions for a successful national drought policy process. The session also highlighted some of the existing challenges to develop national drought policies including: (i) fragmented responsibilities for drought risk management, (ii) low priority given to drought by governments, (iii) weak drought risk governance capacities, and (iv) conflict on water use and excess water use.

The closing part of the presentation introduced successful case studies of national drought policies. The first case presented the efforts of the Australian government, which has successfully moved from a 'crisis management' approach for drought towards an increased emphasis on 'risk management' approach. The Australian national drought policy is aimed at primary producers and other sections of rural Australia to adopt "self-reliant" measures to managing climatic variability and ensure early recovery of agricultural and rural industries consistent with long-term sustainable levels. Brazil is another country, which through its drought policies has reduced the economic and social vulnerability in

the north-east of the country. Environmental vulnerability has, however, increased due to the human pressure on the natural resource of the semi-arid north-east of Brazil. With its clear planning framework for drought risk management which goes from 'preparedness, 'pre-alert', 'alert' and 'emergency', Spain is another good example for the successful implementation of different management actions for drought policy. Lastly, the course of action that China pursues in addressing its drought related activities was presented which include monitoring, early warning, impact assessment, emergency response, hazard relief and recovery.

After the presentation, participants were divided into three breakout groups to discuss in detail some specific elements of the topics raised in the presentation. The breakout group presentations for the two workshops are explained in the following sub-sections.

Group discussions: ESA regional workshop

Group A: What are the challenges for developing national drought policies?

The first group was composed of participants from the following countries: Ethiopia (1), Kenya (2), Malawi (2), Mozambique (2) and Zambia (1) Malawi. The group discussed the question "What are the challenges for developing national drought policies?" The major challenge categories identified included: institutional, resources, governance as well as data and information (Table 8)

Table 8: Challenges for developing national drought policies

CATEGORY	CHALLENGES
Institutional	• Lack of Legal framework • Institutional set /structure • Rules and regulations
Resources	• Human (numbers & skill) • Financial constraints • Limited Technology • Application of Indigenous knowledge
Governance	• Corruption • Lack of Political will • Lack of Political commitment • Poor coordination • Lack of multi-Sectoral approach • Lack of continuity (regime changes, instability) • Bureaucracy (e.g. hinders implementation) • Difficult to identify spearheading institution
Data and information	• Lack of Data sharing • Data quality; • Data availability • Accessibility • Infrastructure; • Lack of awareness
Others	Climate variability & Climate Change

Group B: What are the institutional arrangements necessary for developing national drought policies?

The group came up with a structure that could ideally be implemented for developing and implementing national drought policy.

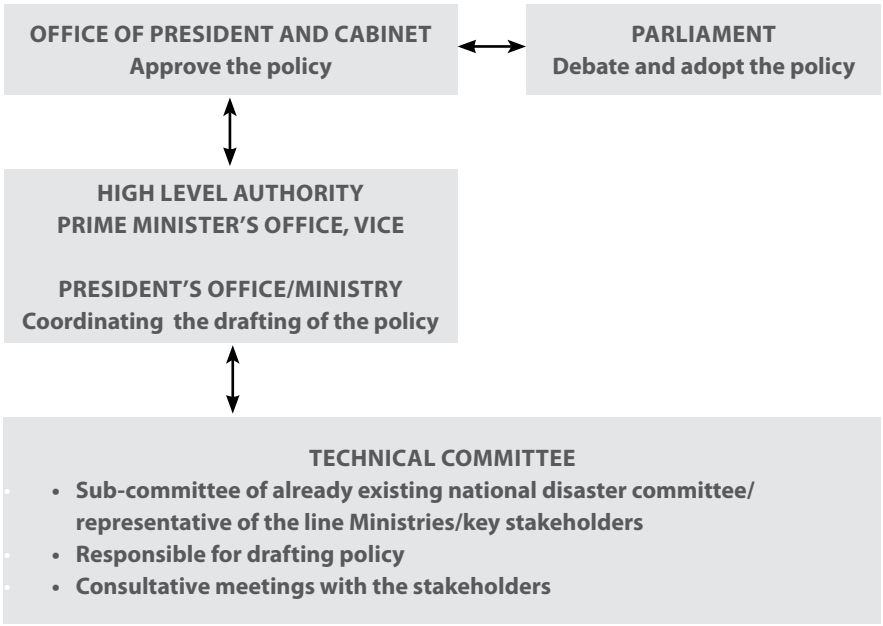

Figure 1: Institutional arrangement for developing and implementing national drought policy

Group C: What are the steps being undertaken for developing national drought policies?

The third group discussed the steps being undertaken in their countries to develop national drought management policies. The participant from Mozambique mentioned that a disaster management policy is in place in Mozambique and national drought management plan is being revised and it is strengthening the national drought coordination unit. Djibouti has a 'general' disaster policy for all disasters, drought being one of them. The country is also working on capacity building on drought at all levels - individual, institutional and community levels. Kenya and Malawi participants indicated the existence of structures to deal with the development of drought management policy where drought issues are integrated. Rwanda is strengthening the irrigation policy through which drought issues are addressed and it is exploring opportunities for the development of a standalone drought management policy. Both Uganda and Zambia expressed the presence of Disaster management policy in their countries that calls for the creation of institutions to address drought issues and enhance coordination among stakeholders.

Group Discussion: NENA regional workshop

Group A: What are the challenges for developing national drought policies?

The group worked on the challenges they are facing regarding developing national drought policies. The challenges are varied which range from economic and financial to institutional, legal, technical and other social dimensions (Table 9)

Table 9: Challenges or developing national drought policies

CHALLENGES	DETAILS
Economic and financial	• Funds • Weak involvement of private sector
Institutional	• Lack of awareness about cost and befits of the importance of development of national policy • Weak coordination among stakeholders responsible of water management (Sudan) • Sectoral thinking (no holistic policy for natural resources) • Lack of decentralization approach • Inadequate human resource
Legal	• Lack or weak legal frame work (Algeria, Yemen , Sudan) Weak implementation
Technical	• Equipment, and infrastructure and technology • Lack of metrological historical data • Lack systemic surveys and assessment • Lack of research for underground water • Lack of predictions and projections
Social	• Water is public good • Social dimensions (water conflicts about befit sharing)

Group B: What are the institutional arrangements necessary for developing national drought policies?

The second group enumerated the institutional arrangements necessary for national drought policies in their countries as follows:

- Enhance willingness of related ministries about importance of creating drought committee;
- Establishing a committee bringing together relevant actors from all drought-related ministries, NGOs, research centers, etc. ;
- Developing legal status for the committee to enable it to perform its duties effectively;
- Securing necessary fund to ensure that all related functions carried out;

- Capacity development and technical support;
- The committee should react at national and regional scales.

Group C: What are the steps being undertaken for developing national drought policies?

The group discussed the steps being undertaken in their countries to develop national drought management policies. Many activities are in place in relation drought policies in the countries. Mauritania has, for example, recently started a process for establishing a multi-stake holder technical task force on drought with a view to establishing a national commission on drought while Sudan's representative mentioned that his country established a unit on 'drought of agriculture' with regional sub-units all over the country. There is also a reseach programme on drought working on various crops and livestock species and ongoing efforts to improve awareness on water scarcity, among others. In Jordan, a 'High commission' for declaring drought is established which is called a 'National council for announcement of drought' while in Morocco an inter agency task force on drought (national observatory of national programmes compensation is set up recently as well as a national council for water and climate. The establishment of a committee of drought under the authority of a high commission for crisis management' is under way in Oman while national council for planning is already in place. In Palestine, UN-DESA is supporting the development of a drought management plan for which a draft document is available, according to the Palestinian participant and two national committees, one on climate change and another one on desertification are in place.

3.6 Summary

The thematic presentations and the breakout group discussions covered several key areas and exposed the participants to a wide spectrum of drought management policies and their context-specific relevance. Issues discussed in depth ranged from drought monitoring and early warning systems to various drought indices and data issues in drought monitoring systems. The major components of drought monitoring systems were emphasized, namely timely data and acquisition, impact data and synthesis/analysis of data used to 'trigger' actions and the need for efficient dissemination networks (web, media, extension, etc.). Approaches of drought monitoring were clarified, ranging from single index/parameter, to multiple indices/parameters and composite index.

The steps on drought vulnerability and risk assessment and the typologies of different

drought risk management measures were also discussed, including drought preparedness, mitigation, response and recovery. A range of risk management options were underlined in order to build societal resilience through national drought policies and preparedness plans, which comprise short and long-term measures. Most notably, the steps towards drought plans were discussed: (i) drought characterization, (ii) monitoring and early warning, (iii) vulnerability and impact assessment, and (iv) mitigation and response options. The generic 10-Step Process of formulating drought policies formed the backbone of the entire discussion during the four-day workshop. The cost of inaction on drought and the long-term cost effectiveness of risk-based drought management strategies when compared with the cost of disaster response and crisis management were highlighted. On the fourth day a field visit was organized by the local partners to Bac Hung Hai, a Vietnamese irrigation company located about 60 kilometres to the south east of Hanoi City. The field visit highlighted the importance of a coordinated irrigation system and exposed the participants to an efficient form of diverting water from large rivers and helping irrigation farmers as a way of tackling drought, which is now becoming more common in the southern and central provinces of Viet Nam.

In general, the achievements of the workshops can be summarized as follows:

- The workshop improved the awareness of participants in drought management issues and the needs and strategies for national drought policies based on the principles of 'risk reduction'.
- The workshop equipped participants with tools and strategies for improved decision support, risk assessments of vulnerable sectors, population groups, regions and, most importantly, mitigating drought effects.
- The workshop furnished participants with up-to-date methodologies to develop/improve drought monitoring, seasonal forecasts, and early warning and information delivery systems.
- The workshop also improved participants' understanding and the long-term benefits of risk-based drought management policies versus crisis-based policies.
- As in the past, the workshops were able to promote national and regional networks of stakeholders working in various ministries including agriculture, environment and meteorology and encouraged mutual learning, which can help ensure the effectiveness of measures to address drought impacts and pave the way for formulating comprehensive national drought policies for their countries.

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Chapter 4

NATIONAL REPORTS (SELECTION)

4.1 EASTERN AND SOUTHERN AFRICAN COUNTRY REPORTS:

4.2 NEAR EAST AND NORTH AFRICAN COUNTRY REPORTS:

Disclaimer: The opinions and views expressed in the country reports are solely those of the authors. The content (including country names, maps, name of organization and other political statements) conveyed within the aforementioned reports, is not official endorsement by any of the partners of the NDMP initiative.

4.1. Eastern And Southern African Country Reports

Botswana[1]

Background

Botswana lies between the latitudes of 18 to 27 degrees south and the longitudes of 20 to 29 degrees east, in the centre of the Southern Africa Plateau at a mean altitude of 1,000 m above sea level. The country has a total land area of 582,000 square kilometres. The climate of Botswana is dry and semi-arid. The northern part of the country lies within the tropics; however, because of the altitude and distance from the oceans, the climate is more temperate than tropical. Rainfall is low, erratic and unevenly distributed, ranging from 600 mm in the north to less than 250 mm in the southwest (Figure1).

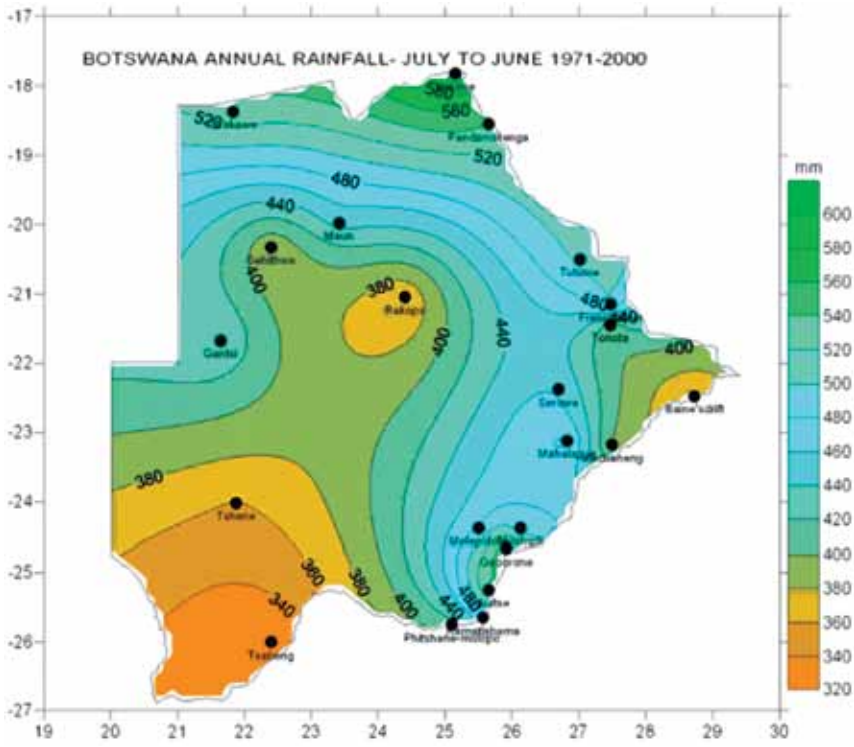

Figure 1: Spatial annual rainfall distribution in Botswana, 1971–2000

Source: Department of Meteorological Services, Botswana

[1] M. Manthe-Tsuaneng, Acting Deputy Permanent Secretary – Natural Resources, Ministry of Environment, Wildlife and Tourism

The country faces several natural hazards, of which drought is one of the most common and recurrent. The worst drought in recent years was that during 1981–1987, followed by that during 1990–1995. Droughts were also experienced in the 1998/99 season, and during 2002–2006 and 2011–2013.

The impacts of drought are wide-ranging and affect almost all sectors of development, especially agriculture, water and health. Loss of income as a result of loss of crops, livestock or employment in these sectors puts the livelihood of many under great stress. Figure 2, for example, shows the decline in national cattle herd size since 2008 mainly as a result of drought.

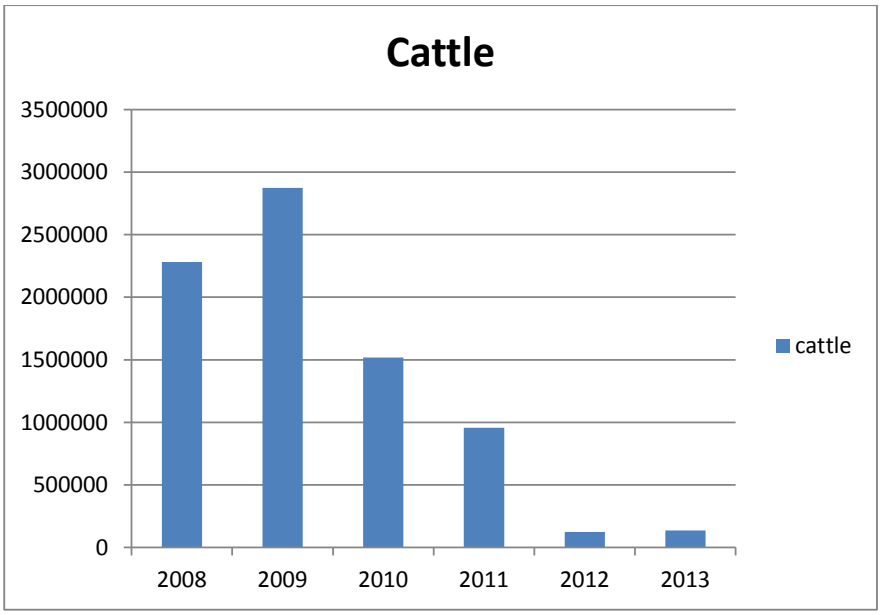

Figure 2: Botswana national cattle herd size, 2008–2013

Source: Botswana Vulnerability Assesment Report 2013

Drought adversely affects the already fragile food and agricultural situation and seriously impairs the rural economy and socio-cultural structures. About 70 per cent of rural households derive part of their livelihoods from agriculture, and crop production is mainly based on rain-fed farming. Rangeland resources, which cover more than 60 per cent of the country are the basis for the cattle industry, are the most affected by drought albeit to varying degrees. Urban communities are mostly affected by lack of water as it

applies to restrictions placed on daily activities, including rationing of drinking water. The elderly, the destitute, children under the age of five are some elements of the population that are severely affected by drought. Malnutrition amongst these groups is usually aggravated during times of drought.

Drought monitoring and early warning systems

Botswana has an organized drought monitoring system. There is a strong network of stakeholders and organizations dealing with drought monitoring and mitigation that include the National Early Warning Technical Committee, Inter-Ministerial Drought Committee (IMDC) and Rural Development Council. Institutions that monitor drought comprise of the Ministry of Agriculture, Ministry of Health, Ministry of Local Government and Rural Development, Ministry of Environment, Wildlife and Tourism and Ministry of Minerals, Energy and Water Resources. The indicators used are rainfall, area ploughed and planted to reflect food security at household level; conditions of rangeland, livestock (Tables 1 and 2), water and wildlife; and malnutrition levels. The above institutions hold early warning monthly meetings to track trends relating to these indicators.

Table 1: Cumulative livestock mortality, 2007

ANIMAL PRODUCTION DISTRICTS	CATTLE	GOATS	SHEEP	HORSES	DONKEYS
Kgalagadi	295	127	0	8	10
Kgatleng	87	0	0	0	0
Letlhakeng	96	48	25	4	8
Maun	150	0	0	16	14
Molepolole	670	151	50	0	115
Nata	81	0	0	0	0
Serowe	12	0	0	0	9
Southern (Kanye)	21	0	0	0	0
Southern (Lobatse)	48	31	2	0	1
Southern (Jwaneng)	16	0	0	1	1
Tutume	8	0	0	0	0
Total	1482	357	77	29	158

Source: IMDC (2007)

Table 2: Estimated crop area ploughed/planted, 2007/08 crop season (000 ha) communal sector

AGRICULTURAL REGION	ESTIMATED AREA PLANTED			
	2004/05 (000 HA)	2005/06 (000 HA)	2006/07 (000 HA)	2007/08 (000 HA)
Southern	14.79	15.64	2.67	15.11
Gaborone	5.74	18.45	1.64	15.91
Central	6.79	28.94	9.76	22.89
Francistown	8.23	16.35	4.94	10.96
Maun	0.99	4.51	0.45	3.17
Western	0.15	0.91	0.29	0.66
Total	36.69	84.80	19.75	68.70

Source: IMDC (2008)

A Drought and Household Food Security Outlook tour is undertaken annually after the rainy season (April–May). This exercise is conducted to complement early-warning reports compiled on a routine basis by the various government departments and ministries. The assessment verifies and reconciles existing information at the national level with district information, and also provides a forum to generate discussions with the districts on issues related to drought and drought management. Therefore, the objectives of the exercise are twofold:

1. To ascertain whether or not it is a drought year. Drought in this context refers to a deficiency in rainfall in terms of its timing, spatial-temporal distribution and/or overall amounts received and whether they were severe enough to negatively affect plant growth, water supplies, wildlife condition and ultimately human livelihoods and food security in general;
2. To determine the need or otherwise for government intervention, including the modification of form, magnitude and scope of such interventions, particularly taking into account the identified manifestations of the prevailing situation.

Meteorological and hydrological institutions form part of the Drought Assessment Team and partake in the annual tour. Located at the Botswana Meteorological Services is the Monitoring for Environment and Security in Africa (MESA) programme for Southern Africa, which provides a drought service. It is an earth observation system that relies on the MESA Drought Monitoring Software and can provide a wide range of drought informa-

tion products including 10-day drought maps and monthly drought risk maps for use by countries in the region.

Vulnerability assessment

One of the Drought and Household Food Security Outlook tour team's assignments relates to assessing the current levels of human vulnerability and signs of stress and the possible effects of their interaction with the observed impacts of drought. To address this, the nutritional status of children under the age of five is reviewed using the information generated by the nutritional surveillance system. The situation with regard to destitution and social welfare issues is also reviewed so as to detect current and emerging trends in the number and distribution of destitute persons. The extent of wildfires is also reviewed since extensive fire damage may exacerbate levels of vulnerability if left unchecked.

The implementation of the feeding and intensive labour works (Ipelegeng) programme is also reviewed. Based on conclusions arising from the above, the assessment team determines the need or otherwise for continuation of government intervention, including the form, nature and scope of such intervention.

The Botswana Vulnerability Assessment Committee (BVAC) was formed in 2008 as part of the regional effort to respond to the food security crisis that faced Southern African Development Community (SADC) countries at the time. Since then, the BVAC has been undertaking annual livelihood vulnerability assessments with the intention of informing decision making for interventions.

Among the most vulnerable sectors of the economy during drought years are agriculture and water. Rural communities are highly dependent on crop and livestock production, whilst shortage of water is a major problem in urban areas. Water rationing is the norm during times of drought. The most vulnerable groups within society include small scale farmers, the destitute, women – especially in rural areas, children under the age of five and the elderly, pregnant and lactating women, orphans and people affected by HIV/AIDS.

Communities with agro-based livelihoods suffer income loss and asset depletion, especially as a result of drought-related livestock mortality. Drought impacts and threatens the nutritional status of the population, especially young children, which is dependent on the countrywide feeding programme for the under-fives and vulnerable groups. Poor

yield harvests, shortage of seeds and impaired purchasing power at the household level are some of the impacts of drought in Botswana.

Emergency relief and drought response

The National Disaster Management Office (NDMO), under the Office of the President, is responsible for coordinating disaster risk management activities in Botswana. Drought, however, is managed under the Ministry of Local Government and Rural Development through the implementation of the 1992 Drought Policy, which gives priority to labour intensive public works to provide temporary employment as it aims to link relief and development (Buchanan-Smith and Tlogelang, 1994).

During drought periods all ministries and local authorities are mobilized to assist in relief programmes, including public works projects designed to create employment during difficult times. The primary aim of the drought packages is to relieve human suffering and prevent loss of life.

The types and forms of emergency provided by the government during times of drought include increasing the employment quota for intensive labour works (Ipelegeng), purchase of additional water bowsers to help respond to human water supply shortages (emergency water supply), free supplementary feeding of vulnerable groups in schools and direct feeding for all children under the age of five years who attend child welfare clinics, and other vulnerable groups.

Provision of drought relief subsidies on selected livestock feeds, vaccines and supplements, cattle purchasing schemes and monitoring of food supplies with the view of importing more if the need arises are some additional measures undertaken.

Practices to alleviate the impact of drought

In line with major agricultural policy changes in the world economy in relation to the green agenda and the reduction of farm policy programmes, in 1992 the government reviewed the Drought Relief Programme. Past relief measures that contributed to land degradation such as clearance and de-stumping schemes were discontinued. Support was given to proposals that gave priority to investment in water conservation, appropriate land use and improved management techniques. The introduction of the National Water Master Plan, National Conservation Strategy and Agricultural Policy contributed to the implementation of this approach.

In order to address the drought situation, in the short term water restrictions and rationing have been introduced. In the medium term, the government has put aside funds for the implementation of drought mitigation projects. These include projects to upgrade and refurbish boreholes, build treatment plants and upgrade water treatment schemes.

To alleviate the impact of drought-related mortality, farmers are encouraged to sell some of their livestock and to buy animal feed for the remaining herd. Cattle farmers are also encouraged to link up with arable farmers so as to use failed crops as fodder for livestock. The Livestock Advisory Centres are also stocked with feed that is sold to farmers at a subsidized price during drought. The government has put in place measures to provide treated waste water from sewage ponds around the country for irrigation of horticultural crops.

The need for drought management knowledge and skills

Although the government has put in place strategies to mitigate the impact of drought, there remains a need to create awareness among the citizenry of the cyclic nature of drought, as years of good rainfall are usually followed by those of drought conditions and, as such, people should adopt coping strategies. Research institutions should develop drought forecasting models and enhance early warning systems to minimize the negative impact of drought on vulnerable groups. Consequently, there is a need to aim targeted training and development programmes toward areas of scarcity and comparative advantage.

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Kenya[1, 2, 3]

Background

Kenya has been stricken by various disasters. The most significant disasters have been droughts, floods, fire, acts of terrorism, technological accidents, diseases and epidemics that disrupt people's livelihoods, destroy infrastructure, divert planned use of resources, interrupt economic activities and retard development.

Kenya is a highly drought prone country because of its peculiar eco-climate: only about 20 per cent of the territory receives high and regular rainfall. The rest, that is, 80 per cent of the territory, is arid and semi-arid lands (ASAL), where annual rainfall varies from 200–500 mm, and periodic droughts are part of the climate system.

Drought in Kenya adversely affects all sectors of the economy and the population at large. This is because it (1) affects water supply in both rural and urban areas, (2) leads to reduced hydropower generation and power rationing, (3) causes crop failure and reduced food security, (4) causes the death of humans, livestock and wildlife, (5) leads to job losses when industries shut down as resources become depleted, (6) causes the deterioration of human health as a result of malnutrition and poor access to good quality water, and (7) causes conflict between communities and wildlife. The scorching effect of drought also leads to environmental degradation – desertification and bio-diversity loss.

The root cause of the country's vulnerability to drought is its dependence on rainfall for its economic and social development. Agriculture, the mainstay of the economy, is almost entirely rain-fed. Water for human consumption and other uses is derived from rivers whose replenishment depends on rainfall. Kenya is a water-scarce country, whose per capita water availability is one of the lowest in Africa, making access to clean water a problem in many areas of the country, including the capital, Nairobi. Recent droughts (especially in 2000) exposed the risk this entails: when drastic power rationing was imposed, the Kenya Power Company lost US$20 million, the economy was paralyzed and national GDP contracted by 0.3 per cent (Kandji, 2006).

[1] E. Mbogo, Ministry of Agriculture, Livestock and Fisheries, Nairobi, Kenya

[2] F. Inganga, National Environment Management Authority (NEMA), Nairobi, Kenya

[3] J.M. Maina, Kenya Meteorological Service (KMS), Nairobi, Kenya

In recent years, Kenya has experienced severe droughts associated with major food crises:

- 1997 – a severe drought threatened the livelihood of two million people;
- 2000 – 4 million people were in need of food aid after Kenya was hit by its worst drought in 37 years;
- 2004 – the long rains (March–June) failed and the subsequent crop failure left more than 2.3 million people in need of assistance;
- 2005 – another 'national catastrophe' was declared in reference to the famine that affected 2.5 million people in northern Kenya;
- 2010/2011 – worst drought in 60 years; it affected 13.3 million people in Kenya, Ethiopia and Somalia (Mwangi, 2012).

Droughts are generally associated with the failure of the seasonal rains. The two major rainfall seasons in Kenya are the long-rains (March–May, MAM) and the short rains (October–December, OND). Impacts of drought are demonstrated in Figures 1-4.

Figure 1: Livestock watering

Figure 2: Dried water pan

Figure 3: People trek long distances for water

Figure 4: Starvation takes its toll on cattle before they reach the market

Figure 5: ICPAC member countries

The Greater Horn of Africa (GHA) is highly prone to extreme climate events such as droughts and floods. These extreme events have severe negative impacts on the key socio-economic sectors in all of the countries in this sub-region.

In order to address this challenge, the IGAD held its Tenth Summit in Kampala, Uganda, attended by heads of state of member countries. At this summit the existing Drought Monitoring Centre, headquartered in Nairobi (DMCN), was adopted as a specialized IGAD institution. The name of the institution was changed to the ICPAC in order to better reflect its mandates, mission and objectives within the IGAD system. The protocol integrating the institution fully into IGAD was signed on 13 April 2007.

The centre is responsible for the 11 IGAD member countries: Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, South Sudan, Sudan, Tanzania, and Uganda (see Figure 5). It works closely with the National Meteorological and Hydrological Services (NMHS) of member countrie**s** as well as regional and international centres for data and information exchange.

Its objectives are:

1. To provide timely early warning information on climate change and to support sector-specific applications for the mitigation of poverty and the management

of environment and sustainable development in relation to the impact of climate variability;

2. To improve the technical capacity of producers and users of climatic information, in order to enhance the use of climate monitoring and forecasting products in climate risk management and environmental management;
3. To develop an improved, proactive, timely, broad-based system of information/ product dissemination and feedback, at both the sub-regional and national scale through national partners;
4. To expand the climate knowledge base and applications within the sub-region in order to facilitate informed decision making on climate risk-related issues; and
5. To maintain quality controlled databases and information systems required for risk/vulnerability assessment, mapping and general support to the national/ regional climate risk reduction strategies.

The main climate information produced by ICPAC is issued in the form of regular bulletins:

- Ten-day, monthly and seasonal climate/weather bulletins;
- Climate watch/El Niño updates; and
- Annual climate summaries

Drought risk is detected using a drought severity index based on a station's statistical inter-quartile rainfall ranges (MIN, Q1, Q2, Q3, Q4, MAX) and the observed rainfall for the period (10-day, monthly, seasonally or annually). The following categories of drought severity are used:

- Driest on record conditions, if the observed rainfall is less than the minimum on record (MIN).
- Drier than normal conditions, if the observed rainfall lies between the minimum on record and the first quartile, Q1.

Seasonal Climate Outlooks (for March–May, June–August and September–December are prepared and issued to member states just before the start of the rainy seasons. The climate outlooks are developed by national and international climate scientists who meet at Regional Climate Outlook Forums (RCOFs). ICPAC is mandated to organize and coordinate the Greater Horn of Africa Climate Outlook Forums (GHACOFs). The forum issues a consensus seasonal rainfall forecast, indicating areas likely to experience drier than normal, normal or wetter than normal conditions during the oncoming season over the region.

The information provided enables sectors such as agriculture and livestock to enact appropriate interventions depending on whether a normal, alert, alarm, emergency or recovery situation is indicated

Vulnerability assessment

The most affected sectors of the economy in order of importance are livestock (particularly among pastoralists), agriculture (crop farming), water and social, as indicated by the joint Government of Kenya interagency post-disaster needs assessment (PDNA) report of 2011. This report revealed that livestock worth KShs. 56.1 billion died because of drought, in addition to approximately KShs. 643.2 billion being lost as a result of emerging constraints along the production and food supply value chains (e.g. water, feed and veterinary services; decline in production of meat, milk and other by-products). The report further indicated that in agriculture (crop farming), production of food and industrial crops reduced by Kshs. 121.1 billion in the same period.

A study financed by EU for the establishment of a National Drought Contingency Fund (NDCF) also noted that accurate data on the economic cost of drought does not exist in Kenya. It was estimated that the government spent KShs. 7 billion on food relief distribution during the 2006/07 drought. They also estimated that the financial cost of the 1999–2001drought was US$340 million (KShs. 22.5 billion), which included emergency relief, loss of livestock and the cost of operating the early warning system (EWS). The net effect of drought has been to draw development resources away from planned programmes to emergency food aid assistance, which has therefore led to a slowdown in economic activity for the whole country.

The communities have experienced more frequent crop failure, reduced yields and low calorie intake, resulting in a declining level of nutrition among the population. The impact of drought is compounded by widespread poverty and disruption of traditional coping mechanisms. After a severe drought, heavy rains tend to follow, leading to flooding and the spread of malaria and other water-borne diseases.

Lack of food at the household level is occasioned by low milk production and the depressed purchasing capacity of pastoralists (as food prices increase), increasing their vulnerability to starvation. Deteriorating livestock health, low crop yields and rising food prices exacerbate food insecurity. Further, increased competition for scarce grazing and water resources often leads to inter-communal conflicts, insecurity, limited access to markets and other basic services, thus compounding an already serious situation.

Drought imposes social costs by undermining the social standing of pastoral households whose position of honor is gauged by the size of their livestock herds. Drought disrupts local power relationships and damages the social safety networks that are built around lending and borrowing of livestock, thus promoting equitable ownership of the only means of livelihood. Drought also increases household vulnerability in event of future climatic shocks and food insecurity. It pushes pastoralists out of their production systems, forcing them to move to urban centres where food distribution, health, sanitation and water supply may be more reliably available.

Emergency relief and drought response

Some concrete responses to drought management in Kenya have been put in place. Documents and processes include: Ending Drought Emergencies (EDE) – a 10-year programme presented to the Horn of Africa Summit in September 2011; the approval of the Nairobi Strategy on Enhanced Partnership to Eradicate Emergencies by the heads of state in September 2011; subsequent regional programme development by IGAD; and a follow-up ministerial-level meeting in March 2012. In the Kenya Vision 2030, drought and climate change are widely addressed under risk management.

The main types of emergency interventions provided include: food relief for affected people, with special food formulas provided for the most affected (children, the elderly and mothers); human disease control and treatment; animal feed and supplements; water for humans and livestock; cash transfers; food/cash for work/assets; livestock disease control (vaccinations against common diseases and mass treatment); shelter; debt relief; destocking; restocking; distribution of seeds; supplementary feeding for livestock, especially breeding stock; rehabilitation of water points; and agricultural credit.

During drought emergencies, rapid response teams are activated to implement preplanned interventions. Decisions on actions to be taken are recommended by the Kenya Food Security Meeting and the Kenya Food Security Steering Group (see Figure 6) based on information gathered regularly by multidisciplinary teams and guided by internationally set common principles and universal minimum standards for the delivery of high quality humanitarian responses.

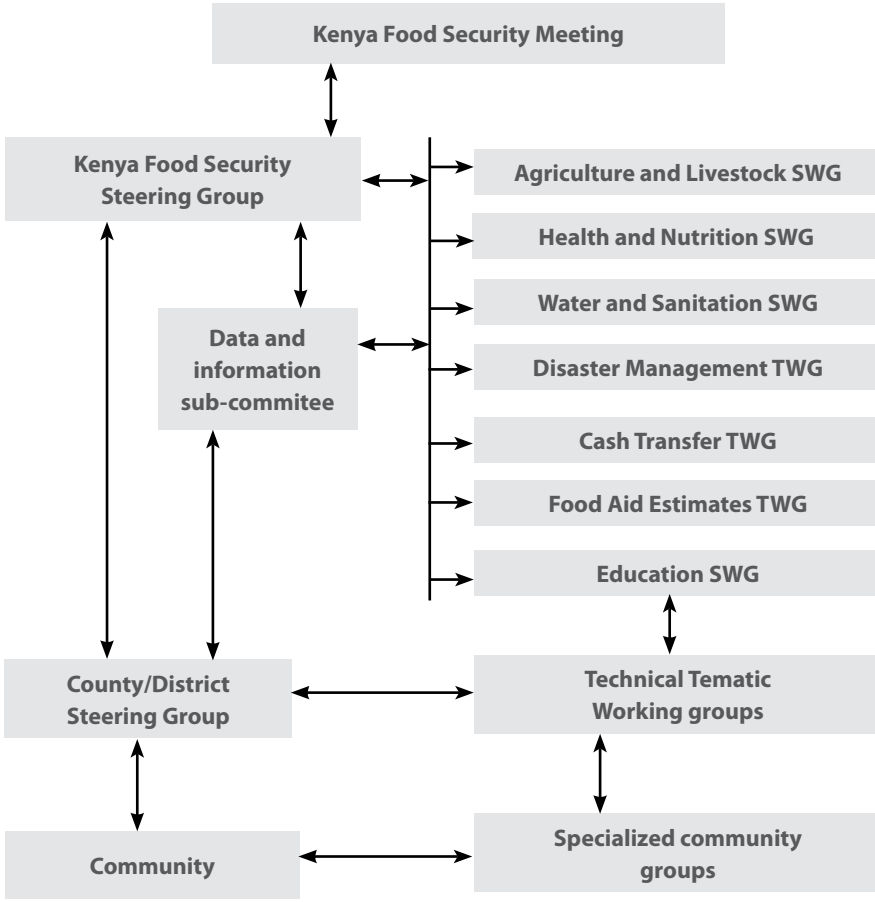

Figure 6: Kenya food security institutional structure

Policy response to drought management

The policy response to drought management in Kenya applies the guidelines from UNCCD to the domestic situation, following its ratification in 1997. It requires that parties prepare and implement the National Action Programmes (NAPs) to address matters of desertification, land degradation and drought. Kenya prepared and adopted its first NAP in 2002 and has been implementing it since then. During the Conference of Parties (Decision 3/COP.8), parties were asked to review and align their NAPs to the UNCCD 10-years strategy (2008–2018). Kenya is at an advanced stage of aligning its NAP to this strategy after receiving both technical and financial assistance from UNEP. It is expected that implementation of this policy document will go a long way in addressing the impact of drought and mitigating its effects in Kenya.

A policy paper (Sessional Paper No. 8, 2012) was also developed with an overall goal of guiding the sustainable development of Northern Kenya and other arid lands by increasing investment in the region and by ensuring that the use of resources is fully reconciled with the realities of people's lives. The policy provisions are consistent with the African Union Policy Framework for Pastoralism in Africa, which was approved in January 2011. This policy resulted in the formation of the National Drought Management Authority (NDMA) to coordinate all matters related to drought management in Kenya.

Practices to alleviate the impact of drought

In Kenya an elaborate drought coping mechanism is in place to respond to drought situations. Noting that drought occurs in cycles, different activities are carried out at different times in the drought cycle. Table 3 shows some of the key interventions and practices applied by the government and other supporting institutions, including NGOs and the private sector, at different times in the drought cycle to help affected communities to cope.

Other alternative sources of livelihood in ASALs consistent with drought mitigation include use of multipurpose trees, like moringa (moringa oleifera), and farming of herbs such as aloe vera. Tapping gum trees is another important source of wealth creation in northern Kenya. Gum can be harvested from drought-resistant Commifora and Acacia species like C holtziana, C pseudopaolii, A. Senegal and A. seyal.

Bee farming (apiculture) is also a rewarding and enjoyable occupation with many benefits. It is a source of many non-perishable foods including honey, bee wax, pollen, propolis, bee venom, royal jelly, bee colonies, bee brood, queen bee and package bees. Beekeeping encourages environmental conservation. Bees are good pollinators of plants, trees and crops and thus play a role in biodiversity and improvement of crop yields. Most hive products provide remedies for a number of ailments (apitherapy).

Table 3: Key interventions at different stages of the drought cycle

AREA OF INTERVENTION	NORMAL	ALERT	EMERGENCY	RECOVERY
Water	Promote water harvesting and storage, train water user associations, plan for new water sources, deepen wells, disilt pans, plan future interventions	Carry out strategic needs assessment, protect strategic wells, repair poorly working boreholes	Implement contingency plans including water supply (tankering), keep strategic watering points functional, monit water availability	Improve water pans and develop new ones through food-for-work or cash-for-work programmes
Food security and nutrition	Promote animal production and drought-resistant crops, improve extension services, develop strategic cereal banks, build capacity	Stock strategic reserves, use data sources to warn and alert donors and government, provide food to most affected	Provide food relief, activate rapid response teams, diversify income, improve activity for health and nutrition	Replace assets, provide tools and seeds, strengthen community management structures, organize cash-for-work and food-for-work programmes
Livestock production	With enough pasture and water, build up the herd, build capacity, strengthen social networks, develop livestock markets, conserve and protect pasture using traditional rules and range management approaches	Select animals for sale, separate and split herd, dry and smoke meat for later use, provide supplementary feeding, store feed, alert donors and negotiate grants, control breeding	Increase sale of animals or barter, migrate in search of pasture, stop breeding, provide emergency water and feed, especially for lactating and breeding animals, work-for food/assets	Review damage and document lessons, restock traditionally, buying or through assistance, build pasture and water resources, strengthen animal health services, build capacity, vaccinate, deworm, adopt alternative livelihoods

AREA OF INTERVENTION	NORMAL	ALERT	EMERGENCY	RECOVERY
Animal health	Establish common approach to disease control, vaccinate, deworm, maintain cattle dips	Carry out mass vaccination, deworm, equip drug stores, carry out cross-border disease monitoring	Instigate emergency disease control, target drought-prone animals (calves, lactating, sick) for special treatment	Document and evaluate lessons learnt, re-stock drug stores, vaccinate and deworm, use feed supplements until animals regain their health, build capacity
Crops	Identify drought-resistant, early maturing crops and indigenous plants that require little water, build capacity, promote agro-forestry for fruit, fuel, fodder and medicine, organize pest and disease control	Promote small-scale irrigation, prepare kitchen gardens by drip irrigation, initiate extension services	Irrigate where possible, provide food relief	Prepare land for planting, provide tools, seeds and other inputs, improve soil fertility, repair irrigation facilities, plant short-term crops as soon as it rains, build capacity

Need for drought management knowledge and skills

Despite improvements to early warning and contingency planning systems, drought management in Kenya has continued to take a reactive, crisis management approach rather than an anticipatory and preventive risk management approach. Until recently, drought management systems had been operated through a succession of time-bound projects since its origins in the mid-1980s.

Some of the gaps/shortcomings in drought management include:

- The gap between information provided by the early warning systems about impending threats and the ability of the government to act to reduce those threats. *There is an urgent need for a change in attitude toward early warning information*;

- District drought management plans have included pre-prepared 'shelf projects' of activities to be triggered by the early warning systems, but without proper funding these projects are not carried out.;
- Access to meteorological information at the local level needs to improve to help farmers cope with increasingly unpredictable weather conditions;
- The NDMA relies on sector departments for some technical data; therefore, ensuring the accuracy of data and its understanding in the sector departments is critical for its effectiveness;
- The early warning system is supposed to trigger support for communities upon a given threshold. The support is to come from the National Drought and Disaster Contingency Fund that is yet to be operationalized;
- There is a focus on initiatives that build resilience in pastoral and agro-pastoral areas that are multisectoral in nature. However, there is a danger of over-emphasizing alternative livelihood approaches at the expense of main livelihoods as a result of a pressure to demonstrate immediate and tangible results; and
- The availability of improved technologies to harness scarce and renewable resources like water, solar energy and wind must be increased.

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Malawi[1, 2]

Background

Highly variable climate in Malawi has a significant impact on the amount, timing and frequency of rainfall resulting in frequent droughts and floods. Drought has greater effects in the country than floods. Drought is said to occur in the country when seasonal rainfall is 75 per cent lower than normal. Dry spells within the rainfall season are common in many parts of the country. Usually dry spells which turn into droughts last for three to four months. Almost all droughts in Malawi are associated mainly with El Niño[3] (Pauw et al., 2010). Virtually all of the country is vulnerable to drought.

Malawi has been experiencing droughts for many years. However, an increased frequency of drought occurrences has been observed from the 1980s onwards as a result of climate change (Government of Malawi, 2006). In the last two decades, Malawi has experienced two notable droughts during the 2001/02 and 2004/05 rainy seasons (Nangoma, 2008). The drought of 2001/02 affected 2,829,435 people (World Bank, 2010) and maize production alone was approximately 30 per cent short of that estimated (Chabvunguma and Munthali, 2008). The 2004/05 drought plunged the country into one of the most serious food security crises experienced in more than 60 years (ibid). At the peak of the crisis 30 per cent of the population needed emergency food assistance and a total of 5,100,000 people, mostly farmers, women and children, were affected as a result of crop failure, insufficient water supply and malnutrition. In terms of area coverage, 11 out of 21 Rural Development Project areas[4] were affected (World Bank, 2010). According to the World Bank, the cost of the 2004/05 drought response in the country was over US$200 million and, following the consequences of the drought, Malawi imported between 200,000 and 300,000 tonnes of maize for distribution during the lean months between January and March 2006.

Drought monitoring and early warning systems: capacity and adequacy of the meteorological and hydrological station network

In Malawi, there are two drought monitoring and early warning systems: scientific-based and traditional-based (Government of Malawi, 2013). Traditional systems use the behaviour of plants or animals. Scientific systems are based on indicators derived from variables such as climate, soil moisture and stream-flow. Indicators commonly used to character-

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[2] J. Mawenda, Environmental Affairs Department, Lilongwe, Malawi; G. Kambauwa, Department of Land Resources Conservation, Lilongwe, Malawi

[3] Warming of the sea surface temperature of the equatorial Pacific Ocean associated with droughts in southern Africa; the opposite is La Niña, which is associated with floods in southern Africa

ize severity of droughts are the Water Requirement Satisfactory Index (WRSI), Standard Precipitation Index (SPI), Normalized Difference Vegetation Index (NDVI), and Weather/ Seasonal Rainfall Forecasts.

The Department of Climate Change and Meteorological Services (DCCMS) is responsible for meteorological stations. The Water Resources Department (WRD) is responsible for hydrological stations. The capacity and adequacy of the DCCMS and WRD in relation to early warning systems depend on station network and technical staff.

The reliability of information is based on the performance of the station network. Hydro-meteorological stations in Malawi are sparsely and unevenly distributed. The number of stations in the country has been decreasing. During the 1970s there were 800 rainfall stations[5] and 23 meteorological stations. By 1988, rainfall stations were reduced to 135. Currently, there are 21 meteorological stations.

The role of the DCCMS is linked to drought management. Its functions are geared toward improving the station network and its operations, and conducting research to improve the understanding and application of climate information. The role of the WRD in drought management is to establish and maintain hydrological monitoring systems for identifying, developing and conserving water resources. These roles are useful in drought mitigation, preparedness, response and recovery.

Some challenges facing the DCCMS and WRD include: inadequate maintenance; changes in management; inadequate training; poor remuneration; high operational costs for data collection; lack of comprehensive early warning systems; inadequate qualified personnel; and high staff attrition.

Malawi has national and district disaster management committees. Therefore, opportunity exists to directly influence and contribute to the development of more effective early warning systems.

Vulnerability assessment

Droughts have negative effects on agriculture, water, gender, health and fisheries (Mkanda, 1995; Government of Malawi, 2006). Most vulnerable is agriculture, followed by water, gender, health and fisheries. Droughts have more adverse impacts on the country's food

[5] Weather station that measures only rainfall.

security, employment and economy, which are dependent on rain-fed agriculture. For example, the drought of 1991/1992 caused a 60 per cent decline in maize production, accounting for a 10 per cent reduction in gross domestic product (GDP) and affecting 6.1 million people (Clay et al., 2003; Government of Malawi, 2006; Khamis, 2006). Over 90 per cent of Malawi's population relies on rain-fed agriculture (Mkanda, 1995). Those sectors that directly depend on agriculture, such as agro-industries, are seriously affected by its failure as a result of the reduced supply of raw materials. Considering that agriculture accounts for a significant share of total exports, foreign exchange earnings, food security and employment, it is the most vulnerable sector in the country.

Water is a critical resource for human and industrial use and for the maintenance of ecosystems. Droughts seriously disrupt water availability in quantity and quality. During droughts, much water is lost through evapotranspiration and little water flows into water bodies resulting in low lake levels and reduced river flows. For example, in 1995 Lake Chilwa dried up as a result of drought (Government of Malawi, 2006).

Human health is directly affected by drought occurrences, and is especially linked to infant malnutrition and chronic ailments associated with malaria, cholera and diarrhoea. The fisheries sector is also affected by droughts, in terms of declining water levels and the drying up of bodies of water, resulting in low fish production and loss of aquatic biodiversity. For instance, droughts have been responsible for the drying up of Lake Chilwa in 1995, which resulted in the total loss of its fish stock.

The most vulnerable groups in Malawian society include women, children and subsistence farmers.[6] Women bear most of the burden of those activities most impacted by drought, including collection of water, firewood and ensuring daily access to food. Women usually have limited access to resources for coping with the impacts of drought. Subsistence farmers are more vulnerable than commercial farmers and are usually poor; they may be unable to afford adequate farm inputs such as improved seeds that are resistant to drought.

Emergency relief and drought response

Malawi maintains an emergency management programme to address its response to hazards such as drought. In fulfilling its primary role of protecting the lives of its citizens and minimizing damage to property during disasters, the Government of Malawi has developed a National Contingency Plan (NCP) that is updated annually to reflect

[6]Small-scale farmers with gardens of less than one hectare and a farm, which produces for household consumption only.

changing weather patterns. The National Contingency Planning process has the ability to bring many humanitarian players together and acts as a framework for raising disaster response resources. The plan acts as a link between local disaster risk reduction measures and international disaster risk reduction efforts through international organizations such as UN agencies (for example, the WFP, UNICEF and UNFPA) and NGOs.

For instance, during the 2005/06 drought, the incomes of at least 4.2 million people, more than one-third of the population, were severely reduced as a result of crop failure. Humanitarian support of around 370,000 metric tonnes of maize costing approximately US$110 million was distributed to maintain nutrition levels. In addition to the immediate humanitarian needs, the crisis had a severe negative impact on domestic investment and production because the exceptional food import requirements constrained imports critical to production, notably petroleum, fertilizer, machinery and construction materials. Further, the disruption to trade and economic activity caused by the drought risked undermining business confidence and investment. The government and development partners agreed on three levels of intervention: (1) provide targeted free food distribution; (2) scale up existing safety nets through expanded public works programmes; and (3) import and sell maize domestically on commercial terms to ensure adequate supplies in the domestic market.

Practices to alleviate the impact of drought

The Government of Malawi and other supporting institutions have put in place measures and practices to alleviate the impact of droughts prior to or during such events, including:

The government, with funding from the World Bank, is facilitating an index-based weather insurance scheme. The scheme helps the government manage the financial impact of drought-related national maize production shortfalls. The scheme is designed to provide compensation to farmers when rainfall during a crop growing cycle is insufficient (Syroka et al, 2010).

The government is encouraging interventions such as green belt initiatives and conservation agriculture, which reduces the impact of pending drought during the crop growing cycle.

The government, NGOs and other institutions such as the Malawi Red Cross Society disseminate early warnings to communities. In this regard, the government facilitates the expansion of the hydro-meteorological station network.

The government and development partners promote social cash transfers to ultra-poor households. Over 3,200 households have been reached (UNICEF-Malawi, 2008). Social cash transfers have helped vulnerable households to build their resilience to disaster-related shocks. Through the Shire River Basin Management Project (SRBMP), Malawi has embarked on the modernization of water resource monitoring systems (real-time hydrological and meteorological systems) and established an operational decision support system to improve integrated hydro-meteorological data visualization, weather/climate forecasting and early warning systems.

The government is implementing an African Monitoring of the Environment for Sustainable Development (AMESD) programme, involving relevant sectors, to improve the use of satellite data for drought monitoring.

Need for drought management knowledge and skills

Financial institutions in Malawi providing crop and weather-related insurance are unwilling to lend money to smallholder farmers because of the risk that they will default in the event of drought. Only a limited number of farming households are involved in the scheme. As a result, by 2005, only 50,000 farming households in the country were able to secure credit. Therefore a need exists for more training for weather experts, farmers, insurers and lending institutions on crop and weather-related insurance and contract design.

Malawi has inadequate capacity to forecast reliable and high resolution data on drought as a result of its distinctive characteristics (that is, low onset, non-structural impacts and large spatial extent). Knowledge, skills and tools are urgently required for institutions and individuals involved in drought monitoring and early warning systems. There is a need for an increased awareness and knowledge of tools and methodologies for national planners, policymakers, institutions and stakeholders in order to develop proactive drought management plans.

Malawi has strategies/policies in place that contain some elements of drought management such as the Disaster Risk Management Policy, National Irrigation and Development Strategy and National Water Policy. Although these instruments acknowledge the effects of droughts (CEPA, 2012),[7] there is no single policy/strategy that wholly focuses on 'integrated' drought management. There is thus an urgent need for a stronger strategy. Although Malawi is implementing an AMESD programme, the use of satellite images needs to be enhanced.

[7] Centre for Environmental Policy and Advocacy (CEPA) is a non-profitable NGO

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Zimbabwe[1]

Background

Agriculture in Zimbabwe comprises 19 per cent of the country's GDP. Approximately 80 per cent of Zimbabweans depend on agriculture, which is mostly rain-fed, for their livelihood (Madzwamuse, 2010). At one point, Zimbabwe was a food-exporting nation, with the country recording surpluses in food production almost every year. In recent years, however, the nation's crop production has greatly declined, largely as a result of erratic and sub-normal rainfall. Over the past decade, the amount of rainfall the country receives has deviated from the multi-decadal mean on a regular basis. In the later part of the twentieth century, run-off in the country decreased by 20–30 per cent (MMET, 1998).

Droughts have been crippling Zimbabwe and have contributed to already low life-expectancy levels and the high level of emigration. During the 1991/92 drought, for example, maize production decreased by almost 75 per cent, leaving a large percentage of the population in dire need of food aid. The Grain Marketing Board (GMB) domestic maize intake during the 1992 drought year was about 13,000 tonnes – just enough for two days consumption for the nation. Over 1 million head of cattle died of starvation during that year. Drought returned in the 1993, 1994, 2002, 2004 and 2012 seasons, which also affected people's livelihoods (see Table 1). The 2012 drought saw a deficit of approximately 45 per cent in the nation's staple food source, maize, (FDI Global Food and Water Security Research Programme, 2012). About 1.4 million Zimbabweans faced famine in 2012 (ibid). The cumulative occurrence of these droughts in rural Zimbabwe since 2002 has culminated in the stagnation of rural livelihoods, which were enormously agro-based. This situation has not only entrenched rural poverty, but also seen the introduction of new strategies such as conservation farming and food handouts, all of which have failed to provide a comprehensive remedy primarily because of the palliative nature of the solutions.

[1] S.S. Nangombe, Meteorological Services Department, Harare, Zimbabwe

Table 1: Droughts in Zimbabwe between 1950 and 2013

	EXTREME DROUGHT	SEVERE DROUGHT	MILD DROUGHT
Years	1983, 1992	1968, 1973, 1982, 2004	1951, 1960, 1964, 1965, 1970, 1984, 1987, 1991, 1995, 2002, 2003, 2005, 2007, 2008, 2009, 2010

Although the bulk of the drought years were mild, they nonetheless had an effect on people's livelihoods, especially in rural areas.

Drought monitoring and early warning systems

Drought monitoring in Zimbabwe is carried out by two main ministries, the Ministry of Environment, Water and Climate through the Meteorological Services Department (MSD) and the Ministry of Agriculture through the Agriculture Research and Extension Services (AGRITEX). The roles and responsibilities of the two organizations include systematic observation and monitoring of hydro-meteorological parameters, provision and publication of information, forecasts, products and services related to weather and climate. These departments are also responsible for the supply of data related to drought-relevant parameters, indices and indicators. The early warning system for drought in Zimbabwe at the national level is not very effective, if not quite non-existent. This is the most overlooked area in relation to drought since so far there is no substantial establishment of a visible structure to that effect; however, an early warning system is the starting point for drought preparedness. It follows that, if effective monitoring and drought forecasting exists, then adaptive capacity can be enhanced; as a result, the management programme becomes proactive rather than reactive. A management system exists only on paper; it has not been put into practice.

The MSD provides early warnings for drought from the period at which it starts disseminating the seasonal forecast. The seasonal forecast is generated by regional climate experts in Southern Africa, together with the Southern Africa Regional Climate Outlook Forum, and is disseminated in August prior to the rainfall season. Each member state then downscales the regional forecast to their national level. Drought status is then monitored as a continual process as the season progresses; such monitoring can thus pick out the intra-seasonal droughts that may have been missed by the seasonal forecast. The MSD uses the Standardized Precipitation Index, which qualifies the severity of droughts in drought

monitoring. AGRITEX also carries out drought monitoring by estimating water requirements for crops and livestock by analysing temperature, soil quality, evapotranspiration and rainfall. It mainly uses the Water Requirement Satisfaction Index (WRSI) in drought monitoring. It is these two institutions that will advise the government on the country's drought status and both are also members of Zimbabwe's National Early Warning Unit (NEWU), which makes for efficient coordination and dissemination of information.

Vulnerability assessment

Zimbabwe's drought vulnerability situation is outlined every year in the Zimbabwe Vulnerability Assessment (ZIMVAC) report, which describes vulnerable areas and groups. Droughts have been by far the most significant threat to Zimbabwe compared to other natural disasters, with huge economic, environmental and social costs. Agriculture (crop, livestock forestry and fishery) depends heavily on water; hence, if sub-normal rainfall is received, it may consequently lead to a loss in crop yields or livestock production and an increase in insect infestations, wind erosion or forest fires, all of which have serious negative effects on the national economy.

The agricultural sector is usually the first to be affected by droughts, given its dependence on soil and water, which can be rapidly depleted during extended dry periods. The approximately 80 per cent of the total population that depends on agriculture in Zimbabwe is that most susceptible to shocks from drought. More than half of the population lives in rural areas where the general quality of living is low; it is also less prepared to deal with problems brought about by drought. Moreover, children and women are more affected than men, most of whom work in towns. Prolonged dry spells and/or droughts affect other sectors relying on alternative sources of water. Sectors using surface water like lakes and dams and sub-surface water are usually those last affected. The dryness of the environment as a result of drought will also substantially increase the risk of forest fires, which compromise the safety of both human and wildlife populations, especially in rural areas, where again they are less prepared to deal with such disasters.

Emergency relief and drought response

The Rural District Council (RDC) in some communities in Zimbabwe has via negotiations and partnerships with NGOs such as CARE Zimbabwe and the World Food Programme engaged the local government in using Grain Marketing Board storage facilities for grain stocks. Grain reserve stocks are very important for response preparation for moderate to severe drought. The proposed reserve stock would serve as relief in the case of the occurrence of drought. Such a minimum reserve stocks policy would avoid delayed im-

portation, since the responsibility for this exercise and provision of funds would lie in the hands of the RDC via the local government. The government-initiated District Development Fund was also made responsible for erecting boreholes in drought-prone rural communities. These boreholes have assisted both people and livestock by providing water whenever droughts occur. However, it was noted that if a drought is prolonged, boreholes in these areas also tend to dry up.

Furthermore, development partners (NGOs) support the government by implementing projects that address extreme drought conditions by providing food aid and water to different affected communities. Livestock are also extremely affected by droughts, especially those of long duration. The Vet Field Services Department also works in collaboration with FAO in providing supplementary feed for livestock in affected areas. However, the government of Zimbabwe plays the major role in emergency relief and response to drought, with the Ministry of Agriculture taking the lead role.

Practices to alleviate the impact of drought

Chipindu (2008) confirms that conservation is not only an essential aspect of development, but also drought management. Alternative energy sources such as jelly oil, paraffin and solar are being distributed to households in the community on condition that they are willing to participate in the drought management programme. Again, livestock that are ecologically viable and provide tillage such as donkeys and goats are promoted. Moreover, people are encouraged to use organic manure as fertilizer rather than relying on inorganic fertilizers that have negative implications for the productive capacity of the soil. This is complemented by the technocratic approach to disaster management that recommends that disaster management efforts be proactive rather than reactionary. It follows that, if drought management follows this recommendation, it would be easier to cope with as a result of the community's mitigation efforts in their adoption of conservation practices.

The following practices are encouraged, especially in severe drought-prone areas:

- Conservation agriculture;
- Climate change adaptation projects (bee-keeping, livestock, etc.);
- Promotion of small grain drought-tolerant crops;
- Promotion of short season varieties;
- Water harvesting techniques; and
- Irrigation.

Farmers, especially communal smallholder farmers, are advised by AGRITEX not to rely solely on indigenous knowledge about seasonal forecasts but to also incorperate the scientific seasonal forecast issued by the MSD. Other scientists argue that the indigenous indicators, such as the physiological behaviour of trees and frogs and the sounds of birds, are related to the response of certain animals and plants to the already prevailing weather stimuli, rather than the coming season.

Need for drought management knowledge and skills

Studies in Zimbabwe are indicating that smallholder farmers are increasingly concerned about unfamiliar climate dynamics, including uncertainty about planting, loss of crops and damage to infrastructure (Zvigadza et al., 2010). The same farmers highlight the lack of access to weather trends and climate data. There is a need for the MSD to embark on a nationwide campaign to help farmers become aware of how to use weather and climate products and where to get such information. In the past, drought relief programmes have suffered from four major shortcomings. First, there has been no adequate definition of drought so that drought declaration has been determined by practical experience and observation rather than as the result of a scientific process. This has resulted in frequent national drought declarations, and extensive relief programmes, when only part of the country has been affected. Second, the government has borne the responsibility for risk management and has financed and delivered substantial relief programmes during drought. This has discouraged farmers from adopting risk-minimizing farming practices. Third, a number of drought programmes, such as the fodder subsidy, have led to unsustainable farming practices. Finally, vulnerable group food distribution programmes during drought have been inefficient, poorly targeted and have had limited impact in ensuring household food security (Chitonga, 2013).

Several studies have been carried out in Zimbabwe's communal areas. For example, the Coping with Drought and Climate Change (Unganai, 2012), Building Adaptive Capacity to Cope with Increasing Vulnerability due to Climate Change (ICRISAT) and many other studies show a lack of capacity and leadership in local government in relation to climate change adaptation. Strong local institutions are a critical factor for successful adaptation. Environmental change is dynamic, so new challenges will always be emerging. These challenges require well-resourced institutions. The most pressing need is to establish a drought early warning system at national and local level. Furthermore, the country would benefit greatly from the following:

- Upgrading and modernizing the hydro-meteorological observation networks,

data management and forecasting system, as well as supporting sustainable organizational, human and technical resources to maintain and operate them;

- Providing training in drought vulnerability and risk assessment;
- Enhancing cooperation and networking between various hydro, agro and meteorological sectors, different stakeholders and end-users of data, services and early warnings;
- Strengthening capabilities for drought preparedness and management, including contingency plans at local and national level; and
- Developing sustainable irrigation systems.

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4.2. Near East and North African Country Reports

Eritrea[1, 2]

The State of Eritrea is located south of the Sahara Desert in the Horn of Africa and is part of the Sudano-Sahelain Belt. It is bordered by the Red Sea in the east, Ethiopia in the south, the Republic of Djibouti in the southeast and the Republic of the Sudan in the north and northwest. Eritrea gained its independence from Ethiopian rule in 1991; it was validated by a referendum in May 1993. Eritrea became the 182nd UN Member State in 28 May 1993.

The country exhibits a varied topography, with altitudes ranging from 120 metres below sea level to over 3,000 metres above sea level. Eritrea encompasses an area of 125,000 sq km and has an approximately 1200 km coastline, with more than 350 small islands, the biggest of which is the Dahlak archipelago, and two important ports, Assab and Massawa._The country has a semi-arid climate with uneven and erratic rainfall distribution ranging annually from about 200 mm in the coastal areas to a wider range, from 400 to 600 mm, in the highlands and western lowlands. In some spots, for example in the Green Belt, annual rainfall may reach up to 1000 mm. There are two major periods of precipitation: the main rains locally known as *Kremti*, covering both the western lowlands and the highlands, last from mid-June to mid-September and the rainy season known as *Bahri* or coastal rains falls from October to February and covers the eastern lowlands. The highlands also receive small rains locally known as *Asmera*, which last from February to March. A century or so ago 30 per cent of the Eritrean land mass was covered with forests and other types of vegetation. However, because of many interrelated biotic and abiotic factors such as deforestation (tree-cutting for expansion of agricultural land, firewood, traditional house construction, urbanization and so on) about 1 per cent of its land mass is currently covered by woodland and scrubland.

Administratively, the country is divided into six *zobas* (regions) and each in turn is divided into sub-zobas. Agro-ecologically, Eritrea is divided into six zones. The western lowlands bordering Ethiopia and the Sudan comprise an area with extensive plains through which the major Eritrean rivers flow. This area is mainly inhabited by pastoralists. The western low-

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lands are divided into the northwestern lowlands, which receive annual rainfall ranging from 200 to 500 mm and support a smaller livestock population of small ruminants and camels, and the southwestern lowlands, which receive annual rainfall of approximately 500 mm. This region supports a large livestock population and most of Eritrea's cattle are found in this area.

The eastern lowlands comprise coastal plains that extend along the Red Sea coast. Most of these areas are too arid for intensive crop production; the exception is small strips of land that are cultivated through rain fed-cum-spate irrigation and inhabited by pastoralists, agro-pastoralists and sedentary farmers rearing livestock and practising crop husbandry including vegetable production. Most of the livestock reared is small ruminants and camels. The central highlands comprise the central plateau, which is frequently interrupted by mountain ranges and deep gorges. The dominant agricultural activity in this area is small-scale mixed farming, that is, crop cultivation and livestock rearing.

Though a census is not carried out, the population of Eritrea is estimated to be 3.5 million. It is composed of nine different ethnic groups, namely, Afar, Bilen, Hidareb, Kunama, Nara, Rashida, Saho, Tigre and Tigrigna. The population is Christian and Muslim and followers of these religions live in harmony. The country's economy largely depends on agriculture. Subsistence farmers and agro-pastoralists make up the majority of the population, vulnerable to the negative effects of climate variability and its consequent results.

Exposure to climate variability and extremes, most particularly drought, poses substantial risks. In rural communities, community-based sustainable livelihood and environmental management measures have been implemented to build resilience to the stresses associated with drought and other climate variations and extremes. These measures build resilience and adaptive capacity to reduce the vulnerability of rural communities in Eritrea to future climate change. Research methods based upon a sustainable livelihood conceptual framework are being developed and applied in case studies in Eritrea to evaluate the performance of sustainable livelihood and environmental management measures for building resilience to current climate-related shocks and their potential for reducing community vulnerability to future climate changes.

Background

Climate change and drought are both an environmental and a development issue. This is critical in Eritrea where the poor are the most at risk from the increased variability and volatility in weather patterns. One of the key climate-related vulnerabilities of Eritrea's economy is its heavy dependence on rain-fed agriculture that depends mostly on the

monsoons. Monsoon rain analysis reveals that parts of Eritrea's land mass are hit by drought periodically. Drought threatens the existing cultivation of traditional rain-fed lands and mechanized and agro-pastoralist groups in the semi-arid areas of Eritrea.

Though detailed research has not been carried out on climate scenarios, it is expected that average temperatures will rise significantly relative to baseline expectations. Projections of rainfall under climate change conditions also show sharp deviations from baseline expectations. Results from some of the models show average rainfall decreases during the rainy season. While in certain respects the country is quite exposed to the potential impacts of climate change, it is simultaneously poised to undertake proactive steps that can preempt certain negative impacts, mitigate others and enable the country to adapt to a changing climate. In response to these challenges, Eritrea has been actively seeking to promote domestic sustainable development policies by engaging in international environmental processes, facilitating strategic research, employing preventive measures and monitoring mechanisms, enabling ground-level sustainable livelihood development work and strengthening its human and institutional capacity.

Drought monitoring and early warning systems

There are several meteorological stations in Eritrea that record rainfall, temperature, wind direction and velocity. The data collected from these stations are analysed, synthesized and used for monitoring purposes. In drought-prone areas temporary vaccination, sanitation and feeding programmes and mobile clinics are established. General health data, which includes body weight, disease type, intensity and frequency, are collected, analysed and compared with baseline data. These are good indicators for the impact of drought.

There is a monthly exchange of meteorological reports with neighbouring countries, which assists in monitoring, evaluating and forecasting weather conditions. In the Ministry of Agriculture there is an office that deals with different aspects of early warning systems. The office collects meteorological data and produces maps showing current weather conditions and predictions. The office has a reciprocal arrangement with other countries in the region to provide information for early warning systems. This information is made public via training sessions, the mass media (newspaper, TV and radio), videos, brochures, pamphlets and so on to raise awareness among the general public and farming communities in particular so that they can take the necessary precautions. For example, farmers are advised to level and plough their land, construct soil and stone bunds to conserve soil moisture, collect their harvests on time and make proper storage facilities.

Vulnerability assessment

Drought is one of the world's major natural hazards that occurs in almost every climate region and periodically impacts nations and livelihoods around the world. It affects millions of people and causes significant economic and ecological damage. Droughts are considered to be the most far-reaching of all natural disasters. Because each location is unique, the number of people affected by drought and the types of effects experienced will vary by region. In developing countries, however, drought ranks as the single most common cause of severe food shortages and its consequent results and is regularly listed as a cause in the majority of food emergencies.

To reduce societal vulnerability to drought, a paradigm shift from the current focus on crisis management to a risk management-based approach is needed. Drought risk management seeks to increase the population's resilience to drought by focusing on preparedness and mitigation measures that begin at the onset of a drought rather than in response to a disaster situation that arises as a result of its cumulative effects. Over recent decades much progress has been made in the scientific field of drought monitoring. Likewise, risk-based responses and coping strategies have evolved, which can help reduce the impact of droughts. It is clear that climate change will, in many parts of the world, adversely affect socio-economic sectors such as water resources, agriculture, forestry, fisheries and human settlements, ecological systems and human health. Developing countries are the most vulnerable.

The following are the most vulnerable sectors of the economy:

- *Agriculture*: Key drought vulnerabilities for crops include crop loss from lack of precipitation or insufficient irrigation, and possible damage to crops due to reduced quality of irrigation water. The livestock sub-sector focuses on impacts on grazing cattle, which can be vulnerable to drought as a result of reduced foraging.;
- *Energy*: Thermo-electric power plants can be impacted by inadequate water supplies and the increased cost of water during drought. Hydropower generation capacity decreases as reservoir levels drop. Mining operations can also be impacted by the increased cost of water for operations or limited water availability. The energy sector is generally drought tolerant. Power providers and mining operations tend to have superior water and power rights;
- *Water*: Drought vulnerability depends on the reliability of a water supply system during a drought and the ability to actively respond. Vulnerability can vary greatly based on the following categories: water supply, water distribution and water demand and adaptive capacity; and

- *Recreation and tourism*: Wild animals may move away from traditional viewing/hunting areas because of lack of water, loss of vegetative cover and/or heat. Fishing areas can be impacted by lower reservoir and lake levels, decreased stream flow and a decline in fish stock. Campsites and surrounding forests may be closed because of the risk of fire. Restrictions may be placed on the watering of trees. Lower reservoir and lake levels can render boat ramps unusable; and lower water levels can deter potential boaters.

Emergency relief and response to drought

The government is largely responsible for risk management in relation to drought and responding to the impact of drought should it occur. The government addresses drought issues from a multi-objective perspective. Various government agencies are mandated to deal with drought in terms of mitigation, preparedness, response or recovery. All those ministries, agencies and organizations concerned with the issue of drought synergize and harmonize their efforts in order to reduce its impact.

Dependent on the intensity and severity of the drought, affected individuals are provided with medication, training and training materials, feeding programmes, clothes, shelter, small ruminants, for example goats, and improved agricultural inputs.

Practices to alleviate the impact of drought

Several community based and owned interventions to alleviate the impact of drought are being carried out in Eritrea. The following is a list of the major practices:

- *Establishing a five-year (2014–2018) strategic and development plan*: The Ministry of Agriculture has developed a five-year strategic and development plan that incorporates drought mitigation and adaptation measures to be undertaken by extension agents and land users. These interventions are meant to develop and increase drought resilience. These interventions are based on risk management approaches as opposed to crisis management approaches;
- *Raising awareness*: The government raises awareness of the effects of drought via training sessions, workshops/seminars and the mass media;
- *Strengthening early warning systems*: The office that deals with early warning systems is being improved in terms of its technical, financial and human capacity;
- *Improving meteorological stations*: The capacity of the existing meteorological stations is being strengthened and new stations are being established that will enable more extensive meteorological data collection;

- *Evading drought*: Transhumance, or the seasonal migration of livestock, has long been recognized as an effective means of evading unfavourable climatic effects such as drought, whereby moving domestic livestock across a landscape allows maximum forage use across a variety of climatic regimes and events. This climate-driven approach has been usedeffectively by lowlanders and highlanders since time immemorial, although at present it is constrained by land ownership patterns and influenced by social norms and current agricultural practices. Transhumance is characterized by yearly movement cycles of livestock, following seasonal shifts in resource availability, coupled with variants in pattern associated with climatic events such as years of drought. A reduction in rainfall or even smaller scale shifts in the timing of rainfall can result in ecosystem responses such as switches from grass to shrub-cover dominance or the failure of annual plant production. Resource fluctuations are effectively evaded by following various well-established transhumance routes. The entrenched nature of the transhumance routes followed by pastoralists attests to a familiarity with resource variability and evasion during times of scarcity;
- *Improving crop production and productivity/unit area using integrated technologies*: To improve production and productivity per unit area, exemplary farmers are provided with improved crop, livestock and forage varieties. The farmers will give back a certain amount of the harvest that will then be redistributed to other farmers. This cycle continues and production and productivity increases annually. The system increases drought resilience. They are also advised to construct physical soil and water conservation structures and to practise conservation agriculture techniques. Currently, this approach seems promising.;
- *Constructing soil and water conservation structures/drylands agriculture*: Led by the village development committee of each administrative *kebabi* (two to three villages are clustered to form an administrative kebabi), farming communities and other land users construct physical soil and water conservation structures such as terraces, plug gullies and check dams along denuded and eroded hills. They build soil and stone bunds along farmland and in school compounds to protect against erosion and conserve soil moisture. These activities are coupled with planting of different multi-purpose tree species;
- *Running summer campaigns*: In Eritrea schools are closed during the rainy season (June–September) and high school students (grades 10–11) go out into the countryside to construct physical soil and water conservation structures and plant multi-purpose tree species on eroded hillsides and along farm land. They also assist farmers in land preparation that plays a positive role in drought resilience.

The summer campaign activities have been carried out every year since 1994 and commendable achievements have been undertaken with positive impacts on the environment and people's livelihoods;

- *Establishing Green Clubs*: All schools in Eritrea have established Green Clubs where students construct physical soil and water conservation structures coupled with tree planting in their school compounds and surrounding areas. Each student plants trees and manages them properly. This practice plays a positive role in increasing drought resilience. Currently churches and mosques are also initiating the formation of Green Clubs;
- *Strengthening the Sustainable Land and Water Management Forum*: This forum has three levels. The first comprises concerned ministers who deal with land, water, environment, marine resources, mines, energy, forestry, wildlife, agriculture, human welfare and social affairs, and so on; the second comprises director generals of the above-mentioned ministries/organizations/agencies; and the third is made up of senior experts. This structure is replicated in all zobas, sub-zobas and administration kebabis. The forum discusses issues related to the management of natural resources and drought mitigation and adaptation measures;
- *Constructing water reservoirs*: An Eritrean motto says, 'Let's conserve any drop of water for immediate and future uses'. To this effect, ponds, dams and roof water harvesting structures are constructed annually. To reduce soil erosion and increase the life span of these water reservoirs, physical soil and water conservation structures are constructed in the surrounding areas (watershed areas) and multipurpose tree species are planted;
- *Developing ground water*: Wells are developed;
- *Developing irrigation systems*: To supplement rain-fed agriculture different types of irrigation system, such as spate, mixed pressurized, furrow and surface, and irrigation from wells, dams, micro-dams and so on are being practised;
- *Introducing a package system*: The Ministry of Agriculture is introducing a package system whereby farmers receive one cow, 25 one-month-old vaccinated chicks along with one month's feed, a variety of improved vegetable seeds, forage seeds and 20 tree seedlings to be planted around their homesteads for firewood. The package system has many positive impacts as compared to the piecemeal system practised earlier;
- *Providing credit and subsidized agricultural inputs*: The Small Scale Marketing and Credit Enterprise, an autonomous enterprise, lends cash to poor women who head up families at a very low (nominal) interest rate as compared to the cash borrowed from other lending agencies such as commercial banks. The ben-

eficiaries use the cash borrowed to improve their livelihoods. The repayment turnover is very high. In addition to lending cash, these enterprises provide improved agricultural input at very low cost. This intervention increases agricultural production and productivity, which has a positive impact in terms of increasing drought resilience;

- *Establishing community-based shops*: There are community run and owned shops. These shops sell improved agricultural inputs such as farm tools (pick-axes, sickles, inorganic fertilizers, vegetable seeds and so on to farmers at a very low price as compared to other private shops. These shops play a very positive role in boosting agricultural yields, which increases drought resilience;
- *Establishing enclosures*: Enclosures are areas delineated for grazing. To reduce erosion and to increase biodiversity, physical soil and water conservation structures are constructed, coupled with tree planting and broadcast sowing of grass and forbs species. Grass for livestock feed and house construction is removed from such enclosures through the cut-and-carry system. Except for lactating cows, sick animals and plough oxen, enclosures are closed to grazing for a certain period of the year, which allows them to increase grass availability. This system of management improves drought resilience;
- *Storing and proper utilization of crop residues*: In rural Eritrea livestock are fed with crop residues like sorghum and maize stocks, hay and straw during most of the year, especially during the drought periods. The extension agents of the Ministry of Agriculture advise the farming communities to prepare and store these crop products properly so that they are not damaged by rain or lose their nutritional value;
- *Exchanging information*: Information on climatic data are collected, analysed and shared with other countries; and
- *Participating in international forums/workshops/seminars*: Experts in many different disciplines participate in international workshops/seminars and a range of courses on drought and drought-related topics. This enables experts to increase their know-how and skill

Need for drought management knowledge and skills

At the ministry level (headquarters and zoba levels), the following is needed:

- Technical support: There is a need to upgrade the skill and know-how of staff working in meteorological data collection and analysis. Hence support in this area is needed;

- Material support: The early warning system at headquarters level is ill-equipped. There is a need to equip it with the necessary materials. The system should be replicated in the six zobas that need technical and material support;
- Regional and global linkages: Drought has negative effects on the livelihoods of individuals and communities, regionally and globally, and should be tackled in an integrated manner. We need support to create linkages with the existing early warning systems, regional and global meteorological organizations and systems so that it will be possible to both get and to provide timely meteorological information; and
- Study tours: One way of developing skill and know-how is through visiting demonstration sites. There is a need to arrange such visits to different meteorological sites. This could be done for land users as well as extension agents of meteorological stations.

At the community level, the following should be addressed:

- Land users should be made aware of the causes and effects of drought and drought prevention measures: Training of trainers should be arranged for land users in different categories. To meet this objective, technical, financial and material support are essential. Such arrangements will enable land users to develop drought resilience;
- Community-owned shops must be strengthened: These shops play a positive role in improving the livelihood of farming communities through the provision of improved agricultural inputs at low affordable prices. They are easy to access by poor female-headed households. These improved inputs increase agricultural production and productivity thus increasing drought resilience of poor sectors of the farming communities, especially female-headed households. It is therefore recommended that these shops be further developed.

In conclusion, in order to reinforce and scale up the above-mentioned practices and to replicate those throughout Eritrea, technical, financial and material support are needed so that positive and sustainable development can be achieved.

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Ministry of Agriculture of Eritrea, Agricultural Extension Department

Iran, (Islamic Republic of)[1]

Background

Iran, with an area of 1,648,195 square km, is located within an arid and semi-arid sphere of the world. Approximately, 73 per cent of the country has an arid and semi-arid climate. Figure 13 shows aridity classification in Iran. Temporal and spatial rainfall distribution is variable and non-uniform, while merely 10 per cent of rainfalls occur during hot and dry seasons in central, southern and eastern spheres of the country. Nearly 52 per cent of annual rain and snow falls in only 25 per cent of the country, which exposes some areas to drought and they are expected to face serious crises in the near future.

Annual rainfall distribution indicates that 74 per cent of the country (122.5 million hectares) has less than 200 mm rainfall. According to average water statistics (over 30 years), rainfall volume all over the country is 413 billion m^2, evaporation is 283 billion m^2, renewable water resources equal 130 billion m^2, accessible surface water equals 92 billion m^2 and aquifer feeding equals 38 billion m^2. Considering that almost 70 per cent of precipitation evaporates, any measure concerning natural resources in watersheds, which might mitigate evaporation and increase penetration of such precipitations into underground water resources or stabilize base flow of rivers, is effective.

Currently, out of 609 plains in the country, 353 are in a crisis situation as a result of uncontrolled exploitation of underground water resources. Average reduction of the water table is approximately 60 cm per annum in the plains, which results in an average 30-cm subsidence of land in the country.

Positive aspects of the policies adopted by the government include consideration of infrastructural ideas to combat drought and adopt preventive measures and the special attention paid to the development of insurance schemes to cover both products and the provision of potable water for rural and urban areas. Through its current or completed programmes, the Ministry of Energy is promoting the optimal use and exploitation of water.

[1] Parviz Garshasbi, Deputy Head of the Forest, Range and Watershed Management Organization, Ministry of Agricultural Jihad

Drought monitoring and early warning systems

To control, monitor and combat the adverse impacts of drought, governmental bodies including the Islamic Republic of Iran Meteorological Organization (IRIMO) are tasked with recording and reporting the level of risk and vulnerability of different social sectors in relation to climate change and drought; reducing the impact of drought; creating adaptations during droughts; generalizing and exploiting knowledge and technical competence to inform monitoring systems; providing early warnings and drought notifications all over the country; raising awareness of drought-related issues; coordinating action to alleviate adverse impacts of drought; building capacity to cope with drought; and carrying out applicable surveys and studies through the establishment of the National Drought Warning and Monitoring Center (NDWMC). The Ministry of Agricultural Jihad is in charge of providing a comprehensive data bank to supervise and field confirmation of crops and existing livestock. The ministry established the National Committee on Agricultural Drought (NCAD) in 2001. Remote sensing is the responsibility of the Iranian Space Agency (ISA), a subsidiary of the Ministry of Communication and Information Technology (MOCIT); it is tasked with undertaking research, design and execution of programmes in the field of space technology, remote sensing and communication networks. The Ministry of Energy collects a vast amount of information on hydrologic indicators concerning river water levels, stream acceleration, river discharge, water quality, snow masses and transferred sediment rates. The Department of Environment is in charge of preserving the environment and making effective use of natural resources to ensure sustainable development of the environment, prevent destruction and contamination of the environment and preserve biodiversity all over the country.

In order to review the incidence of drought in relation to the dominant climate of Iran, an index such as the Standard Precipitation Index shall be utilised together with high spatial and temporal resolution satellite images, which have been experimented with in over 40 countries.

Vulnerability assessment

The economic effects of drought are huge and multifaceted. It has the biggest negative effect on areas such as change of land use, rain-fed agriculture, livestock and forest management, rather than on processing and complementary industries. Lack of occupational opportunities and income, sales of land and livestock, high production costs, low food supply and high taxation are examples of the effects of drought. The Management and Planning Organization estimated the cost of the 1999 drought to be US$1.25 billion, of which more than 80 per cent was incurred by damage toof crops, ranges and

livestock. According to the latest estimate, the total damage to the national economy resulting from the 1998–2001 drought cost over US$7.5 billion. The impact of drought on food security and population growth according to statistical indicators shows that, in the best case scenario, the population of Iran will exceed 90 million in 2021. Subsequent to drought, in order to pursue economic activities by various ministries including the Ministry of Agricultural Jihad during 1999–2010, a credit of IRR62,366,150 million was allocated to implementing preventive projects, providing compensation and setting up insurance funds in the form of cost and capital acquisition and affordable banking facilities. In recent years, water has been supplied from both surface and underground resources seriously affected by consecutive drought cycles. Loss of underground water resources is almost over its standard (additional exploitation of 5 cubic km) and its rapid reduction in many areas is alarming. Existing data indicate continued extraction of underground water resources connected to other critical areas of water supply for central areas and other plains and valleys.

Fifty years ago, with a population of 19 million, water per capita was 7000 cubic metres per annum; today, with a population of 70 million, it is less than 1900. Considering the population growth rate and other consumption behaviour changes, it is expected that water per capita until 2025 will reduce to approximately 1400 cubic metres per year. It is estimated that in 2020 water consumption shall increase to 116 cubic kilometres, of which 106, or 91 per cent (compared to the current 93 per cent) shall be used in agriculture.

As a result of restrictions, especially lack of water resources, only 18.5 million hectares of a total 37 million are cultivated; approximately 8.5 million hectares (46 per cent) is irrigated and 10 million (54 per cent) is rain fed. Despite the arid climate and lack of water, agriculture is a vital economic sector. It provides 18 per cent of gross domestic product, 25 per cent of employment, 85 per cent of the food supply, 25 per cent of non-oil products and 90 per cent of raw material used in agricultural industries.

Emergency relief and drought response

To measure the effects of drought on the economy, the following must be addressed:

- Estalishment of effective communication among public and non-governmental organizations to ensure a timely response during emergencies. Establishment of technical crisis committees in the fields of emergency food and water supply and damage control is essential;
- Exploitation of the mass media, including the national broadcasting service and

national and local publications, to raise awareness of drought-related issues and provide effective warnings;

- Development of the indigenous population's competence in alleviating the effects of drought and optimizing efficiency in normal and drought situations;
- Effective selection of and change in land use, modification of the cultivation frequency system, reasonable selection of plant species or changes in technology, land reclamation through cultivation of trees, forestation, green spaces, loosening soil, soil reform, control of underground water resources, irrigation, coordinated supply of nutrients. Such measures might be effective in mitigating the damage wrought by drought in a specific area. In this field, the breeding and cultivation of more resilient plants is of critical importance;
- Control of land and soil erosion, application of strategies and measures in watershed management, development of resilient seeds and promotion of the effectivesness of water resources;
- Planning and management of water distribution, quality, use, quotas and rationing.
- Establishment of an agricultural product insurance fund;
- Banks considering extending loan reimbursement deadlines in order to support to support vulnerable groups, especially farmers;
- Provision of a map detailing those areas at risk of drought, assessment of environmental resources (biodiversity) in areas coping with mid- and long-term drought (periods of 10 to 30 years) and provision of ecosystem sensitivity maps; and
- Support of non-governmental organizations in promoting public awareness.

Practices to alleviate the impact of drought

As a result of repeated drought, the government implemented an aid and rescue programme in 2003. The programme included leadership and guidance, public training on how to deal with natural disasters, the duties of various institutions during a crisis, the provision of a mass media map, financial resources and statutory support during natural disasters. The National Water Programme was prepared in 1999. The focus in Iran is on drought prevention and alleviation; emergency interventions were conducted and aid measures include provision of agricultural inputs, small- and medium-sized funds, price caps, food subsidies and provision of forage.

The Aid and Rescue Programme 2003 was approved as part of the third five-year development plan. The Natural Disaster Task Force was established in 1996 by the Ministry of the Interior and it provides a range of assistance covering all types of disaster. The programme has five sections covering an insurance strategy and financial and logistic support for the

management of natural disasters. The programme includes the terms of and guidelines for crisis management through rescue and aid interventions, provision of training and public preparedness for special measures against disasters, definition of participatory approaches for various institutions, provision of a map created by the national broadcasting service and other media and operational measures, financial resources and logistic support.

The government provided in-water pumps and water purification and supplied food and forage. A water police service was established to supervise water consumption and prevent loss of scarce resources. Also, parliament instructed national banks to extend the deadline of loan reimbursement for another two years. The most important issue in drought risk management is the agricultural product insurance fund. Product insurance started in 2005.

Need for drought management knowledge and skills

Comprehensive knowledge of watershed management needs to be developed. Relevant organizations must be coordinated at both the national and provincial level. Farmers and ranchers need to be made aware of the techniques and technologies needed to practise sustainable agriculture. The success or failure of various strategies and plans for water distribution, flood water management, construction of artificial feeding pools, mitigation of evaporation and sustainable agriculture in the farmlands of each province or area must be analysed and the resultant lessons shared. There is a need for proper technology, management measures and technical expertise within the national strategy framework for drought preparedness.

The Agricultural Research and Training Organization has 24 research centres and is capable of active involvement in the implementation of long-term research programmes exploring drought management. The Ministry of Energy provides a significant number of training workshops on water use and drought management efficiency via its applied research centres. The application of local competence to systems supporting sustainable use of farmland shall be promoted by the government in its drought preparedness strategies. Also, the qanat water network system is a proper method for accessing underground water resources for irrigation and the supply of potable water.

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Mauritania[1, 2]

Mauritania is one of the Sahelian countries most affected by the drought of 1968. The ensuing desertification has had a much greater negative effect than either climate change or human activity. In fact, desertification has had a direct impact on an already fragile environment; it has caused environmental degradation and the progressive impoverishment of the rural population. Desertification has:

- Negatively affected agricultural productivity;
- Challenged food security and the living standards of the rural population;
- Induced a huge movement of people from rural to urban areas;
- Made supplying water to meet the needs of people and livestock difficult; and
- Generated significant economic losses.

Given the scale of the phenomenon, and like many other countries affected by drought and desertification, Mauritania has expressed a strong political will to fight against this scourge. It is within this context that both the Club of Sahel and the Permanent Inter-State Committee to Fight against Drought in the Sahel (CILSS) were created.

In 1980, the CILSS developed a strategy to fight against drought in the Sahel; its two main objectives were food self-sufficiency and ecological balance. However, the complexity of the problem has meant that this strategy has not produced the expected results. Following this failure, the government of Mauritania chose to integrate the fight against drought and desertification within a broader process of sustainable development that included technical, socio-economic, legal and institutional factors. Like most countries in the Sahel region, Mauritania experienced a rainfall deficit in 2011, one of the most significant deficits of the decade. In comparison to the period between 1971 and 2000, which was considered normal, 60 per cent of observation stations noted a severe deficiency of water; indeed, the distribution of rainfall in 2011 was similar to that in 2002, which is classified as a drought year. At the end of September 2011, according to WFP more than a million people in Mauritania did not have enough food or water.

Poor families, the elderly and children were among the most affected; more than 110,000 children under the age of five suffered acute malnutrition. The decrease in grazing signifi-

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cantly affected livestock, which was the main source of income for the majority of the rural population. In fact, breeders in some regions anticipated the drought and sold off their animals in advance. Heavy economic losses worsened the food situation of small farmers.

Drought monitoring and early warning systems

In recent years Mauritania has experienced considerable economic losses related to atmospheric and oceanic recurring phenomena. These losses prompted the government to create in 2006 the National Office of Meteorology (ONM), responsible for monitoring weather conditions and planning for drought. The ONM brings together all existing weather services, with the exception of the hydrology service that remains within the auspices of the Ministry of Agriculture at present. The mission of the ONM is to contribute to the safety of people and property by providing weather reports, warnings regarding adverse events such as drought and locust invasions, and climate data. .

Drought monitoring in Mauritania is carred by several institutions, including the ONM, the Ministry of Agriculture, the Office of Food Safety (CSA) and the Ministry of the Environment and Sustainable Development (MEDD). At the national level, the ONM develops and distributes seasonal climate forecasts for Mauritania each year in collaboration with ACMAD, AGHRYMET and global centres specializing in the field; this forecast predicts droughts and the nature of the rainy season (wet–normal–dry) during the period from July to September. Monitoring drought and managing its effects are the responsibility of the Ministry of Agriculture and MEDD.

To better monitor and evaluate seasonal forecasts, the ONM utilizes a meteorological observation network, including the Météosat Seconde Génération station, to share satellite images, observation data and the results of forecasting models.

The station was completed in 2012 by the acquisition of, allowing the ONM and the Directorate of Planning of the Ministry of Agriculture to monitor water points and the development of vegetation throughout the whole country. These stations allow the ONM to assess seasonal cumulative rainfall and other parameters and to develop daily, decadal weather reports and alert notifications to warn of drought.

Meteorological observation system in Mauritania

Meteorological observation began in Mauritania in 1905 with the arrival of the French. A network consisting of 18 synoptic stations, including four marine observation stations, and over 600 rainfall stations distributed throughout the country allows continual observation of the weather and climate. However, this network is still far from meeting the observation needs of Mauritania. All meteorological parameters such as temperature, winds, evaporation, pressure, isolation and precipitation are measured, exchanged within the global meteorological community and archived at the ONM.

Mauritania has hydrological observation stations at Rosso, Kaédi Selibaby and Foum Gleita Lekseiba. Dams and rivers are thus monitored at the national level, enabling the Ministry of Agriculture to take appropriate action in response to lack of water reserves.

Emergency relief and drought response

The government of Mauritania and humanitarian organizations are conducting reconnaissance missions at various sites after each drought to ascertain the extent of the damage. The Mauritanian Red Crescent, International Federation of the Red Cross and World Food Programme are committed to building resilience within affected families. These organizations have adopted a two-pronged approach to drought: to meet the immediate challenge of feeding the hungry and to simultaneously work with communities to reduce their vulnerability to new drought events. The first prong provides emergency assistance, for example to malnourished children. The second prong provides ongoing assistance in the form of activities that could prevent other children and families experiencing such crisis situations. During droughts, the efforts of the government, Red Cross and WFP focus on food distribution, 'money against work' programme screening and identification of malnourished children. Long-term projects have been designed with sustainability in mind, thus technical advice is provided, dozens of women's cooperatives distribute seeds, wells are restored and equipped with solar panels to facilitate the collection of water and goats are distributed to hundreds of families with children suffering from severe malnutrition. Food insecurity is a recurring problem in Mauritania, which is why long-term solutions, rather than short-term crisis measures, must be developed to ensure that communities will be able to cope as each drought occurs. The selection of target groups for attention is based on family size, permanent residency status and their involvement in their communities. Women are particularly targeted because of their involvement in productive activities.

Practices to alleviate the impact of drought

To minimize the impact of drought, the Livestock and Food Security section of the Ministry of Agriculture is applying the following strategies:

- Distributing and disseminating seeds;
- Encouraging crop diversification (intercropping);
- Encouraging the use of organic manure;
- Advising on the use of drought-resistant crop varieties;
- Focusing on farming techniques that promote economical use of soil water; and
- Providing cattle feed.

If the cumulative rainfall and other indicators such as agricultural production, household access to essential goods and pasture conditions confirm that the year is a drought year, the government of Mauritania launches an emergency plan called 'Hope' at a cost of US$157 million. This plan is designed to mitigate the effects of drought on people and livestock by rescuing of livestock and ensuring the availability of essential commodities for the needy.

'Hope' provides human alimentation by:

- Supporting low-income rural households practising sedentary farming by checking the availability of food and animal feed at subsidized prices;
- Distributing free food to households with no income that are severely affected by drought; and
- Supporting the purchasing power of low-income households in rural, urban and peri-urban areas.

In terms of livestock, 'Hope' offers:

- Animal feed;
- Vaccinations and veterinary care;
- Pastoral hydraulic; and
- A credit component to breeding.

Need for drought management knowledge and skills

Given the difficult agro-climatic and environmental conditions, Mauritania is one of the world's most vulnerable regions. As a result, those people and organizations responsible for monitoring and management of drought need to strengthen capacity in the following areas:

- Developing and using seasonal climate forecasting;
- Gaining the skills needed to communicate the results of seasonal climate forecasts to rural users;
- Training on techniques for estimating rainfall, combining satellite data and data provided by observation on the ground;
- Providing information on livelihood diversification, in particular the development of dry season crops;
- Training on how to monitor crop conditions and forecasting returns
- Coordinating all systems in the case of drought;
- Gaining knowledge on the technical mastery of water;
- Integrating weather and climate parameters in decision making;
- Strengthening capacity for assessing the impacts of drought;
- Analysing vulnerability/resilience to drought; and
- Integrating drought risk management in national development.

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Office National de la Météorologie Nouakchott - Mauritanie

Morocco[1]

Background

Morocco has been experiencing more frequent drought events over the last two decades. Drought frequencies have risen from one event every 10 years at the beginning of the twentieth century to five or six events every 10 years at the beginning of the twenty-first century (Agoumi, 2003). Review of the literature on drought in Morocco also indicates that drought occurred increasingly regularly during the twentieth century (Mhirit et al., 2011). Also, many regions in Morocco (namely, Oujda, Taza, Kenitra, Rabat and Meknès) became more arid (according to the aridity index of De Martonne) between 1961 and 2008, (Driouech, 2009). Table 1 lists some of the most significant drought events of the last two decades. It can be observed that drought has considerable negative effects on the economy and population of Morocco in terms of loss of crop production, reduction in GDP and loss to livelihood (Figure 1). It also demonstrates that drought is a major obstacle to agriculture and food security in the country. With several indications suggesting an increased frequency in drought events in Morocco, the average annual impact might become even greater in the future. It is, therefore, crucial that policy makers take heed of the severe implications of drought, especially for the most vulnerable in society, such as resource-poor, small-scale farmers and poor urban households.

Table 1: Socio-economic impacts of recent droughts in Morocco

DROUGHT EVENT	REMARKS
1994/95	Reduced incomes caused GDP to fall by 7.6 per cent in 1995; the production of cereals, for example, fell from 9.5 million tonnes in 1994 to 1.6 million tonnes in 1995
1996/97	Reduced incomes caused GDP to fall by 2.3 per cent in 1997
1998/99	Reduced incomes caused GDP to fall by 1.5 per cent in 1999
1999/00	275,000 people were affected; economic damage equalled US$900 million
2000/01	The country imported about 5 million tonnes of wheat in 2001 (compared to 2.4 million tonnes in normal years)
2004/05	The economic growth rate declined from 3.5 to 1.3 per cent in 2005
2006/07	700,000 people were affected; grain production reached only half of the level of a normal year

Source: RMSI (2012)

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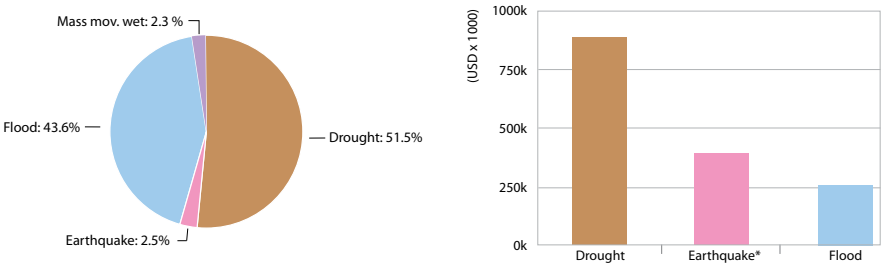

Figure 1: Percentage of the population affected by drought in Morocco (left) and estimated accumulated economic damage (right)

Source: EM-DAT, OFDA/CRED International Disaster Database, University Datholique De Louvain, Brussels, Belgium; data version: v11.08

Drought monitoring and early warning systems

Morocco's experience over the years has allowed the country to gradually adopt several drought monitoring and early warning systems. The list below describes briefly those systems and the relevant stakeholders.

DMN seasonal forecasting system

Since 1994 the Direction de la Météorologie Nationale (DMN) has explored both statistical and dynamical approaches to providing seasonal predictions of precipitation in Morocco through two major projects, Al Moubarak (based on statistical models) and El Masifa (based on both dynamical and statistical models). These studies have led to the adoption of a model that uses sea surface temperature (SST) anomalies in the tropical Pacific Ocean during October–December to make precipitation predictions for February–April in Morocco. The Arpège-Climat dynamical model from Météo-France has also been evaluated and is now running on the DMN supercomputer. The DMN's experience in seasonal forecasting is seen as a success story (Troccoli, 2008) and its results are disseminated to many users, particularly national authorities and agricultural and hydrological services. Furthermore, Morocco was chosen as a leading seasonal forecaster for the Regional Climate Centre of North Africa.

National system for crop monitoring and cereal yield prediction

A national system for monitoring agro-meteorological predictions regarding cereal crops, the CGMS-MOROCCO, has been operational since 2011 (Balaghi et al., 2012). It was initiated by the National Institute of Agronomic Research (INRA) as part of the E-AGRI project (Balagui, 2014). The CGMS-MOROCCO is managed by a national consortium and

the Directorate of Strategy and Statistics within the Ministry of Agriculture. The CGMS-MOROCCO is the first web-based monitoring system in Morocco. Crop monitoring and forecasting is an essential component of climate risk management in relation to agricultureand the CGMS-MAROC allows instant prediction of grain yields two to three months before harvest. Forecasting the production of crops before harvest allows decision makers to be prepared in advance for eventual consequences of abnormal climate deviations, particularly those crucial to food security like cereals.

The SMAS (Système maghrébin d'alerte précoce à la sécheresse) project which aimed to establish a Maghreb-wide drought early warning system was coordinated by the OSS (Observatory of Sahara and Sahel) and implemented in Algeria, Morocco and Tunisia from 2006 to 2009 within the framework of the LIFE Pays Tiers programme, financed by the European Union. At the Moroccan level, the DMN, the CRTS (Royal Centre of Spatial Teledetection), Ministry of Agriculture and HCEFLCD (High Commission for Water and Forests and the Fight against Desertification) were involved in the project. Each institution contributed by producing an ensemble of drought indicators, depending on their capacity. These indicators were compiled in drought early warning bulletins that were produced on a monthly basis from November to April 2008 and 2009 and were available on the CRTS website.

Vulnerability assessment

Morocco's economy is vulnerable to water scarcity. For example, its economy expanded by only 2.4 per cent in 2012, dragged down by the drought-weakened agricultural sector, which was much lower than the 7 per cent growth promised by the government. Agriculture is the most vulnerable sector in the economy. Indeed, only 15 per cent of the land in Morocco is irrigated; 85 per cent is rain-fed. Morocco's 1.4 million hectares of irrigated crops consume, on average, 85 per cent of available water resources (60–70 per cent in a dry year), while 12 and 3 per cent is used for public water supply and industry, respectively. The agricultural sector in Morocco accounts for 15 per cent of GDP and 40 per cent of all employment; 70 per cent of farmers own no more than 2.1 hectares of land and struggle with frequent drought in the absence of any appropriate protection mechanisms.

In Morocco, food security is based on cereal production which is sensitive to climatic risks. Domestic production of cereals is highly exposed to climate risk as it is mainly localized in the arid and semi-arid areas of the country, characterized by limited soil and water resources. Cereal imports had been consistent since 1980, representing nearly half

(48.7 per cent) of cereal production and most imported food products and the associated import costs. Annual cereal imports amounted to 2.6 million tonnes on average for the period 1980/81 to 2010/11, most of it composed of soft wheat (77 per cent), followed by durum wheat (12 per cent) and barley (11 per cent). Since the 1990s cereal imports have always been necessary,, fluctuating in volume over time and ranging from 10 per cent of average cereal production (during the 1994/995 season) following the good harvest of 1993/94 to 244 per cent during 2000/01 following the dry season of 1999/2000. However, cereals are imported even during record seasons in terms of production, such as during 2008/09 (10.2 million tonnes); indeed, a significant quantity was imported during the next season (2.56 million tonnes), that is, 25 per cent of total cereal production in 2008/09.

Emergency relief and drought response

Morocco has longstanding experience in the development and implementation of programmes to alleviate the impacts of drought. These programmes are based on interventions aimed at:

- Securing safe drinking water for rural populations in particular;
- Reserving livestock through feed distribution;
- Implementing income and job-creating activities (maintenance of rural roads and irrigation infrastructures);
- Conserving forests and natural resources; and
- Modifying weather using artificial means.

Practices to alleviate the impact of drought

In 1995, Morocco established the water law, which emphaszes integrated water resource management through more efficient water use, resource allocation practices and the protection of water quality. In 2001, Morocco created a National Drought Observatory (NDO), and it is now adopting an insurance approach to cereal production (Ouassou et al., 2005).

Preparation for drought and water scarcity situations is evident in both supply and demand side measures. Supply side measures include:

- Maximizing storage of rainwater (more than 140 dams);
- Using marginal resources (groundwater);
- Recharging aquifers;

- Improving the efficiency of water distribution networks;
- Carrying out water transfers;
- Desalinating; and
- Reusing waste water.

Demand side management measures include:

- Metering water;
- Making water rationing mandatory;
- Restrictions on municipal use of water;
- Operating water markets (tariffs) and full cost recovery;
- Running water-saving campaigns to encourage voluntary action;
- Running awareness campaigns to minimize the damage wrought by drought;
- Increasing the regulation capacity for irrigation purposes; and
- Increasing the regulation capacity for urban supply.

Strategies to reduce risk in agriculture fall into three categories: (1) in irrigated agriculture, save water by minimizing losses and improving water use efficiency; (2) in pasture and forest areas, make use of evaporated water by developing pasture and fruit tree ecosystems; (3) in rain-fed areas, increase productivity by using dry farming techniques, which consist of improving water harvest, storage and use at farm and plot levels (Balaghi et al., 2007).

Need for drought management knowledge and skills

In Morocco, as in many developing countries, there are gaps in the management of drought and water scarcity. Many organizations are involved in drought management.

The main advisory authorities are the:

- Economic and Social Council (Committee on Environmental Affairs and Regional Development);
- Superior Council for Water and Climate;
- Council for Agricultural Development;
- Permanent Inter-Ministerial Council for Rural Development; and
- National Drought Observatory.

The executive administration authorities are the:

- Ministry of Water (National Meteorological Office; Directorate General of Hydraulics, Water Basin Agencies, National Office of Water Drinking and Electricity);
- Ministry of Agriculture and Sea Fishing (Regional Offices for Agricultural Development);
- High Commissariat of Water, Forest and Fight against Desertification; and
- Ministry of Interior (Directorate General of Local Collectivities, Directorate of Utilities and Services Licensed); Ministry of Finance; Ministry of Health; Ministry of General Affairs.

However, an independent organization or unit responsible for the management of drought needs to be established. This unit should be responsible for coordination between the various departments and agencies. In fact, in every organization there is a unit that is responsible for drought issues in relation to its own interests. A standard and complementary drought management approach is needed. It should begin by strengthening the sharing of information on drought and establishing a global early warning system. Mitigation plans for emergencies should be updated regularly.

In principle, the ability to provide early warning forecasts of drought could be a powerful tool for avoiding many of the economic costs associated with the misallocation of resources that arise because farmers, herders and other decision makers have to commit resources each year before key rainfall outcomes are known (Solh and Saxena, 2011).

Insofar as drought protection is concerned, a concerted national strategy should be initiated by the drought management plans at the level of all river basins, aimed at:

a. Characterization of droughts: identification and proposal of monitoring indicators;
b. Implementation of structural measures: diversification of sources of water supply;
c. Development of contingency plans; and
d. Development of financial mechanisms such as insurance and funds for natural disasters. (Alaoui, 2013).

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State of Palestine[1]

Background

The seasons of rainfall in Palestine, especially the years between 2003–2010, are characterized by below average rainfall and many agricultural drought episodes. The worst two seasons were 2007/08 and 2010/11 (see Figure 1). In the 2007/08 season, annual average rainfall for the northern and southern areas of the West Bank represented 64 and 55 per cent of historical means, respectively (Ministry of Agriculture, 2009). The 2010/11 rainy season registered just 73 per cent of the average annual rainfall in the West Bank and only 66 per cent of the average rainfall in the Gaza Strip (Ministry of Agriculture, 2011b). A decreased amount of rainfall means a decreased amount of groundwater recharge, and hence, an increased water shortage. The increase in water shortage will result in a competition for water between various economic sectors, that is, domestic, agricultural and industrial. Not only will water availability be affected, but so too will the affordability and quality of water (ARIJ, 2011).

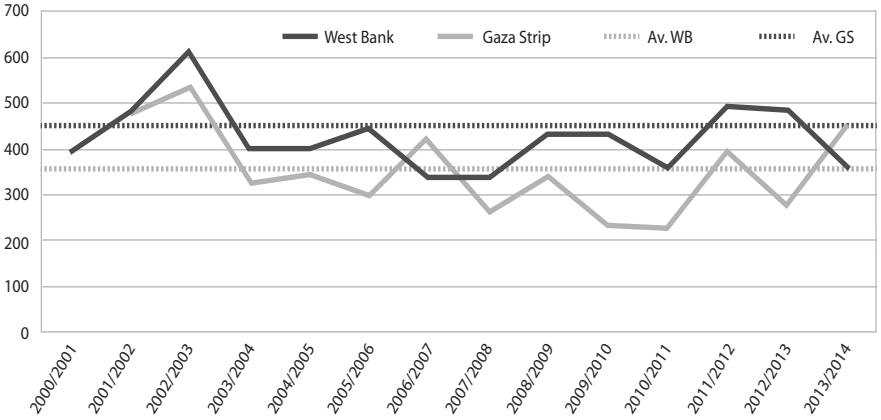

Figure 1: Annual average rainfall (in mm) for the West Bank and Gaza Strip for the 2000–2014 rainy seasons

The 2013/14 rainy season was unusual, demonstrating variation in the amount and distribution of rainfall. Rain-fed horticulture was affected as a result. With annual rainfall estimated to be 85 and 127 per cent of annual historical average rainfall for the West Bank and Gaza Strip, respectively (Figure 1), Palestine and other countries in the region have been exposed to mid-season agricultural drought. In the West Bank, around 50 per cent of total rainfall fell in a five-day period in mid-December 2014, followed by 85

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days of drought and dry spells period (Ministry of Agriculture, 2014). In the Gaza Strip, average annual rainfall was above the annual historical average level (127 per cent); however, 80 per cent of that was in December 2014, followed by more than 80 days without rain (ibid).

Extreme weather events such as droughts have noticeably increased on the southern and eastern slopes of the West Bank. Eighty-seven per cent of the cultivated land is dedicated to rain-fed agriculture and 33 per cent of the entire land mass is used as pastureland for grazing (ARIJ, 2011). About 35 per cent of the land area of the West Bank is arid or hyper-arid. Consequently, drought increases the vulnerability of rural communities (rain-fed farmers and livestock herders) whose coping strategies are already exhausted as a result of the deterioration of the country's economic situation, high food prices and the closures regime that has existed since the second Intifada. Drought is expected to become more frequent, more intense and less predictable as a consequence of climate change (ibid).

According to the Palestinian Central Bureau of Statistics, an obvious rise in temperature occurred during the twentieth century (ibid). The year 2010 was the warmest in 125 years (Ministry of Transport and PMA, 2011). It is noted that there is no information on Gaza because of the damage to the meteorological stations caused by the Israeli occupation in 2007 (ibid).

Drought monitoring and early warning systems

It is agreed that planning and management of drought in Palestine, as in other countries, needs collaborative effort from all stakeholders concerned with issues related to various types of drought, not only on the political level but on the technical and socio-economic levels too. The policies of closure, confiscation and ghetto creation have decreased the ability of Palestinians to manage natural resources and to build the infrastructure needed to establish early drought warning systems. The current situation is characterized by (1) a limited number of meteorological stations, (2) inefficient distribution of low technology stations and rain gauges in the semi-coastal and highland agro-ecological zones, (3) an absence of meteorological stations on the eastern slope and Jordan valley zones, and (4) a lack of data and information for historical records. Installing a network of meteorological stations is a priority for the Palestinian authorities, especially for the eastern slope and Jordan valley where condensed irrigated agriculture is practised (Abdo, 2007).

The existing database related to climate conditions and water resources is fragmented and limited and does not support the comprehensive data sharing and analysis neces-

sary for an effective monitoring and early warning system. Developing a data collection tool to facilitate data gathering and archiving, such as a national climate databank, is a first step toward creating an effective early warning system (Ministry of Agriculture, 2011a). Baseline surveys have been conducted by the Ministry of Agriculture to explore the type (model), location, technology and operators of meteorological stations in the West Bank to ascertain what is needed to set up such stations to inform an early warning system (ibid).

A methodology to quantify the impacts of drought across all relevant sectors needs to be developed. The methodology should cover all levels and types of drought impact. This step would provide much needed support to decision makers in developing mitigation and adaptation plans. It is worth mentioning that the Ministry of Agriculture has started installing a drought early warning system in relation to agricultural drought ; however, some technical and financial limitations have constrained its full operation (ibid).

Vulnerability assessment

Compared to other economic sectors, and indeed to the situation in neighbouring countries, the agricultural sector in Palestine is very vulnerable to drought. Rain-fed agriculture dominates in Palestinian territories. Drought has a worse impact on this form of agriculture than on irrigated agriculture, especially in arid and semi-arid areas. The diminished water supply during drought periods requires that farmers are capable of adopting efficient water use practices. Agricultural drought in Palestine seriously aggravates the socio-economic situation in rural areas. Thus, the current and possible drastic reduction in farmers' incomes should be highlighted and response and mitigation measures should include modified insurance policies.

The most vulnerable communities are the Bedouins who rely on spring water during the winter time and completely on water trucking during the summer time. Networks and filling points are often far away and transport costs weigh heavily on their weak economic condition. Most of the very vulnerable people rely on herding and they are exposed to many Israeli-imposed restrictions regarding movement and access to water sources. Israeli restrictions have meant a lack of access to water cisterns and the Bedouin thus do not have a safe quantity of water during the summer season; they are compelled to depend on frequent deliveries by small (3.7 mc) tankers.

The Israeli authorities apply restrictive planning and zoning regimes to Palestinian communities living in Area C, making it extremely difficult to carry out legal constructions, including for very basic infrastructural projects. These communities should be the main

target of future interventions for domestic water or for animal watering (GVC and Unicef, 2010). Agriculture is diffused in the area categorized as Area C, and it depends on an old irrigation system that is poorly managed and maintained because of limited funds and the impediment to improving infrastructure created by Israeli policies in the Palestinian Jordan valley. Farmers own few dunums and the quantity of irrigated water is not enough to optimize productivity.

The upgrading of storage facilities should be a solution to emergency preparedness for the frequent drought events that characterize the summer season. Intervention in improving water access should alleviate the poor condition of those communities already suffering as a result of limited access to grazing lands for herders and limited access to markets for selling agricultural products (ibid).

Emergency relief and drought response

It is observed that weak coordination and cooperation among all stakeholders made the information on types and forms of emergency aid limited and not clear. It is estimated that the 2007/08 drought, in which total rainfall was only 67 per cent of the annual average for the West Bank, resulted in direct losses in rain-fed horticultural production equalling US$113.5 million (farm gate prices) and an adverse effect on more than 200,000 small ruminants (Ministry of Agriculture, 2008). Examples of these losses are shown in Table 1. In addition to agriculture, food security, health and shelter were also affected. Humanitarian support needed included fodder, shelter for lambs and veterinary kits in the agriculture sector, tankered water and new filling points in the water sector, food aid and better nutritional security in the food security sector, and equipment, mobile clinics and training in the primary health care sector. According to a UN–OCHA report (2008), an estimated US$44 million was needed to provide such support; in fact, only US$3.6 million was spent. Many international organizations, such as ACF, CISP, CARE, ACTED and Oxfam, covered different geographic areas and distributed water, seeds and fodder, according to the agreed criteria. Thus 25/litres/person/day and 9/litres/animal/day was distributed as well as 1 kilo of fodder/animal/day for a minimum of 60 days.

Table 1: Yield reduction and losses in production during the 2007/08 season

CROP	YIELD REDUCTION (%)	LOSSES (US$ MILLION)
Wheat	40	6.9
Fodder crops	35	4.5
Fruit	35	10.6
Olives	40	60.7
Grapes	35	14.1

Source: Ministry of Agriculture (2008)

In 2009, a new body was formed – the Water Scarcity Task Force, WSTF – to improve coordination among government institutions, local and foreign NGOs and international and United Nation bodies (Figure 2). After the 2010/11 drought, the WSTF actively supervised many water scarcity assessments and coordinated and monitored the distribution of many humanitarian and emergency interventions in Palestine (WSTF, 2011). The criteria for support was modified and updated as follows.

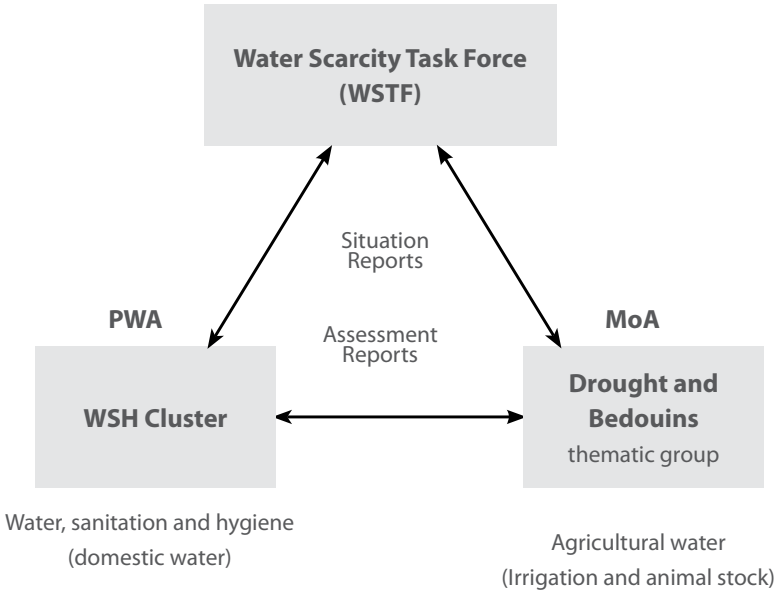

Figure 2: Water Scarcity Task Force

Source: Abdo (2012)

The criteria for selection of beneficiaries are:

1. Water and sanitation

- Consumption- – Humanitarian scarcity baseline: less than 30 litres per capita per day (rating = high <30, medium 30–60, low >60);
- Affordability – Price of safe water (household, including price of transport);
- Humanitarian scarcity baseline – more than US$5.4 (rating (US$) = high >5.4, medium 2.7–5.4, low >2.7). This criterion implies distance to nearest safe water source, taking into account the price of water transport; ideally this parameter should be cross-checked with household income and the percentage of that income spent on water;
- Storage capacity for water (at household level); and
- Quality.

Humanitarian scarcity baseline – not fully secure or safe source

2. Agriculture

- Animal water consumption;
- Dependency;
- Indicator – dependency on herding;
- Measurement units – percentage of overall household income;
- Humanitarian scarcity baseline – more than 50 per cent;
- (Rating = high >50%, medium 25–50, low <25);
- (c) Viability;
- Indicator – number of months that herders rely on purchased fodder; and
- Measurement units – in number of months.

Humanitarian scarcity baseline – more than 6
(rating = high >6, medium 4–6, low <4)

Practices to alleviate the impact of drought

In the agricultural sector, the following strategies and priorities must be addressed (Ministry of Agriculture, 2013).

Institutional and legal environment:

- Implement and activate the endorsed Law of Farmers Compensation Fund; and
- Develop an Agricultural insurance service.

Safeguarding:

- Improve the quality and accessibility of data;
- Establish an early warning and forecasting system for agricultural drought (many components of an early warning system are in place within the Ministry of Agriculture structure);
- Minimize the impact of natural hazards such as drought, flood, frost and wind storms by improving extension services;
- Tackle environmental conditions such as land degradation, desertification and water scarcity;
- Increase variability and deal with uncertainty in food production;
- Control volatility in agricultural commodity markets and soaring food prices; and
- Build the technical and institutional capacities of the department within the Ministry of Agriculture dedicated to climate change and drought monitoring.

Link the early warning system to food security information systems; develop tools to enable the provision of early warning estimates, including pictorial evaluation tool to forecast levels harvest; the Ministry of Agriculture should learn lessons from current project-based monitoring activities and up-scale these to the national level

- Prepare to respond more predictably to climatic uncertainty;
- Enhance innovative and indigenous practices (climate smart sustainable agriculture, for example); and
- Build resilience and improve adaptive capacity of farmers.

Measures to alleviate drought and the impact of water scarcity include:

- Develop groundwater supply (drilling of new wells and restoration of springs and wells;
- Harvest water by installing water collection ponds for irrigation and constructing small scale dams in Fara'a and Auja wadis;
- Control groundwater abstraction from upper and lower aquifers so that it is within the sustainable yield limits (Froukh, 2010);
- Improve groundwater recharge through utilization of generated run-off (ibid);
- Institute demand management to instigate a water loss reduction programme, a communication strategy, a community education campaign, a change in crop patterns, restrictions on water usage that balance demand with water supply and the saving of fresh water by the use of non-conventional water;
- Use alternative approaches such as purchasing water, desalinating, reusing of treated wastewater and reallocating water; and
- Conduct public awareness campaigns to inform people of the need to control demand for water (ibid).

Need for drought management knowledge and skills

There is no doubt that the political (situation, willingness and commitment) and technical contexts in Palestine are the main reasons for the absence of comprehensive and proactive drought risk reduction strategies. The Palestinian Authority prioritised the foundation of institutional, legal and legislative frameworks and the formulation of policies and strategies to improve the water supply. In addition to constraints imposed by the Israeli occupation forces that distort performance and hinder development planning, the lack of scientific and technical knowledge bases is another constraint to achieving comprehensive disaster risk reduction, starting with hazard and risk assessments and vulnerability analysis and ending with preparedness, response and recovery processes. Institutional reform, good governance, participatory approaches and the strengthening of technical and human capacity requires substantial financial resources. Lack of financial resources is considered to be one of the most significant difficulties in updating and formulating policies and strategies. Reform and good governance require a clear commitment on the part of policyand decision makers; political complications hinder such approaches.

In conclusion, the interaction between political and technical difficulties is worsening the suffering of Palestinian communities, especially those located in Area C. Developing

a comprehensive drought strategy and national plan is becoming a priority. However, this cannot be achieved without building capacity at the organizational, methodological and operational levels. Monitoring and early warning systems, carrying out risk and vulnerability assessments for each economic sector, and formulating appropriate mitigation, actions and responses to drought are the core constitutes of such a plan. Preparedness leads to a greater institutional capacity to cope with drought events through the improvement of information flow and coordination between and within different levels of government. It is also about increasing the capacity of individuals, communities, and governments to cope with drought events. Drought preparedness, coupled with appropriate mitigation actions and public awareness and training programmes, can reduce and, in some cases, eliminate many of the impacts associated with drought.

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Sudan[1, 2, 3]

Background

During much of the twentieth century Sudan experienced major droughts. The most devastating droughts occurred in 1913, 1940 and 1954 and covered many parts of the country. In 1913 and 1940, about 1.5 million people were affected. In 1984, 4.5 million people went hungry. Some of the affected people became relief-recipients and thus less work-orientated. Different tribes responded differently to recurring drought.

Insufficient and highly variable annual precipitation is a defining feature of the climate of most of Sudan. Analysis of rainfall between 1961 and 1990 in northern and southern Kordofan revealed that annual precipitation ranged from 350–850 mm, within the average annual variation of 65 per cent in the northern parts of Northern Kordofan and 15 per cent in the southern parts of Southern Kordofan. Annual variability and relative scarcity of rainfall in the north of Sudan in particular have a significant effect of agriculture and food security, and are strongly linked to displacement and related conflicts. Drought events also change the ecosystem, as dry spells kill otherwise long-lived trees and result in a general reduction of the vegetation cover, leaving land more vulnerable to overgrazing and erosion.

Together with other countries in the Sahel belt, Sudan has suffered a number of long and devastating droughts in recent decades. All regions have been affected, but the worst hit have been Northern Kordofan state, the North states, Northern and Western Darfur and the Red Sea and White Nile states.

The most severe drought occurred in 1980–1984, resulting in localized famine. Localized and less severe droughts (affecting between one and five states) were also recorded in 1967–1973, 1987, 1989, 1991, 1993 and 2000. Isolated drought years generally have little permanent effect on the environment. In the case of central Sudan, however, the 18 recorded years of drought within the last half century are certain to have had a major influence on the vegetation profile and soil conditions seen in 2006 (UNEP, 2007).

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Drought monitoring and early warning systems

The early warning system used is a climate outlook seasonal forecasts), in regional co-operation with the Intergovernmental Authority on Development (IGAD). The Sudan climate change study conducted in 2003 provides a solid technical basis for discussion. Moreover, a range of very recent regional assessments of the potential impacts of climate change indicate good agreement with earlier work. Following is a concise description of this study to set the context for the findings of the United Nations Environment Programme (UNEP) assessment (Nur, 2007). The 2003 study selected Northern and Southern Kordofan for detailed analysis; all the results presented thus relate to these areas only. A baseline climate was determined using rainfall and temperature data from 1961 to 1990. A rang of global warming scenarios were then modelled based on changes in temperature and rainfall from the baseline to 2030–2060.

The climate model results indicate a 0.5–1.5 C rise in average annual temperature and an approximate 5 per cent decline in rainfall, though results varied across the study area. These findings were then used to project potential crop yields for sorghum, millet and gum arabic. The final result was alarming: the crop models show a major and potentially disastrous decline in crop production for Northern Kordofan and smaller but nonetheless significant declines farther south (UNEP, 2008).

Vulnerability assessment

Vulnerability to drought is partly related to social and developmental factors such as the tendency to maximize herd size rather than herd quality, and the lack of source water resources such as deep boreholes that can be relied upon during short-term drought.

This report focused on camps for internally displaced people because this population is placing new demands on the– beyond those that history has proven they can support. However, humanitarian imperatives demand that water security for host communities is also addressed. Water demand at camps is a more complex issue than that described in reports on emergency responses to drought because the arid environment means that people are used to using water sparingly and the water demands associated with livelihoods are over and above the minimum supplies provided in an emergency context.

Whilst drought preparedness at camps is rightly part of Darfur's emergency response, it should not be seen in isolation from lager scale water resource management activities, and the development of drought preparedness strategies for these communities should be seen as supporting agricultural and environmental recovery. This work will need to

be matched by efforts on the part of government to address sufficient water supply for people to maintain their livelihoods together with recovery planning. This needs to be part of a wider water resource strategy supporting areas of projected drought and for rural populations including nomadic groups. These issues will be addressed using the integrated water resources management (IWRM) process.

To analyse water use to maintain livelihoods in order to better understand water demand at displaced persons camps, assessments of water use are needed at the household level. In addition to the potentially vulnerability of these camps, other areas also need a strategy for managing water resourcest. The following should be prioritized:

- Large towns on Basement Complex geology [AQ – please explain what this means] (Nyala, EL Fasher);
- UNAMID camps;
- Rural populations in arid areas (such as camps in Northern Darfur and the Northern part of West Darfur: Umm Baru, Kondobe, Ed Daein, Morni, Geniena, Gereida); and
- Rural populations in less arid areas.

Emergency relief and drought response

Emergency drought relief provides food but no cash. It does offer 'cash for work' on a limited scale, however, which helps to address nutrition gaps and water shortages. Smallholder farmers and their animals use traditional approaches to manage water scarcity:

- Eating the fruit from local plants such as mukhied (Basica senegalensis), using an abuasabi millet mixture to make soup, using godiam fruit (Grewia mallis Juss) (Hassan, 2008);
- Using water stored in the huge Tabaldi trees (Adansonia digitata Linn) and collecting water run-off from small lakes (Fula);
- Migrating to humid areas to ensure the survival of their livestock;
- Using mixed crop and livestock systems that integrate the use of drought-tolerant crops and manure, which can help increase agricultural productivity while at the same time diversifying risks across different products;
- Employing crop rotation systems which consider both food and fodder crops, which can reduce exposure to climate threats while also improving family nutrition; and
- Using combined agro-forestry systems and communal ponds, which can im-

prove the quality of soil, increase the availability of water during dry periods and provide additional income.

According to yield records for the periods 1953/54 and 2004/05, the impact of drought on crop production and livestock decreased for both food and cash crops. The yield for mechanized rain-fed crops in 1983/84 fell to 12 kg/fed.

Degradation of grazing resources is a major problem in terms of livestock, as are overgrazing and the expansion of large-scale mechanized farming on marginal grazing lands. A land satellite STM map for 1983/84 showed that the semi-desert (455,000 km2) and some parts of the northern fringes of the low rainfall woodland savannah were severely affected by drought and environmental degradation. A report noted that 177 million feddans (Arabic unit of area) of rangeland is considered a severely degraded area (Abdelrahman, 2008).

Practices to alleviate the impact of drought

The National Drought and Desertification Programs Coordinating Unit (NDDPCU) will provide a platform for IGAD Drought Disaster Resilience and Sustainability Initiative (IDDRSI) monitoring and evaluation system. Hopefully, this system will enable IGAD to identify the needs of member states in terms of drought management in the future.

Many practical programmes run by the government to mitigate the impacts of drought are informed by the National Adaptation Programme of Action (NAPA), funded by the United Nations Environment Programmes, including:

- Enhancing resilience to increasing rainfall variability through rangeland rehabilitation and water harvesting in the Butana area of Gedarif state;
- Reducing the vulnerability of communities in drought-prone areas of southern Darfur state through improved water-harvesting practices;
- Improving sustainable agricultural practices under increasing heat stress in the River Nile state; and
- Addressing environmental conservation and biodiversity restoration in northern Kordofan state as a coping mechanism for rangeland protection under conditions of increasing climate variability.

The Sudanese Society for Environmental Protection (SSEP), an NGO, carries out many activities designed to mitigate the effects of drought and desertification.

Need for drought management knowledge and skills

Increasing awareness of the impacts of drought and how to deal with them requiresa huge programme of on-the-job training for the government, NGOs, the private sector and community-based institutions. Policies should also be implemented to promote local university courses in nutrition, agriculture and business. Such broad training efforts will create the absorptive and implementation capacity for larger investments and a corps of paraprofessional extension workers could be created for agriculture, nutrition and health, residing in villages identified as awareness hotspots.

Other capacity development efforts might deal more with structural incentives that lead to poor performance. People concerned remain healthy and actively engaged in relevant work; policies aimed at human capacity development will have highly positive long-term effects. Investments in capacity building at the local level should cover the education, childhood nutrition and healthcare sectors in addition to agriculture and natural resource management. Across sectors, special attention should be given to the needs of children and women, with a sharp focus on gender equality.

Policies to build capacity should encourage the participation of communities in the planning, implementation and monitoring of anti-hunger programmes. Decentralization without attention to governance issues will fail if it merely establishes new local elites and does not liberate the skills and talents of ordinary people.

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Yemen[1,2]

Background

Yemen is an Asian country, 527,970 km^2, occupying the southwestern corner of the Arabian Peninsula. The climate of Yemen generally ranges from sub-humid to hyper-arid. About 90 per cent of the country has an arid to hyper-arid climate but Yemen's highlands have a generally mild temperate climate.

Two seasons of rainfall can be observed in Yemen: March–May and July–September. The coastal areas have an arid tropical climate with low and irregular precipitation that ranges between 50–300 mm annually. The highlands receive the greatest amount of rainfall, usually between 400–800 mm. Records report that the eastern desert plain receives less than 50 mm of rainfall per annum. Many definitions and classification are used in the relevant records and literature; however, as a considerable part of Yemen receives significant rainfall, the drought classification that most suits it is the meteorological drought. This type of drought is defined as departure of precipation from the norm over a particular period of time.

Yemen experiences a meteorological drought cycle every 10–15 years, each episode enduring for two to three years. However, the magnitude and impact of such drought episodes, for different reasons, are rarely documented or drawn to the attention of public and government authorities, which is in contrast to the attention drawn to the magnitude and impact of floods. The impact of drought directly hit rain-fed agriculture, which constitutes around 60 per cent of total cultivable land (47 per cent rain-fed, 17 per cent run-off and 3 per cent irrigated by check dams and small dams). This means that the impacts of drought affect almost 65 per cent of the population who are living in the hilly areas and valleys and depend mainly on rain-fed agriculture. In addition to agriculture and farmers, the impact of drought affects the ranges and Yemen's herders who possess 1.3 million head of livestock.

Drought monitoring and early warning systems

There are many government bodies that are interested in and monitoring hydro-climate data. However, none of these bodies has earmarked drought monitoring data. Nevertheless, information concerning drought monitoring could be inferred from the available data as a secondary data resource.

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The main authorities that operate agro-climate and hydro-climate monitoring stations in many governorates are the National Water Resources Authority (NWRA), which has 76 stations for producing climate, rainfall and surface running water data. And alson the Civil Aviation and Meteorological Authority (CAMA), which has 16 stations dealing with climate data. Agencies interested in agro-climate data include the Tiham Development Authority (TDA), which has 65 stations in three governorates. The Agricultural Research and Extension Authority (AREA) has three stations for producing climate data. In addition, there are other authorities that are mainly concerned with surface running and groundwater, including the National Water and Sewage Authority (NWSA), National Irrigation Programme (NIP) and Wadi Hadramout Agricultural Development Project (WHADP).

There are no records highlighting or monitoring soil state, physical or chemical characteristics with respect to the drought phenomenon in Yemen. The same could be said for socio-economics indicators. However, this could be the result of prejudice rather than negligence or lack of awareness. The main body that is supposed to form the hub of climate change information does not have stations covering all governorates. This situation has obliged the respective organizations to cooperate only at a minimum level, mainly depending on personal contact. Although networking is of the utmost importance in drought monitoring, it is hard to identify formal networking between the organizations working in this field or to envisage such a situation in the immediate future.

Capacity building is required at all levels and in all meteorological and agro-climate organizations; at the very least, technicians must be updated on recent developments in the field of drought management. This can only be achieved through regional and international workshops and conferences. However, the current budget deficit and regulations making participation in international travel difficult, very little help is expected from the government.

Vulnerability assessment

According to the drought definition applied by UNCCD, which considers drought a naturally-occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems, many sectors are directly or indirectly feeling the impact of drought (Anon, 2004).

In Yemen, the sector that will most directly be affected by drought is agriculture. More specifically, farmers who depend on rain-fed agriculture are the group most affected. The

situation is exacerbated if a drought occurs after the farmers have prepared their lands and invested their savings in the potential crop. As almost all those in rain-fed agricultural areas are subsistence farmers, the loss of one season's crop means that they will have to find alternative employment and may be forced to relocate. Livestock is also affected by drought as the animals are unable to find enough fodder or drinking water. Dairy and non-dairy production is reduced as a result, negatively affecting the already low income of subsistence farmers.

Groundwater, the main source of water for people in Yemen, is also affected by drought and the balance that exists between charging and discharging it is disturbed.

Honey bee farmers are also greatly affected by drought. Honey bee production provides a good return for more than 16,500 farmers. According to the Ministry of Agriculture and Irrigation, bees produces 2600 tonnes of honey. The Yemeni honey bee has an excellent reputation and the average price for one kilo of Yemeni honeyis almost US$100.

Drought will have an indirect effect on society, particularly women and children. During drought episodes, the journey undertaken by rural women to collect water is doubled or even quadrupled. Children in general, but specifically girls, will be forced to leave school to help their mothers collect water for household consumption. This situation will negatively affect government activities aimed at fighting illiteracy among rural people, especially women and girls, more than 65 per cent of whom are illiterate.

Finally, although local crop production provides a minute proportion of Yemen's food needs, any reduction in this amount will increase spending in foreign currencies and increase the food security gap.

Emergency relief and drought response

There are no documentedr cases of the government providing assistance during droughts. The government has not been exposed to the concept of responding to drought by offering emergency relief and no one expects generous assistance from it. Terrorist activity means that the government's financial budget is already strained by the need to care for displaced communities; indeed, some communities have taken shelter in government buildings such as schools. No food assistance has ever been provided by the government during floods, wars, drought or other disasters. However, local charities, NGOs and international organizations such as IRC, CARE, Oxfam and UN agencies were and still are the major providers of tents, shelters, health and education services.

The beneficiaries of such assistance are mainly women, children, the elderly and those who cannot find relatives to support them or relocate to safer places. No criteria is applied to selecting people to receive assistance; it is usually offered on a first-come-first-serve basis. It is difficult to estimate the cost of drought-related relief activities because no case study data exists; the same applies to evaluating the impact of drought. However, data related to Somalia or Ethiopia would be very good proxies for such.

Practices to alleviate the impact of drought

Historically Yemeni farmers have realized that their water resources should be well-managed to maximize their benefit and minimize their loss. The terrace system, canals and small dams are examples of rainfall harvesting and water conservation measures.

The government has taken steps to adopt a drought early warning system. Even though no real impacts have been felt thus far, it is nonetheless a move in the right direction. AREA, a government authority, persistently encourages its researchers to test and breed crop species that are fast growing, early maturing and drought resistant. Similar activities are carried out by agricultural faculties in highlighting drought and the better management of soil and water resources. The Ministry of Agriculture and Irrigation and the Ministry of Water andEnvironment work together in promoting the development of a modern irrigation system that will increase the efficiency of irrigated water and reduce consumption of irrigated water.

Almost no NGOs work to establish drought precautionary measures such as awareness raising or providing training sessions for technicians or farmers in rural areas. However, during crises, including drought, these NGOs are very active in raising funds and providing relief assistance to affected communities.

Need for drought management knowledge and skills

The first step in dealing with drought and reducing its impact is to understand the issue and learn from others who have experienced similar situations. A quick survey of those countries adversely affected by drought reveals that what they most lack is knowledge. Information about drought incidence, magnitude and cycles can be obtained by research and the exchange of information among different stakeholders. Yemen lacks a drought 'think tank'. The current institutions deal only with reporting and documenting the circumstances and impacts of drought episodes. Though such efforts are valuable they do not have a direct impact on resolving the problem of drought.

International organizations have a big role to play in harmonizing isolated regional activities and facilitating the exchange of information. At the country level, technicians and professionals require periodic training and development. Farmers and local rural communities should also be trained in issues related to drought management. Last, but not least, the different authorities dealing with the issue of drought should adopt a team-working approach in contrast to the current competitive approach. Better results will then be achieved and available resources will be used more efficiently.

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ANNEX: REGIONAL WORKSHOP PARTICIPANTS AND ORGANIZERS

Regional Workshop for Eastern and South African Countries

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Regional Workshop Near East and North African Countries

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WORKSHOP AGENDA

Day 1

08:30-09:00	Registration
09:00-13:00	**Session 1: Opening**
09:00-10:00	**Session 1a: Opening statements** • Opening statement • Welcoming statement • A roundtable introduction of participants and their expectations
10:00-10:30	**Session1b: Overview** Overview of the initiative, objectives and scope of the Workshop
10:30-11:00	Group Photograph/Coffee and tea break
11:00–18:00	**Session 2: Setting the scene and country reports**
11:00-12:30	**Session 2a: Keynote**
12:30-13:30	Lunch
13:30 -14:15	**Session 2b: Biodiversity and drought**
14:15- 16:00	**Session 2c: Country reports** Country reports on drought status/management strategies
16:00-16:30	Coffee and tea break
16:30-18:00	**Session 2c: Country reports (Cont.)**

Day 2

09:00-13:15 **Session 3: Drought Monitoring and Early Warning Systems**

09:00-10:00 **Session 3a: Thematic presentation**

- Introduction to drought monitoring and early warning systems
- Data requirements (meteorological, hydrological, etc.) for drought monitoring
- Identifying occurrence of/exposure to droughts (types, onset, intensity)
- Different drought indices and measurement methods
- Successful examples/ongoing initiatives

10:00-11:45 **Session 3b: Breakout groups**

- Group A: What are the current procedures/ challenges on Early warning systems?
- Group B: What are the meteorological and hydrological networks, data quality, sustainability needed?
- Group C: What mechanisms are in place for communicating and liaising drought monitoring and early warning information between national institutions?

11:45-12:15 Coffee and tea break

12:15 – 13:15 **Session 3c: Presentations of working group results and discussion**

13:15 14:15 Lunch

14:15-18:30 **Session 4: Vulnerability and Risk Assessment**

14:15-15:15 **Session 4a: Thematic Presentation:**

- Impacts of drought: Environmental, economic, societal considerations/ implications
- Significant secondary and tertiary impacts
- Successful examples/Ongoing initiatives targeting vulnerability and risk assessment

Day 2 cont'd

15:15–17:00	**Session 4b: Breakout groups:** • Group A: Who/What is most vulnerable to drought in your country • Group B: Provide the causes/reasons of vulnerability to drought in your country • Group C: What are the criteria you used for prioritizing vulnerability?
17:00-17:30	Coffee and tea break
17:30-18:30	**Session 4c: Presentations of working group results and discussion**

Day 3

09:00 -13:15 **Session 5: Drought preparedness, mitigation and response**

09:00–10:00 **Session 5a: Thematic Presentation**

- Drought preparedness
- Drought mitigation measures
- Integration of drought response and recovery in drought plan

10:00-11:45 **Session 5b: Breakout Groups**

Using the result of the impact and vulnerability assessment (in Session 4),
i. Develop risk managements measures,
ii. Include both medium- and long-term measures;
iii. Specify for each measure the responsible agency (ies)

- Group A: Water
- Group B: Agriculture
- Group C: Other sectors

11:45-12:15 Coffee and tea break

12:15 – 13:15 **Session 5c: Presentations of breakout group results and discussion**
(10 minutes per group and 30 minutes for discussion)

13:15 – 14:15 Lunch

14:15 – 18:30 **Session 6: Towards action plan - Developing national drought management policy**

14:15 – 15:00 **Session 6a: Thematic Presentation**

- Process for preparing national drought policies
- Institutional arrangements
- Challenges and remedial actions
- Successful case studies

Day 3 cont'd

15:00 – 16:45 Session 6b: Breakout groups

- Group A: What are the challenges for developing national drought policies?
- Group B: What are the institutional arrangements necessary for developing national drought policies?
- Group C: What are the steps being undertaken for developing national drought policies (country specific discussion)?

16:45 -17:15 Coffee and tea break

17:15 – 18:15 Session 6c: Presentation of breakout group results and discussion
(10 minutes per group and 30 minutes for discussion)

Workshop Agenda: Day 4

09:00 – 12:00 Session 7: Wrap-up

09:00 – 11:00 Countries' feedback

Countries' representative's feedback (a selection of countries present the "take home "message from the workshop & their action plans and specific foreseen implementation challenges followed by discussion)

11:00 - 11:30 Coffee and tea break

11:30 – 12:00 Closing

- Closing Statements
- Synthesis and concluding remarks

12:00 – 13:00 Lunch and farewell

Adding Value in Water-Related Capacity Development

The UN-Water Decade Programme on Capacity Development (UNW-DPC) is a Programme of UN-Water and strengthens the capacity development activities of UN-Water Members and Partners, supporting them in their efforts to help Member States achieve the Millennium Development Goals (MDGs) and other international goals and commitments related to water and sanitation. It is hosted by the United Nations University.

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WATER FOR LIFE 2005-2015

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