UN WATER

A UN-Water initiative with the following members:

WMO

UNCCD
United Nations Convention to Combat Desertification

FAO FIAT PANIS

Convention on Biological Diversity

UNITED NATIONS UNIVERSITY UNW-DPC

WATER FOR LIFE 2005-2015

UN WATER

Proceedings of the Regional Workshop on

Capacity Development to Support National Drought Management Policies

for Asia-Pacific Countries

Editors: Daniel Tsegai, Reza Ardakanian
UN-Water Decade Programme on Capacity Development (UNW-DPC)

A UN-Water Initiative

Proceedings of the Regional Workshop on

Capacity Development to Support National Drought Management Policies

for Asia-Pacific Countries

UN-Water Decade Programme on Capacity Development (UNW-DPC)
Published by UNW-DPC in January 2015

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AADMER	Agreement on Disaster Management and Emergency Response
AAI	Aridity Anomaly Index
ACOS	Arid Climate Observation System
ADRA	Adventist Development Relief Agency
AIC	Agriculture Insurance Company of India
AMFUs	Agro-Meteorological Field Units
APF	Advocacy Policy Framework
ARDC	Agricultural and Rural Development Corporation
ASEAN	Association of Southeast Asian Nations
BMA	Bangkok Metropolitan Administration
BMKG	Agency for Meteorology, Climatology and Geophysics
CAAS	Chinese Academy of Agricultural Sciences
CBD	Convention on Biological Diversity
CCOS	China Climate Observation System
CEEP	Eastern and Central Pacific Ocean
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CMA	China Meteorological Administration
CMDGs	Cambodian Millennium Development Goals
COP	Conference of the Parties
CRC	Cambodian Red Cross
CRIDA	Central Research Institute for Dryland Agriculture
CRWRC	Christian Reformed World Relief Committee
DALRM	Department of Agricultural Land Resources Management
DEWMS	Drought Early Warning and Monitoring System
DEWS	Drought Early Warning System
DID	Department of Irrigation and Drainage
DLDD	Desertification, Land Degradation and Drought
DMH	Department of Meteorology and Hydrology
DRR	Disaster Risk Reduction
DZGD	Dry Zone Greening Department
ENSO	El Niño Southern Oscillation Phenomenon
EOC	Emergency Operation Center
ERP	Emergency Response Plan
ESSO-IMD	India Meteorological Department, Earth System Science Organisation
ETP	Evapotranspiration
FAO	Food and Agriculture Organization of the United Nations
FD	Forest Department
FDRS	Fire Danger Rating Index
GDA	General Directorate of Agriculture
GDP	Gross Domestic Products
GFCS	Global Framework for Climate Services
GIS	Geographic Information System
GISTDA	Geo-Informatics and Space Technology Development Agency
GPCC	Global Precipitation Climatology Centre

GWP	Global Water Partnership
HDI	Human Development Index
HFA	Hyogo Framework for Action
HMNDP	High-Level Meeting on National Drought Policy
ICAR	Indian Council of Agricultural Research
IDMP	Integrated Drought Management Programme
IEDA	Institute of Environment and Sustainable Development in Agriculture
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
ISDR	United Nations International Strategy for Disaster Reduction
IWDP	Institute for Water Development and Partnership (IWDP)
ITCZ	Inter-tropical Convergence Zone
ITK	Indigenous Technical Knowledge
IWMP	Integrated Watershed Management Programme
IWRM	Integrated Water Resource Management
KVKs	Krishi Vigyan Kendras
LAPAN	Ministry of Forestry, National Space Agency
MAFF	Ministry of Agriculture, Forestry and Fisheries
MARD	Ministry of Agriculture and Rural Development Viet Nam
MCA	Ministry Civil Affairs
Met Malaysia	Malaysian Meteorological Department
MOECAF	Ministry of Environmental Conservation and forestry
MOF	Ministry of Finance
MOP	Ministry of Planning
MoWRAM	Ministry of Water Resources and Meteorology Cambodia
MRC	Mekong River Commission
NADAMS	National Agricultural Drought Assessment and Monitoring System
NAIS	National Agricultural Insurance Scheme
NAP	National Action Plan
NAPA	National Adaptation Programme of Action to Climate Change
NATMO	National Atlas and Thematic Mapping Organisation
NCACMW	National Center for Arid Climate Monitoring and Warning
NCDM	National Committee for Disaster Management
NDMA	National Disaster Management Authority
NDMC	National Drought Mitigation Center of the University of Lincoln-Nebraska
NDMP	UN-Water Initiative on Capacity Development to Support National Drought Management Policies
NDRC	National Reform and Development Commission
NDRF	National Disaster Response Fund
NDRRMC	National Disaster Risk Reduction and Management Council
NDVI	Normalized Difference Vegetation Index
NGAs	National Government Agencies
NMHS	National Meteorological and Hydrological Services
NPRS	National Poverty Reduction Strategy Cambodia

NSDP	National Strategies Development Plan
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PDSI	Palmer Drought Severity Index
PMPMS	Drought Prevention and Mitigation Programmes
SAUs	State Agricultural Universities
SDRF	State Disaster Response Fund
SLM	Sustainable Land Management
SNAP	Strategic National Action Plan on Disaster Risk Reduction
SOP	standard operating procedure
SPEI	Standardized Precipitation Evapotranspiration Index
SPFS	Special Programme for Food Security
SPI	Standardized Precipitation Index
SST	Sea Surface Temperatures
TSU	Technical Support Unit
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNW-DPC	UN-Water Decade Programme on Capacity Development
USDM	United States Drought Monitor
VAWR	Viet Nam Academy of Water Resources
WFP	World Food Programme
WMO	World Meteorological Organization
WST	Water Saving Technologies

© Neil Palmer / CIAT

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 Member States 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 and the Pacific regions (the topic of this proceedings), Eastern and Southern Africa as well as Near East and North Africa. The topic of the present proceedings covers the outcomes of the regional workshop for Asia and the Pacific Countries, which took place from 6-9 May 2014 in Hanoi, Viet Nam.

The level of cooperation required to execute an initiative like NDMP is considerable, not only among the partners involved at the UN 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 would like to warmly thank our partner institutions, local hosts for regional workshops as well as, of course, all of the engaged participants who have made this initiative a success so far. We look forward to the future outcomes of this initiative and hope that by helping countries develop and implement national drought 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.

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

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

SETTING THE SCENE

Donald Wilhite *University of Nebraska, USA*

The implementation of drought policy based on the philosophy of risk reduction can alter a nation's approach to drought management by reducing the associated impacts (risk). 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 programmes, creating a safety net of emergency response programmes 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.

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. Historical-

ly, 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 policymakers. 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 a 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 for many locations. 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 creates greater resilience to future episodes of drought.

The formulation of a national drought 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 published in 2014 are available from the IDMP website (**http://www.droughtmanagement.info/**) and can be used as a template by countries in the Asia-Pacific region.

© Georgina Smith / CIAT

Chapter 1

BACKGROUND AND RATIONALE

Drought ranks first among all natural hazards according to severity, duration, spatial extent, life and economic loss and other measures (Bryant, 1991). Drought is recognised as a creeping natural hazard and it affects all climatic regions. Drought has enormous impacts on food security, social stability, livelihoods, the environment and economies at large. The impacts and associated risks of drought can be significantly reduced through improved preparedness and policies and practices that support early warning systems, and by assessing vulnerability to drought and thus strengthening the emergency and recovery strategies. Such proactive and risk-based national drought management practices would greatly assist countries to build societal resilience to drought. However, to date most countries pursue reactive and piecemeal approaches which are often referred to as "crisis management approaches" and act only after droughts have taken their toll. This approach often proved to be ineffective calling for a paradigm shift from crisis-based and 'reactive' drought management approaches to risk-based and proactive approaches.

With the aim of supporting countries towards building their capacities for developing such proactive and risk-based drought management policies and practices, a number of United Nations agencies came together to launch a capacity-building initiative on national drought management policies. The UN-Water initiative was launched at the occasion of the High-level Meeting on National Drought Policy (HMNDP) held in March 2013 in Geneva, Switzerland, which was followed by regional workshops as explained below. The UN entities cooperating under this initiative comprise the Food and Agriculture Organization of the United Nations (FAO), the Secretariat of the United Nations Convention

to Combat Desertification (UNCCD), the World Meteorological Organization (WMO), the Secretariat of the Convention on Biological Diversity (CBD) and the UN-Water Decade Programme on Capacity Development (UNW-DPC).

1.1 Objectives of the Initiative

There are three important concerns related to national drought management that need to be addressed in the process:

1. Raise awareness of the misperception between general development activities and drought preparedness. There is a need for identifying the problems related to specific drought issues in order to develop adequate plans and take appropriate and timely actions. This confusion is also perceived at the scientific and technical level;

2. Advance national drought management policies taking into account long-term issues to address drought problems. It is not a matter of short-term planning; and

3. Promote collaboration between sectors at country and regional levels. In general, there is poor coordination between drought-relevant institutions. Sector coordination is very important if implementation on the ground is to succeed. Thus, preparing for drought and drought-related actions needs strong collaboration at different levels of planning, response, preparedness and capacity development.

The concerns described above are related to the mandate of various UN agencies. The objective of this joint initiative is to increase the capacities of developing countries and countries in transition in developing risk-based national drought management policies. This is based on the identification of the capacity needs from national to local levels to develop such policies and implement risk-based drought management strategies.

1.2 The Regional Workshops on National Drought Management Policies

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

- International Kick-off Workshop at the High-level Meeting on National Drought Policy (HMNDP), which took place on 12 March 2013 in Geneva, Switzerland;

- Regional Workshops for Eastern Europe (9-11 July 2013); Latin America and the Caribbean (4-6 December 2013); Asia-Pacific (6-9 May 2014), Eastern and Southern Africa (5-8 August 2014) and Near East and North Africa (17-20 November 2014);

- International Conference (due in 2015).

Based on the proposed elements in the Compendium of National Drought Policy (Sivakumar et al., 2011), the regional workshops contain different sessions, which were structured following 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 important to note that a session on "Biodiversity and Drought" added value to the contents of the whole workshop by bringing the ecosystem aspects into the general picture of mitigating the drought impacts. Each session in the workshops included a thematic presentation, which was followed by extended roundtable discussions in breakout groups. As situations vary significantly 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. Most importantly, participants were introduced to a generic 10-Step process for formulating drought policies (World Meteorological Organisation and Global Water Partnership, 2014).

The purpose of these workshop proceedings are to elaborate and document the workshop presentations and discussions in breakout groups for Asia-Pacific countries, which took place in Hanoi, Viet Nam from 6 to 9 May 2014.

© Neil Palmer / CIAT

Chapter 2

THE WORKSHOP FOR THE ASIA-PACIFIC REGION

Viet Nam was selected to be the location of the regional workshop for the Asia-Pacific region. Based on the expressed interest and experience in organizing international events, the Viet Nam Academy of Water Resources (VAWR), Institute for Water Development and Partnership (IWDP) and the FAO Viet Nam Office hosted and served as active local partners for the workshop.

The workshop, held from 6 to 9 May 2014 in Hanoi, was attended by more than 30 participants from 10 countries in the Asia-Pacific region (Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Thailand and Viet Nam) along with 10-15 observers from the Viet Nam Academy of Water Resources and the FAO Office in Viet Nam. The participants of the workshop were primarily experts who lead the development of drought management policies at the national level and high-level policymakers as well as researchers from research institutions. Most of the countries were represented by at least three participants from diverse ministries (Agriculture, Environment and Meteorology), reflecting the interdisciplinary nature of drought. The ministries in the above-mentioned countries were asked 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 its management in their respective countries, including existing capacities and perceived capacity needs (to be

submitted ahead of the workshop);

- Ability to work jointly in multisectoral teams for organizing and coordinating a network of stakeholders at country level; and

- Ability to influence policy development and contribute to subsequent activities at country level.

2.1 Workshop Structure

The four-day workshop started with an opening session by Dr. Hoang van Thang (the Vice Minister of the Ministry of Agriculture and Rural Development of Viet Nam), Associate Professor Dr. Nguyen Tung Phong (Vice Director General of the Vietnamese Academy of Water Resources) and Dr. Jong-Ha Bae (the Head of FAO office in Viet Nam). In the opening session, the relevance of drought issues as part of climate change and the increasing frequency of drought in the Asia-Pacific region was highlighted and the need for timely and effective measures for improved preparedness and mitigation measures were stressed.

In the following session, Dr. Donald Wilhite, Professor at the University of Nebraska and founder of the National Drought Mitigation Center in Lincoln, Nebraska in the United States, presented a keynote on 'Managing drought risk in a changing climate: the role of national drought policy'. A step-by-step process towards developing national drought management policies was presented. Then participants were exposed to the biodiversity aspect of drought and the impact of drought on ecosystem services. The rest of the session was dedicated to presentations and discussion of country reports by the participants from the 10 countries. The country reports mainly assessed the state of the national drought management practices of the respective countries. Preparing the country reports ahead of the workshop provided participants an opportunity to work together and interact, creating a network among the different ministries and sectors in the participating countries.

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 ele-

ments 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 workshop's thematic presentations were streamlined to follow the above-mentioned three key areas. Each thematic presentation was followed by extended round table discussions in breakout groups.

The UN-Water entities engaged in this initiative were represented by Dr. Mohamed Bazza (Senior Officer, FAO), Dr. Robert Stefanski (Chief of Agricultural Meteorology Division in the Climate and Water Department, WMO), Dr. David Coates (Environmental Affairs Officer, CBD), Dr Sergio Zelaya (Special Advisor on Global Issues, UNCCD) and Dr. Daniel Tsegai (Programme Officer, UNW-DPC).

2.2 Workshop 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 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 kilometers 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 workshop can be summarized as follows:

- The workshop improved the awareness of participants in drought management issues and more so 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' perception and understanding on the long-term benefits of risk-based drought management policies.

The workshop was able to promote national and regional networks of stakeholders working in various ministries including agriculture, environment, water 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.

Photos from the regional workshop

Workshop participants

Workshop in progress

Participants in breakout group discussions

Chapter 3

THEMATIC SESSIONS

3.1 Biodiversity and Drought

David Coates, Convention on Biological Diversity (CBD)

Biodiversity is an integral and cross-cutting topic regarding drought management planning. The topic of "biodiversity" involves not only species and their conservation, but importantly the role that biodiversity plays in supporting the functioning of ecosystems and the benefits they provide to people (ecosystem services). In this context, therefore, biodiversity and ecosystems are interdependent concepts.

Drought and biodiversity are linked in a number of ways. Droughts can have severe negative impacts on biodiversity and ecosystem services which in turn can result in impacts on socio-economic conditions. Biodiversity and ecosystems can play a crucial role in reducing risks associated with drought. Attention to biodiversity and ecosystem services, therefore, needs to be mainstreamed into all drought management planning.

Droughts have negative impacts on biodiversity. For example, droughts and sustained high temperatures can lead to habitat and species degradation and loss, leading to a decrease in biological productivity (see for example, Anderegg et al., 2013). The reduction in biological productivity caused by droughts can lead to a lower vegetation cover that increases albedo, and to reduced water recycling, thus decreasing precipitation. Reduced vegetation cover also leads to soil erosion and further reduction of productivity.

Ecosystem degradation, caused by droughts and other factors, can aggravate the impacts of droughts, as the degradation process reduces the capacity of ecosystems to buffer its impacts. When an ecosystem collapses, the buffering ability and other vital ecosystem services are lost (Munang et al., 2013). Hence, environmental degradation can also impact livelihoods of people and reduce their resilience to droughts. Reduced vegetation increases soil erosion and the siltation of water bodies both within and beyond drought affected areas which leads to a reduced availability of water (Tabacchi et al., 2000).

Soil biodiversity is particularly important. The health of soils is underpinned by biodiversity in them such as bacteria, fungi, invertebrates and vertebrates (such as burrowing mammals), and plants (particularly their root systems) which collectively maintain ecological processes in soils and notably water cycling together with nutrient cycling and carbon storage. Degradation of soil, primarily through loss of biodiversity and its reduced functioning, including loss of soil structure and carbon, affects the ability to retain moisture leads to a reduction in yields (FAO, 2005). Droughts also lead to a reduced availability of non-timber forest and range products such as wild fruit and vegetables.

3.1.1 The role of biodiversity in the water cycle

The water cycle is a biophysical process determined by physical/chemical factors (such as geology, temperature, topography and climate) and biological factors (ecosystem functioning). Ecosystems play a major role in the amount of water available and its quality, at any time and place. Forests, for example, play a major role in local and regional precipitation patterns, wetlands can play a significant role in buffering water flows in rivers, absorbing water during flood events and releasing it slowly and therefore contributing to maintaining dry season flows. Figure 1 presents a simplified illustration of these and other aspects.

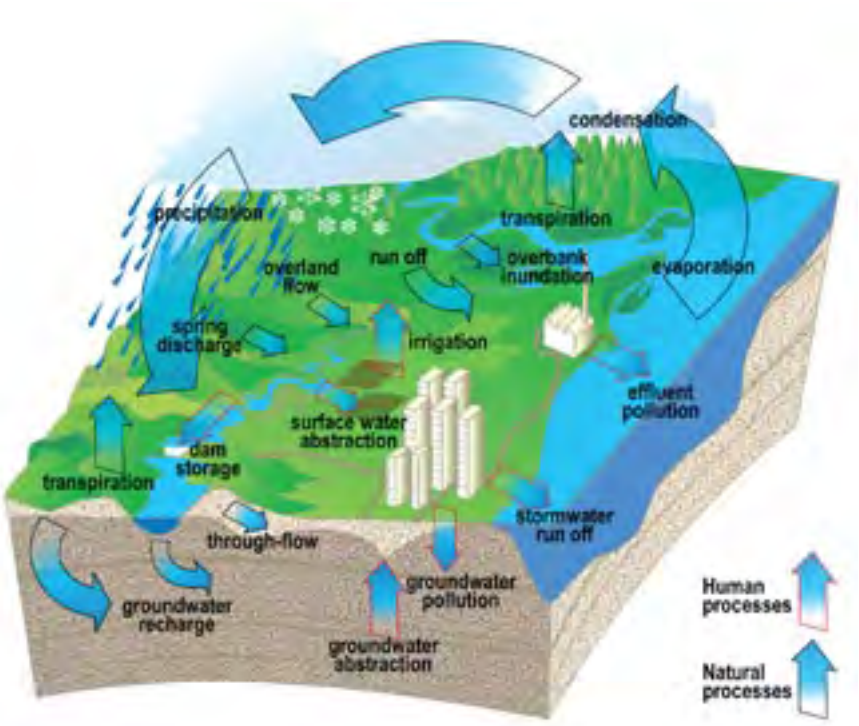


Figure 1: A simplified water cycle illustrating how human and natural (ecosystem) processes influence water (from Secretariat of the Convention on Biological Diversity 2013)

3.1.2 The concept of "natural infrastructure"

The area of water policy remains dominated by interest and investment in hard (physical) infrastructure and planning and management is heavily biased towards engineering approaches. The more we refer to the ability of Earth's ecosystems to achieve water-related management objectives as natural infrastructure, the more readily they will be received as a possible alternative or complement to hard infrastructure. For example, wetlands, well vegetated catchments and soundly managed soils can all deliver similar water quality outcomes as artificial physical/chemical water treatment facilities and similar water storage outcomes (including flood and drought risk reduction) as dams, drainage, networks and impoundments.

This approach is founded on the fact that ecosystems are not just the victims of water use, but are also responsible for making water available in the first place. The considerable advantages of this include improved sustainability, often cost-effective solutions and the

delivery of co-benefits, in addition to sustaining water for direct human use: for example, the recreational and cultural benefits of an improved landscape, regulating and maintaining soil formation, soil transfer and the health of estuaries and supporting fisheries.

3.1.3 Role of biodiversity and ecosystems in reducing risks associated with drought

Ecosystems contribute to reducing risks associated with disasters, including droughts, in two important ways: First, ecosystems can reduce physical exposure to drought and mitigate its impacts. For example, vegetation cover in dry land areas increases resilience to drought, and shelterbelts, greenbelts and other types of living fences act as barriers against wind erosion and sand storms (PEDDR, 2011). Second, healthy ecosystems provide various ecosystem services important to human well-being, which enable communities to cope with and recover from disasters (Munang et al., 2013). For example, marshes, lakes and floodplains release wet season flows slowly during drought periods. Forests on watersheds are important for water recharge and purification, drought mitigation and safeguarding drinking water supply. Ecosystems also play a particularly important role as affected communities, especially in poor, rural areas often turn to their surrounding environment to meet their immediate needs for food, water and shelter (PEDDR, 2011).

It is important to recognize the multiple functions and services provided by ecosystems, and to understand the ecological and technical requirements for their conservation and restoration, in order to harness the potential of ecosystems for drought management. Ecosystem functions should be considered in long-term planning, but demonstrating short-term benefits, especially to local communities, can support the engagement of key stakeholders. Local stakeholders can play an important role in promoting the sustainable management of ecosystems for drought management (Munang et al., 2013).

3.1.4 Drought management options based on the conservation and sustainable use of biodiversity

The important role of ecosystems as "natural infrastructure" applies at all scales, from local through to regional, and needs to be considered at all levels of planning and management. Ignoring this role can lead to significant escalation of drought risks and loss of cost effective and sustainable solutions. However, the appropriate responses need to be identified on a case-by-case basis.

A number of management options based on the conservation and sustainable use of biodiversity can reduce drought risks and, therefore, should be considered in drought

management planning and implementation (Convention on Biological Diversity, 2009). These include integrated land and water management (the application of the ecosystem approach), conservation and management of key natural resources, traditional knowledge, innovations and practices and the use of agricultural biodiversity.

Measures that protect soils from erosion, salinization and other forms of soil degradation effec¬tively prevent desertification and reduce the vulnerability of ecosystems to droughts. Practices such as overgrazing, overexploitation and unsustainable irrigation exacerbate dryland vulnerability. Land management strategies to reduce vulnerability include rotational use of rangelands, matching stock-ing rates to the carrying capacity of ecosystems, developing management plans for wetlands in dry lands and favouring diverse species composition.

It is important to mainstream integrated land and water management for food security and poverty reduction. Improved water management prac¬tices to reduce vulnerability include the use of traditional water-harvesting techniques, water storage and diverse soil and water conservation measures. Improving groundwater recharge through soil-water conservation, upstream revegetation and floodwater spreading can provide reserves of water for use during drought periods (MEA, 2005).

Furthermore, the conservation of locally-adapted species of plants and animals can increase the resilience of the ecosystem in the face of drought. For example, droughts have been demonstrated to have a more significant impact on imported livestock species when compared to local varieties or wild relatives (Convention on Biological Diversity, 2009).

Inland wetlands are an important land and water interface and can therefore mitigate the effects of hydro-climatic variations associated with droughts. Inland water bodies, such as lakes, surface water reserves and groundwater reserves, are a strategic source of water and their conservation can help increase resilience of semi-arid countries and water stressed communities (ECOSOC, 2009).

An essential element of drought management plans is building the resilience of farming and pastoral communities and the resilience of landscapes. Indigenous and local communities have an important role to play in preventing desertification through effective dryland resource management and in particular water management which is often based on local decision-making structures and conflict resolution mechanisms. Indigenous and

local communities also use seed, crop and animal diversity as a portfolio against weather extremes including drought and climate change. As such, many local communities have a well-developed knowledge of plant and animal biodiversity which can support conservation and sustainable use efforts (CBD, 2009).

Indeed, drawing on local and traditional knowledge, innovations and practices, and in partnership with science, it is the local communities that are in the best position to implement practices to pre-vent desertification and to manage drought (MEA, 2005).

Another element of drought management is addressing food security. Therefore, some countries look to increase access to drought-tolerant crop varieties in drought-affected regions. The idea behind the development of drought-tolerant crop varieties is to exploit the drought-tolerance genes of the staples which have withstood harsh climatic condition for thousands of years (CGIAR). This includes both identifying varieties with lower water requirements and varieties with higher salt tolerance (in response to increased salinization associated with irrigation and drought).

In order to take advantage of such genetic resources, however, it is important to conserve wild races of common crops. Such conservation can take place either in situ through the protection of areas where such wild races can be found, or ex situ through mechanisms such as seed banks. In addition, regional efforts to improve the drought tolerance of crops can be effective when considering the scope and scale of most droughts which cross national borders (Convention on Biological Diversity, 2009).

The conservation and sustainable use of agricultural biodiversity through methods such as agro-forestry, conservation tillage and intercropping, etc., can also reduce vulnerability from drought. In particular, such practices in managed ecosystems can help maintain vegetative cover, conserve soil biodiversity and provide alternative sources of food and fodder during times of drought, thereby reducing off-farm pressures on biodiversity and associated ecosystem services (CBD, 2009).

3.1.5 The convention on biological diversity

The Convention on Biological Diversity (CBD) is one of the three Rio Conventions that emerged from the UN Conference on Environment and Development in 1992. Its objectives are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CBD has 193 Parties. The governing body of the CBD, the Conference of the Parties (COP), adopted a number of decisions which are relevant to the development of national drought management plans.

In Decision X/35, the COP urged Parties to develop, revise and implement drought management plans taking into account the impact of drought and desertification on biodiversity, including through risk management and management of biodiversity for the prevention of drought and desertification.

The COP, in Decision X/28, also noted the role of biodiversity and ecosystems in providing services that reduce vulnerability to the impact of some natural disasters, in particular water-related impacts such as flooding and drought. The COP encouraged Parties to recognize the role of healthy ecosystems, and in particular wetlands, in protecting human communities from some natural disasters and to integrate these considerations into relevant policies. In addition, the COP encouraged Parties to conserve, sustainably use and, where necessary, restore ecosystems so that freshwater flows and water resources sustain biodiversity and thus contribute to human well-being.

Furthermore, the COP, in Decision X/2, adopted the Strategic Plan for Biodiversity 2011-2020 and its twenty Aichi Targets, representing a universally agreed framework for action on biodiversity and a foundation for sustainable development for all stakeholders, including agencies across the United Nations system:

- Aichi Biodiversity Target 14: "By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable".

- Aichi Biodiversity Target 15: "By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks have been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification";

In the context of the Strategic Plan for Biodiversity, the COP also requested the Parties to develop national and regional targets, using the Strategic Plan for Biodiversity and its Aichi Targets as a flexible framework and to review update and revise their national biodiversity strategies and action plans in line with the Strategic Plan for Biodiversity. National biodiversity targets and elements of national biodiversity strategies and action plans provide readily available elements for national drought management plans.

3.1.6 Examples from the region

Since 2007, China has been implementing a series of key ecological projects such as controlling areas of origin of sandstorms affecting Beijing and Tianjin, building forest belts in north, north-east and north-west China, returning cultivated land to forests and grazing land to grasslands, grassland conservation and soil erosion control in small river basins. China has also initiated a number of regional desertification prevention and sand control projects, based largely on ecosystem restoration, such as those in Talimu Basin and Shiyanghe River Basin of Xinjiang, as well as building ecological barriers in Tibet. These projects are intended to control key desert areas and enhance ecological improvements in degraded or desert lands across the country. The monitoring results show that during the eleventh five-year plan period, on average desertification was reduced by 1,717 km^2 annually. The total reduction within five years in areas of severely, medium and extremely severely desert land is 36,000 km^2, an indication of decreasing desertification level. Soil erosion in some areas has been effectively controlled. The soil erosion modulus is significantly reduced, with annual erosion of yellow sand cut by more than 300 million tons every year.

Myanmar's National Biodiversity Strategy and Action Plan includes actions to reforest watershed areas to restore forest cover in critical watersheds, increase knowledge of desert and mountain ecosystems and identify areas most at risk from soil erosion, etc., stop unsustainable agricultural and other land uses leading to deforestation, soil degradation and desertification and to develop appropriate sustainable farming systems. All of these are examples of elements of actions in response to drought management plans.

In India, the Mahatma Gandhi National Rural Employment Guarantee (MGNREG) Act 2005, which aims to promote livelihood security in rural areas, and its subsequent implementation, is an example of how biodiversity and ecosystems can be effectively integrated into socio-economic development policies, including the consideration of drought. The objective of the Act is to create durable assets and strengthen the livelihood resource base of the rural poor. MGNREGS works are largely focused on land and water

resources and include water harvesting and conservation; soil conservation and protection; irrigation provisioning and improvement; renovation of traditional water bodies; land development and drought proofing; afforestation; horticulture development; and pastureland development. The MGNREGS works have the potential to generate environmental benefits such as groundwater recharge; soil, water and biodiversity conservation; sustenance of food production; halting of degradation of land; and building resilience to current climate risks such as moisture stress, delayed rainfall, droughts and floods. The total financial outlay of MGNREGS for 2012-2013 was Rs 33,000 crores or USD 5.5 billion. The 'green jobs' created by the scheme are contributing to replenishing the depleting water table and afforestation. MGNREGS currently cover 632 districts in the country, and is considered the world's largest social security scheme, in terms of people covered and money spent to combat rural poverty.

Viet Nam's National Water Resource Strategy (to 2020) puts emphasis on protecting the intactness of aquatic ecosystems, wetlands, river mouth areas and coastal areas and on sustainably developing water resources by promoting the protection and development of forests, notably "watershed forests" (those identified as priorities for protecting specific water supplies). This is supplemented by a national target of regenerating 50 per cent of degraded watershed forests. The National Action Plan to Combat Desertification in 2006-2010 and orientation towards 2020 includes tasks for sustainable management of forest, water and land resources. Viet Nam, in common with most countries, also has strong community based, or traditional, approaches to land and water management that stress the role of nature; for example, different forms of community-based forest management have commonly existed in mountainous areas with the most common traditional community forests known as holy forests, rainforests, watershed forests, village forests or kinship forests. Their role in sustaining water supply is a central part of the motivation for conserving these areas.

3.1.7 Concluding remarks

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.

3.2 Drought Monitoring and Early Warning Systems

Robert Stefanski, World Meteorological Organization (WMO)

The thematic session on "Drought monitoring and early warning systems" dealt with the different drought indices and the 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. The bases for this initiative were the outcomes of the HMNDP, which produced the Science and Policy Documents.

The Science Document noted that National Drought Management Policy (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 were organized along these five elements. HMNDP documents and other materials can be found at: www.wmo.int/hmndp.

With regard to drought monitoring and early warning systems, it was stated during the workshop sessions 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, Standardized Precipitation Index (SPI), other indices, automated networks, satellite and soil moisture data, media and official requests), and also predictions/ projections (SPI, 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, supplies 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. During the presentation on drought preparedness, it was pointed out by a representative from FAO that there was an example of how drought triggers are used in a drought plan.

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 in 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 perspective such as the Standardized Precipitation Index (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), 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 evapotranspiration (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, available at 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.

During the workshop, 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 (Kogan et al., 1995). A historical overview of the ASIS for South America was presented from 1984 to 2013.

Finally, two initiatives organized by WMO and involving many other partners were briefly summarized. The first was the Global Framework for Climate Services (GFCS-http://gfcs.wmo.int), a United Nations led initiative spearheaded by WMO to guide the development and application of science-based climate information and services in support of decision-making. This concept was first developed during the World Climate Conference-3 (Geneva, 2009) and was approved by an Extraordinary WMO Congress in 2012. The GFCS has four initial priority sectors: agriculture and food security, water, health and disaster risk reduction. 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.

The other initiative is the Integrated Drought Management Programme (IDMP) which was also established at the HMNDP. The expected IDMP services to be provided are the following: regional coordination of drought monitoring, prediction and early warning activities, inception of pilot projects and coordination of regional projects to showcase best practices, collection and dissemination of information and knowledge on good practices, guidelines, methodologies, tools and supporting documentation on policy development and management practices and procedures, and capacity building and advice on Integrated Drought Management. The IDMP website is available at www.droughtmanagement.info. It was stressed that the IDMP will work in conjunction with all partners involved in these regional workshops to ensure that there is a coordinated and cohesive effort with regards to drought management issues.

3.2.1 Procedures and challenges on early warning systems

The first group tackled the question "What are the current procedures and challenges on early warning systems?" The group discussed the following challenges: the need to coordinate among ministries, updating drought early warning procedures due to climate change, communication to stakeholders and the sustainability of the early warning systems in terms of funding, institutional and technical support.

3.2.2. 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 participants highlighted the following meteorological and hydrological data that are needed: precipitation (frequency, intensity), minimum and maximum temperature, evaporation, sunshine, humidity, wind speed, stream flow (upstream, off stream, flow coefficient), stream width, ground water, soil moisture, reservoir levels, water quantity, water discharge, water use, rainfall at the regional scale and snow melt. The group discussed the needs of meteorological and hydrological network at the national scale. These needs include strengthening the national data analysis and data coordination, standardizing data analyses, upgrading the technical capacities, increasing the number of automatic monitoring station and strengthening mainstream weather stations, sharing data from networks from different national agencies, capacity-building and developing a data sharing policy. The group listed the following needs at the regional scale: establishing a regional network for sharing and monitoring data, capacity building to share information and experience between different countries, regional cooperation and transboundary information sharing. The group also discussed data quality issues such as capacity building for equipment, infrastructure, staff skills and methodologies, the frequency and accuracy of data collection, information delivery, quality data analysis and standardization of data, and the need for continuous data collection, monitoring, analysis, forecasting and dissemination. Finally, the group discussed sustainability which included identifying the short-, medium- and long-term planning needs, how to demonstrate to the governments the need for investment in the organizations, developing country briefs in order to educate the top management on data needs, and develop the actions to get financial commitment from governments.

3.2.3 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?". Participants discussed their specific experiences from their countries' perspective. In summary, the following mechanisms were identified: direct communication (e-mails, fax, reports, websites) from meteorological departments and hydrological agencies to the national disaster agencies, frequency of disaster meetings, direct disseminations to the various relevant agencies, and the disaster/drought committee can meet depending on reports from the drought/flood monitoring agencies or from public pressures and reactions. The group concluded that there needs to be an adequate frequency of drought committee meetings with the relevant drought agencies, national support based on regulations and budget, better climate prediction, vulnerability assessment, capacity building and an improvement in service delivery systems for the dissemination of information and warnings.

3.3 Vulnerability and Risk Assessment

Sergio A. Zelaya-Bonilla, United Nations Convention to Combat Desertification (UNCCD)

The thematic session addressed drought vulnerability and risk assessment including the main concepts and methodological aspects related to the topic. The focus of the discussions were 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, analysed 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, hydropower 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 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 biophysical 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 deficiency of agricultural / livestock production, inadequacy 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 and overscarce natural resources, especially regarding water availability.

The Presence 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 (available at http://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap12_FGDall.pdf) state that there is evidence of association between climate change and conflict, albeit 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. As such, it has been recognized in the forthcoming SDGs as an issue of global nature. The (forthcoming) report of the Open Working Group of the United Nations is expected to contain clear references to drought management linked with other sustainable development priorities, such as food security and environmental protection (sustainable land management included).

Increased awareness on the risks of drought might refer 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 of developing countries there is a pressing need to focus drought management policies on rainfed smallholder farmers, for the building-up of drought resilience and to guarantee increased food security. This is the case considering that:

- 70 per cent of the world's 1.1 billion farmers are poor smallholder farmers,
- 80 per cent of the world's agricultural land is rainfed,
- Between 1900 and 2004, droughts caused more than 50 per cent of all deaths from natural disasters and represented 35 per cent of the population affected by disasters; and
- 7 per cent of economic losses are caused by floods and earthquakes, but the (unaccounted) economic costs of droughts could be even 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 / 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 approaches which means the full involvement of affected communities, both men and women, as well as all users of land resources when designing drought policies and measures to increases resilience,
- Financial predictability: The budget (local/national and from international cooperation) 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 started to formulate/implement 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 develop 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 during the workshop include:

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

- Establishing National Coordinating Mechanisms as institutional tools for improving efficiency of decision-making (national authority, budget, etc.);
- Establishing of a preparedness system to cope with the effects of drought as it is done with other natural disasters;
- Creating 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 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;
- Adoption of traditional and new technologies (irrigation, rainwater harvesting) and innovation schemes for dry land development: Sustainable Land Management (SLM), Integrated Water Resource Management (IWRM).

The role of UNCCD and partners

- The UNCCD 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 Policy (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 'Towards A Compendium on National Drought Policy' on 14-15 July 2011,
- United Nations Partner Agencies and networks: UNCCD along with WMO, FAO, UNW-DPC and CBD are cooperating in supporting countries to improve their own decision-making process and develop National Policies on Drought Management,
- United Nations and International Agencies promote the establishment of an investment framework to cope with drought and desertification at country level.

A note on the UNCCD Advocacy Policy Framework (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 to efficiently and effectively address 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 are a summary of the main features and concerns of the 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, as it was mentioned in the workshop, we only need to adapt 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 capacity needs priority for addressing drought policies, their implementation and the accountability at the community / regional and national levels, aiming at improving the ability to deliver.

The session concluded with a round table of discussion in which participants reflected on drought cases in their countries taking place / which took place in their respective countries. Also, participants made some recommendations for the UNCCD and partners on how to address risk and resilience to drought impacts:

1. The UNCCD and partners called for supporting action on the specificities of countries in Asia and the Pacific for in-country action on drought risk management, by assisting these countries in the development of their own national drought management policies and funding derived projects,
2. The participation of UNCCD focal points in the training workshops on drought policies is necessary, as in the region there are some uncertainties on the proper development of national drought management policies linked with the implementation of the convention. For the UNCCD, drought issues are a priority and as such they are strategically positioned in the convention's programme of work and should be translated into the UNCCD National Action Programmes to Combat Desertification (NAPs),
3. The UNCCD national focal points participating at the meeting identified several linkages and connections between drought management policies

discussed during the session with the NAP alignment processes, with options to be followed in future stages,

4. Additionally, it was suggested that countries should report at next CRIC sessions on the progress made towards the development and implementation of national drought management policies.

During the breakout group discussions, countries exchanged on these questions and produced the results as described below.

3.3.1 Who is vulnerable?

This group was tasked with identifying areas or persons that are most vulnerable to drought in their respective countries as well as discussing response measures that have been taken so far. Since these countries mostly depend on agriculture and fisheries for their livelihood; thus agriculture and fisheries turned out to be the most vulnerable sectors. Drought negatively affects upland and low land rain fed areas, livestock and even irrigated areas. As a result, this negatively affects about 80 per cent of the population as well as high value crops for exportation such as palm oil and rubber. Paddy rice and sugar cane are also among drought vulnerable crops. In 1987, India's Agricultural GDP reportedly went down by 3.4 per cent. Other vulnerable areas include water resources and energy sectors (hydropower), the environment sector (natural resources, biodiversity, forest fires) and the Industries.

Coping mechanisms which have been implemented so far include the introduction of subsidies in terms of seeds, fertilizer, pumps, etc., in a bid to ensure crop production. Other policies, measures and mechanisms include anchoring drought policies with food or sovereignty. However, the increasing number of migrants from rural areas and between urban areas, in search of employment, is becoming a big problem especially in Cambodia. In addition to the general drought vulnerable areas, the discussions also highlighted each country's specific drought related problems. For example, the Philippines have suffered from El Niño and La Niña, while compensation schemes are of concern in Malaysia. Myanmar needs to address urbanization and tourism issues, Viet Nam needs to protect its wetland and rivers and there is urgent need to set up a climate field school for farmers and early warning systems in both Indonesia and the Philippines. In comparison, in India, 300 million people are directly affected by drought affecting wildlife, protected areas and increased temperatures. At the end of the discussions, it was agreed that the need for a water use policy should be a top priority for drought mitigation.

3.3.2 What are the causes of vulnerability?

The task of this group was to provide the reasons for country vulnerabilities to drought. Before going into the 'why", the group first identified the following as vulnerable sectors: agriculture, tourism and transport, commerce/industry, energy, livestock, fisheries/aquaculture, biodiversity/ecosystems and domestic water supply. Naturally, a breakdown of these sectors will affect differently the two groups: people and animals. Therefore, the first vulnerable group includes subsistence farmers, the underprivileged, rural and urban dwellers, illiterates, women and children, agricultural laborers, minority/indigenous people as well as water dependent entrepreneurs. The latter is represented by livestock and wildlife.

Many factors can be identified as causes for vulnerability. Some of the most common contributing factors include: weak or absent drought monitoring and early warning system, reactive approaches of governments to incidences of drought and limited or no preparedness, and lack of information, education and awareness including lack of financial resources and infrastructure.

Furthermore, many farmers lack access to essential resources to face drought impacts, such as: technology (e.g., irrigation facilities, weather forecasting, climate related information, etc.), lack of alternative cropping technologies, unsustainable development practices (e.g., inefficient ground water storage, high non-revenue water, land degradation, deforestation and urbanization processes without due regard to recharge systems (e.g., impervious conversion of wetland). In addition, the poor planning, operation and management of irrigation system/reservoirs as well as deterioration of water quality/water pollution also hinder any productivity measures. Depletion of vegetative covers, climate change and reduction of ground water availability as a result of salt water intrusion can be partly blamed on nature, but also to consequences of man-made actions. However, options are available, for example, promoting crop varieties/plant species that use less water and avoidance of overexploitation of ground water resources. These options can be more effective when properly managed with proactive policies.

3.3.3 Criteria for prioritizing vulnerability

The task of this group was to discuss the criteria used by each country in prioritizing vulnerability. Based on the inputs from the first two groups, the vulnerable sectors include: agriculture, health, tourism, recreation, wildlife and forestry, environment, as well as hydropower and navigation. Drought mostly affects those living in rural areas and especially women and children in the rural communities that are located in drought prone areas.

The group evaluated and focused on the following criteria for vulnerability: loss of life, food insecurity and productivity loss, forest fires (area), domestic water supply (reduction), reduction of water for irrigation, degradation of water quality, a decrease in the groundwater table, air quality and other health hazards as well as land degradation. Other areas of focus contained economic-environmental aspects including the evaluation of income loss, loss of biodiversity, reduction in inland fisheries, pasture and feed production reduction, livestock productivity loss and power generation reduction.

3.4 Drought Preparedness, Mitigation and Response

Mohamed Bazza, Food and Agricultural Organization of the United Nations (FAO)

Drought is widespread in Asia and the Pacific, albeit with varying levels between regions. Between 1900 and 2013, the top 10 drought disasters, in terms of total number of persons affected, occurred in India and China . This included seven drought episodes that killed more than a half million people each, of which three occurred in India, two in China and one in Bangladesh. Drought is mentioned in Chinese history as far back as the pre-Confucian era where the following tale comes from (Shaughnessy & Edward, 1997).

> *"Perhaps the most important of the battles in which dragons engaged was that between the Yellow Emperor and Chi You. […] Chi You, described in one source as having the feet of a turtle and the head of a snake, met the Yellow Emperor on the field of Zhuolu, said to be situated in the wilds of the north. At the beginning of the battle Chi You marshaled his forces of wind and rain and caused a great fog to descend over the field, throwing the forces of the Yellow Emperor into confusion. The Yellow Emperor is said to have thereupon looked up and regarded heaven. Inspired by the astral dipper, he invented the compass-chariot. When even with celestial guide he could gain only a stalemate, a "dark woman" named Drought was sent to the aid of the yellow Emperor. With her arrival, the rain finally ceased and Chi You was killed".*

This story is probably associated with the change in dynasty in pre-Confucian China as a result of drought. During the Confucius area that followed, it is said that (Columbia University):

"The ruler was understood to be at once the Son of Heaven, and the father of the people, ruling under the Mandate of Heaven. […] The Mandate of Heaven was understood as justifying the right to rule, with the corollary right to rebel against a ruler who did not fulfill his duties to the people. The state played a major role in determining water rights, famine control and relief, and insuring social stability. The state encouraged people to grow rice and other grains rather than commercial crops in order to insure an adequate food supply; it held reserves in state granaries, in part to lessen the effects of drought and floods, particularly common in northern China. For fear of losing the Mandate of Heaven governments levied very low taxes which often meant that the government could not provide all the services expected of it, and that officials ended up extorting money from the people."

The lesson from this Confucius wisdom is that preparedness to drought should be one of the top policies of rulers, lest they be overthrown

Nowadays it is possible to mitigate drought impacts much better than in the past, thanks to new advances in science, technology and knowledge; yet, no Asian country has a full-fledged drought risk management plan that is operational.

3.4.1 Introduction

"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 also closely linked.

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

> **Drought Preparedness:** Policies and specific plans and activities are established before drought occurs in order to: 1) prepare people and enhance institutional and coping capacities, 2) forecast or warn of approaching dangers, and 3) ensure coordinated and effective response in a drought situation (contingency planning).
>
> **Drought Planning:** An action 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 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, an emergency measure after drought has been declared. Such response is unplanned and hastily applied after drought has taken its toll and resulted in damage to property and ill-health, poverty and disease.

Response to drought, including recovery, remains an important component of proactive drought risk management. However with a proactive approach it is planned before drought occurs and constitutes an integral part of a drought plan. As such, response measures contribute to building long-term resilience to drought. Numerous advantages and synergies result from the integration of response and recovery measures into a drought plan as 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".

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 of their action: long-, medium-, and short-term, 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 like drought indicators determined by "Monitoring and Early Warning". The three categories complement each other and constitute an integral drought risk management plan.

Table 1: Risk management options based on time of action

CATEGORY	LONG-TERM	SHORT-TERM	RESPONSE AND RECOVERY
Objective	Resilience building	Drought mitigation	Impact reduction
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 session's presentation. The procedure for linking actions to indices and drought indicators was also explained and examples were provided. 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 and environment, etc. These measures constitute an integral part of national drought risk management, and for this reason, revisiting the strategies of these sectors to ensure their inclusion is an important step in 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 or 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 methodologies introduced during the session. The three groups focused on water, agriculture and ' all 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 nearly all participating countries have some experience in proactive risk management. But drought is only rarely part of the framework and even when it is included; it is still managed reactively on emergency basis. The slow onset and long duration of drought, along with the creeping impacts over time, in comparison with other natural hazards, such as tsunamis, make 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 main priority measures identified by the working groups as valid for their countries are indicated below. The agencies responsible for their development and implementation are indicative because they vary from one to another. The groups found difficulties in agreeing on the difference between long-term and medium-term measures as illustrated in the table. However, they unanimously agreed that they would need additional support for developing and applying the three pillars of drought risk management.

3.4.2 Drought risk management strategy – the water sector perspective

The first group tackled the question "Using the results of the Impact and Vulnerability Assessment session, develop long- and medium-term drought risk management measures and specify for each measure the responsible agency(ies)" from the perspective of the water sector.

Table 2: Long-term risk management measure - water sector

MEASURES	RESPONSIBLE AGENCIES
New irrigation facilities for surface/ ground water; building dams for stream flow	Water institute, national irrigation administration, bureau of soils and water management, ministry of agriculture, etc.
Ground water recharge options, e.g. infiltration wells	Water institute, national irrigation administration, bureau of soils and water management, ministry of agriculture, etc.
Reforestation, rehabilitation of degraded catchment, eco-restoration	
Public education about drought management	
Revisiting outdated water laws and policies, adopting IWRM approaches	Ministries of water, environment and natural resources
Use of grey/brown wastewater	Local community, local government and national government agencies (NGAs)
Improve water use efficiency esp. in agriculture, industries and domestic uses	Ministries of agriculture, industry and drinking water supply agencies
Water pricing, water demand and pricing mechanisms	State level and local level leadership

MEASURES	RESPONSIBLE AGENCIES
Protection of water catchments, economic incentive for preservation of catchments, National Greening Programme	Forestry department, ministry of environment, some coordination mechanism should be in place
Desalination for areas w/n coastal areas	National water resources departments
Cloud seeding operations	Meteorological department, bureau of soils and water management, local government, military/air force
International cooperation for sharing water resources	Mekong river commission, ministry of public works/foreign ministry, ASEAN water resource council, ASEAN SOM (Senior Officers Meeting)
National Water Resource Programmes: Supply vs. demand	Ministry of water resources and water use departments
HRD in drought management	Relevant ministries, universities and institutes, UNESCAP

Table 3: Medium-term risk management measures – water sector

MEASURES	RESPONSIBLE AGENCIES
Strengthening institutional capacity	Applies to all departments/institutes
Early Warning Systems – status of water supply; improve capability to handle	Meteorological department, water ministry, etc.
Demand reduction: lawns, car wash and agriculture/aquaculture	Local government, agricultural district offices and water operators
Mapping of water supply/ allocation and augmentation	Ministries of water, environment and public works
Supply augmentation-drilling additional wells (subjected to feasibility study)	River basin organizations and watershed level organizations
Prepare for water transfer, e.g. via water tankers, to critical areas in times of drought	Ministry of water, municipal and local levels
Rain harvesting systems	National and local government agencies
Connecting ponds to rivers	River basin organizations (RBOs)
Pumping water for irrigation	Ministry of agriculture and irrigation, department of agriculture

3.4.3 Drought risk management strategy – The agriculture sector perspective

The second group tackled the question "Using the results of the Impact and Vulnerability Assessment session, develop long- and medium-term drought risk management measures and specify for each measure the responsible agency(ies)" from the perspective of the agriculture sector.

Table 4: Long and medium-term risk management measures – agriculture

IMPACT	LONG-TERM MEASURES	MEDIUM-TERM MEASURES
Reduction of crops yield	Drought resistant crops	Adjust sowing/crop calendar
	Irrigation	Alternative management practices
	Green house	
	Cropping pattern change	
Reduction of food security	Food reserves	Food distribution to regions
	Post harvest storage facilities	
	Crop insurance	
Insect/pest outbreak	Pest resistant genotypes, ecosystem	Intervention groups
	Legal framework review	
	Crop insurance	
	Integrated pest management (IPM)	
Change of phenology	Crop selection/adaptation	
Reduction of fodder availability	Feed stock reserves	Inform owners to destock livestock and poultry
Unemployed farm workers	Employment guarantee scheme	
	Unemployment insurance scheme	
Forest fires	Early warning system	Information dissemination
	Fire roads	Cloud seeding
	Forest management	Peat flooding
Land degradation	Land use planning	
	Sustainable land use management	
Loss of biodiversity/ ecosystem	Protected area reserves	Ex-situ conservation
	Wildlife corridors	

3.4.4 Drought risk management strategy – other sectors

The third group tackled the question from the perspective of the other sectors outside agriculture and water.

The group agreed to discuss Marine, Biodiversity and Health sectors and came up with the following measures, without making any distinction between medium- and long-terms.

Table 5: Drought risk management strategy in other sectors

MARINE	BIODIVERSITY	HUMAN AND ANIMAL HEALTH
Creation/development of sanctuary protected areas Prevention of illegal harvesting of mangroves Delta areas: • Create zoning regulations in urban areas • Build barriers to prevent salinity intrusion • Treated water to recharge groundwater • Regulation of pump along coastal areas/ reduce rate of extraction Inland fisheries • Reduction in stocking density (medium-term) • Increase fish-harvesting (short-term) Water quality • Reduce fertilizer • Reduce industrial waste • Enhance treatment of water	Increase use of plants that clean water/native plants Reduce invasive plant species Ensure protected areas such as wetland/water catchments Control deforestation/ enhance forest cover (increase soil moisture and decrease soil erosion) Create buffer areas Use climate resilient plant species Crop selection/adaptation Feed stock reserves	Water quality • Build drinking water facilities for transport • Rainwater/harvesting/ purification/rural areas • Diseases/medical rescue • Education on water use during drought Air quality • Control burning for agriculture purposes during drought/Link FDRS • Control overgrazing to reduce soil erosion/ reduce dust storms • Enhance rescue efforts for forest fire.

3.5 Developing Drought Management Policy: The 10-Step Process

Daniel Tsegai, UN-Water Decade Programme on Capacity Development (UNW-DPC)

The 'business as usual' approach to drought in which governments react to the impacts of drought after it has taken its toll without coordinated effort between various relevant actors and stakeholders is not only ineffective but also unsustainable and thus it is no longer an option. 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, developed by Wilhite et al. (2011) was discussed in detail during the session by focusing on the most relevant elements of each of the steps, which are:

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.

The generic 10-Step Process has been described in more detail in the recent "National Drought Management Policy Guidelines" publication by WMO and GWP (2014). The 10-Step Process can and should be modified according to the specific national context and the level of the country's preparedness to drought management. Thus, drought policies should be broadly stated to accommodate changes in time and space and context/country specific conditions. As such, implementation 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 population groups as well as economic and social groups. 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 'prepared-

ness, 'pre-alert', 'alert' and 'emergency', Spain is another good example for the successful implementation of different management actions for drought policy. Lastly, a process that China pursues in addressing its drought related activities, including monitoring, early warning, impact assessment, emergency response, hazard relief and recovery was presented.

After the presentation, participants were divided into three breakout groups to discuss in detail some specific elements of the topics raised in the presentation. These are explained in the following sub-topics.

3.5.1. What are the challenges for developing national drought policies?

The first group discussed the challenges that they foresee when it comes to developing national drought policies (from the perspectives of their own countries). The challenges are wide ranging. The major ones can be summarized as follows:

a. Lack of political will: The lack of commitment of governments to address drought issues with priority was mentioned as key point by the group. Factors that could have contributed to the lack of political will by governments include inadequate communication and thus lack of awareness among various levels of government and other players; the fact that drought impacts build slowly (as opposed to floods, for example, which have immediate effects); and inadequate knowledge/information about the cost of inaction and lack of quantification of drought impacts,
b. Lack of integration of sectors: Drought is a cross-cutting issue and as such it requires the involvement of many sectors. Getting the attention of all sectors with regard to drought threat is challenging because not all sectors are equally vulnerable to drought and thus their priorities can also be different (for example, agriculture versus the tourism or industry sectors differ in their reliance on water and accordingly their response to drought is different),
c. Institutional capacity: The shortage of human resources and expertise which is necessary for developing drought policies, lack of organisational capacities and more importantly the lack of financial resources to deal with the issue,
d. Others: Other general challenges potentially hindering the progress toward development of drought policies include government bureaucracies, high labour-market turnover in key departments, resistance to change at grassroots level, lack of incentives to farmers to plant drought resistant crops as well as cultural and religious constraints. In some of the countries, for example,

Malaysia, India and Cambodia, drought is embedded in the framework of a larger disaster management policy with a focus on drought as 'crisis' rather than 'risk'. When drought is part of wide-reaching policies like this, revisiting the policy and strengthening the drought component would be a remedial procedure.

3.5.2. What Are the Institutional Arrangements Necessary for Developing National Drought Policies?

The group listed the existing institutions in their countries which are readily available for taking the lead in developing national drought policies: El-Niño Task Force at the Ministry of Agriculture (the Philippines), National Committee for Disasters Management (Malaysia), Water Management Committee for Drought and Flood (Thailand), National Disaster Preparedness Centre Committee (Myanmar), Ministry of Natural Resources and Environment (Laos) and Steering Committee for Climate Change Adaptation and Response (Viet Nam). The participants recommended the creation of a Task Force in the framework of the countries' existing institutional arrangements, which incorporates stakeholders from sectors including agriculture, water resources, power, rural development, environment and forestry, finance, science and technology, human resources development and research institutions. Some of the terms of references for the task force would include reviewing existing policies of sectors related to drought, monitoring and early warning systems, vulnerability and risk assessment, and taking measures on mitigation, response, recovery, outreach and awareness.

3.5.3 What Are the Steps Being Undertaken for Developing National Drought Policies?

The different countries in the Asia-Pacific region are at various stages in their effort to develop national drought management policies with almost all of them at the very beginning with little or no drought management plans. The Philippines has a national disaster risk reduction and management council, El-Niño Task Force and water crisis committee which are relevant institutions for drought plans. Also, the Philippines has an updated action plan to combat desertification, land degradation and drought. Indonesia has a national board for disaster management and drought monitoring and early warning systems are established, but so far no assessment of drought impact has been conducted. Laos has a national disaster prevention and control committee which is linked with the Inter-Agency Standing Committee (2007) with roles on disaster assessment and a role on plans for reducing the risk disaster, but yet the country has no drought policy. Viet Nam has established a national disaster prevention committee and national prevention strategy action plan (2014-2020) while Malaysia has established a national security council on disaster with standard operating procedure for drought, but no risk assessment and national drought policy. China has relatively better experience when it comes to

drought plans with more focus on a 'crisis' than 'risk' approach. China has a national committee for disaster reduction with a state flood control and drought relief program. Yet, no separate assessment for drought has been undertaken. Myanmar was another country in the group where a national disaster preparedness control committee and national disaster preparedness management committee were established in 2013. Myanmar does not have a drought risk assessment or drought monitoring and early warning systems in place; however drought prone areas in the country are identified. In general, no country in the group has a comprehensive drought management policy.

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 workshop 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.

The workshop was 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.

References

Anderegg, W. R. L., J. M. Kane and L. D. L. Anderegg (2013). *Consequences of widespread tree mortality triggered by drought and temperature stress.* Nature Climate Change, vol. 3, pp. 30–36.

Bainbridge, B. A (2007). *Guide for Desert and Drylands Restoration: New Hope for Arid Lands.* Society for Ecological Restoration International.

Bryant, E.A. (1991). *Natural hazards.* Cambridge University Press, Cambridge, England.

Columbia University(n.d). *Asia for Educators. Introduction to Confucian thought.* Retrieved from http://afe.easia.columbia.edu/special/china_1000bce_confucius_intro.htm

Communication from the Commission to the European Parliament and the Council (2007). *Addressing the challenge of water scarcity and droughts in the European Union.* COM/2007/0414 final.

Consultative Group on International Agricultural Research (CGIAR), *Drought-Tolerant Crops for Drylands*. Available from http://www.cgiar.org/impact/global/des_fact2.html.

Convention on Biological Diversity (2009). *Biodiversity of Dry and Sub-humid Lands: Follow-Up to Requests of the Conference of the Parties in Decision IX/17*, Note by the Executive Secretary, UNEP/CBD/SBSTTA/14/13.

Economic and Social Council, Commission on Sustainable Development (2009). Seventeenth session, 4-15 May. *Policy options and actions for expediting progress in implementation: Drought.* Report of the Secretary-General, UN Document.E/CN.17/2009/6.

Food and Agriculture Organization of the United Nations (2005). *The importance of soil organic matter. Key to drought-resistant soil and sustained food and production*, FAO Soils Bulletin 80.

Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Desertification Synthesis.* World Resources Institute, Washington, DC.

Munang, R. and others (2013). *The role of ecosystem services in climate change adaptation and disaster risk reduction*. Current Opinion in Environmental Sustainability, vol. 5, pp. 1-6.

Keyantash, John, and John. A. Dracup (2002). *The Quantification of Drought: An Evaluation of Drought Indices.* Bulletin of the American Meteorological Society, vol. 83, pp. 1167–1180.

Shaughnessy, Edward L., (1997). *Before Confucius: studies in the creation of the Chinese classics*. State University of New York.

Sivakumar, M VK and others (2011). *Towards a compendium on National Drought Policies.* Proceedings of an Expert Meeting. World Meteorological Organization. Geneva.

Tabacchi, E. and others (2000). *Impacts of riparian vegetation on hydrological processes.* Hydrological Processes, vol. 14, No.16-17, pp. 2959-2976.

Turner, B. I. and others (2003). *A Framework for Vulnerability Analysis in Sustainability Sciences.* Proceedings of the National Academy of Sciences, vol. 100, No.14, pp. 8074-8079.

Vicente-Serrano, Sergio. M. Begueria and Juan I. López-Moreno (2010). *A multi-scalar drought index sensitive to global warming: the standardized precipitation evapotranspiration index*. Journal of Climate, vol. 23, pp. 1696-1718.

Vörösmarty, Charles, J. Pamela Green, Joseph Salisbury, Richard B. Lammers (2000). *Global Water Resources: Vulnerability from Climate Change and Population Growth*. Science, vol. 289, pp. 284-88.

Wilhite, Donald A., Michael J. Hayes and Cody L. Knutson (2005). *Drought Preparedness Planning: Building Institutional Capacity.* In Drought and Water Crises: Science, Technology, and Management Issues, Wilhite, ed. Boca Raton: CRC Press.

World Meteorlogical Organisation (WMO) and Global Water Partnership (GWP) (2014) *National Drought Management Policy Guidelines: A template for action* (D.A.Wilhite). Integrated Drought Management Programme (IDMP) Tools and Guidelines Series 1. WMO, Geneva, Switzerland and GWP, Stockholm, Sweden.

©Georgina Smith / CIAT

Chapter 4

NATIONAL REPORTS (SELECTION)

Map of Participant Countries:

Cambodia

Chan Phaloeun[1], Cheth Kimngoy[1] and Khen Bopreang[2]

Throughout the course of human history, drought has been a problem affecting the welfare and food security of the Cambodian population. Agriculture was perhaps the first sector for which humans recognized the strong relationships between crops and weather. Short-term rainfall deficits prompted early humans to find alternative food crops. However, even a single year with a severe drought during the rainy season resulted in crop failures, which most likely led to humans migrating to other areas. Therefore, in early human history, even limited droughts had large impacts.

In recent times, short-term drought adaptation mechanisms have improved, but extended periods of drought are now the main concern for human welfare and food security. These periods of dryness, when coupled with other climatic factors, such as extreme rainfall and wind events or unsustainable agricultural and development patterns, can result in land degradation and, if unchecked, it increases desert land areas and/or desertification.

The pattern of risks faced by the poor and vulnerable in rural areas of Cambodia, as a consequence of drought disaster, is posing an increasing threat to their livelihoods. One third of the past three years has been taken up with drought. The period of this natural disaster was more prolonged than in the past. The damage caused by drought was comparable, although the drought of 2002 was the most extensive of the disasters that happened in the recent history of Cambodia.

There is a strong need at the policy level to design social protection interventions to emphasize ex-ante instruments rather than the ex-post response to natural disaster with regard to focusing on emergency assistance and relief.

1 Ministry of Agriculture, Forestry and Fisheries (MAFF)
2 Ministry of Environment

Introduction

The pattern of risks faced by poor and vulnerable people in rural areas, particularly those involved in agriculture and other ecosystem-dependent livelihoods, is becoming a major cause of chronic poverty. Dependency on subsistence agriculture, in particular for the rural poor in Cambodia, accumulates the impact of stresses and shocks (such as droughts). This has profound implications for the security of their livelihoods and for their welfare. Such stresses and shocks, on the other hand, will not necessarily always lead to negative impacts, as risks and uncertainties that are often associated with seasonality are embedded in the practice of agriculture, and there is considerable experience of coping and risk management strategies among people working in the rural sector. However, in the face of climate change, the magnitude and frequency of stresses and shocks is changing and, therefore, approaches such as social protection, disaster risk management and climate change adaptation will be needed to bolster local resilience and supplement people's experience.

The basic nature of disaster impact in Cambodia seems to be the occurrence of relatively moderate drought events combined with a high level of vulnerability and major limitations in the ability of rural people to cope with the impact of these events on their livelihoods. Yet even moderate droughts, in terms of both magnitude and intensity, are enough to threaten livelihoods and to cause widespread suffering among rural people. By understanding that natural disasters have a huge impact on social and economic welfare, policies to manage them need to be integrated and well-grounded to the specificities of natural hazards as well as local capacities in terms of fiscal, administrative and economic capabilities.

Drought monitoring and early warning systems

Considerable progress is being made in drought monitoring and early warning systems in many countries. The increased emphasis on improving these systems is largely the result of the mounting impacts of drought, reflecting greater societal vulnerability. Heightened monitoring capability, including the expansion of automated weather station networks and satellites and the Internet are contributing to such improvements. The Internet allows for improved access to critical data and information to assist in climate and drought assessments and the delivery of this information through a wide range of tools or decision support products to users in many sectors.

Drought is considered a period of abnormal dry weather that causes serious hydrological imbalance in the area. In Cambodia in a normal year the typical rainfall distribution is from May to October with heavy rainfall from August till mid-October with a dry spell

for about two to three weeks between July and August. In a year when this dry period is extended too long, an agricultural drought could occur in addition to the late rain and early end of rainy season.

There are four characteristics of agricultural drought in Cambodia:

1. Unpredictable delays in rainfall onset in the early wet season;
2. Erratic variations in wet season rainfall onset, amount, and duration across different areas;
3. Early ending of rains during the wet season; and
4. Common occurrence of mini-droughts of three weeks or more during the wet season, which can damage or destroy rice crops without irrigation.

Localized drought is also becoming increasingly apparent and significant throughout many areas of Cambodia, including areas that are also flood-affected. Drought impacted a number of areas in 2001, 2002 and 2003. The direct impact has predominantly been in terms of water stress on agricultural crop production, especially rice and vegetable production, with 80 per cent of agricultural fields lying idle in most areas up to six months and to a lesser extent in terms of increased rates of water-related disease mortality and morbidity.

Vulnerability Assessment

With regard to the agricultural sector, land degradation is considered the biggest threat increasing (or causing) vulnerability in Cambodia. Land degradation resulted from traditional agriculture land use, and depletion of forest cover has threatened the overall agriculture production including agro-industry of Cambodia. Productivity, security and sustainability of a major part of agricultural land in Cambodia are influenced by constraints of natural soil nutrient, traditional land use practice, and impacts of climate change.

Other underlying factors include socio-economic conditions, poverty pressure and unplanned human settlement and land use. The country remains one of the least developed countries in the world reflecting the impact of 30 years of war and social as well as political instability with a human development index (HDI) rank of 138 (0.54) in 2013. In

addition, poverty is a key determinant of people's vulnerability to disasters. A study by the Cambodian Red Cross (CRC) has shown that poverty in Cambodia varies according to the geographical area and is especially attributed to those people living in areas vulnerable to floods and droughts. As well, unplanned patterns of human settlement and land use have resulted in dramatic increases in the population of people living in the Mekong floodplains. Irrigation systems and water conservation measures remain inadequate particularly in the face of an increasing incidence of drought. Vulnerabilities to natural hazards are formed around these linkages between physical, socio-economic and environmental vulnerabilities that prevent many people from living in a safe environment. The last major drought in Cambodia took place in 2002 when unusual dry weather during the rainy season affected some 420 communes in 76 districts located in the 10 provinces of Prey Veng, Kandal, Kampong Speu, Takeo, Svay Rieng, Kampong Thom, Kampong Cham, Kratie, Odor Meancheay and Banteay Meanchey. The drought prevailed until the onset of rains in mid-August and covered 62,702 hectares. Statistics from the National Committee for Disaster Management (NCDM) indicate that the drought affected 2,047,340 people or 442,419 families. The cost of the drought was estimated to be more than USD $21.50 million and it is considered to be the worst drought to affect Cambodia.

Figure 1: Drought-prone Communities in Cambodia

Emergency relief and drought response

There are several frameworks, strategic policies and agreements that influence Cambodian policy in agriculture:

1. Hyogo Framework for Action (HFA) 2005-2015

The HFA 2005-2015 was adopted by 168 countries; and Cambodia is one of the signatory countries. HFA is a solid legal framework for imparting knowledge on natural hazards and disasters and the implementation of disaster risk reduction measures around the globe. The HFA sets out three strategic goals and outlines five priorities for action, which cover the main areas of disaster risk reduction. The five priorities for action are:

i. Ensure that disaster risk reduction (DRR) is a national and local priority with a strong institutional basis for implementation;
ii. Identify, assess and monitor disaster risks and enhance early warning;
iii. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
iv. Reduce the underlying risk factors; and
v. Strengthen disaster preparedness for effective response at all levels.

2. ASEAN agreement on disaster management and emergency response (AADMER)

AADMER is a regional legally binding agreement that binds South East Asian Nations (ASEAN) Member States together to promote regional cooperation and collaboration in reducing disaster losses and intensifying joint emergency response to disasters in the ASEAN region. AADMER is also ASEAN's affirmation of its commitment to the Hyogo Framework for Action (HFA). AADMER contains provisions on disaster risk identification, monitoring and early warning, prevention and mitigation, preparedness and response, rehabilitation, technical cooperation and research, mechanisms for coordination, and simplified customs and immigration procedures.

The agreement has objectives to provide effective mechanisms to achieve substantial reduction of disaster losses in lives and in the social, economic and environmental assets of the Parties, and to jointly respond to disaster emergencies through concerted national efforts and intensified regional and international cooperation. This should be pursued in the overall context of sustainable development and in accordance with the provisions of this agreement.

3. National Strategies Development Plan (NSDP) 2009-2013

The NSDP has been developed to serve as the implementation tool or roadmap for the implementation of the Rectangular Strategy for Growth, Employment, Efficiency and Equity. The NSDP 2008-2013 (phase II) covers the period of the Fourth Legislature and the Rectangular Strategy. The plan recognized that natural disasters such as floods, droughts, typhoons and epidemic diseases caused losses of human lives, damage to crops and properties, and affected the national economy. The plan envisaged addressing the underline factors causing community people to be more and more vulnerable through sustainable interlinked development works.

4. Strategic National Action Plan on disaster risk reduction (SNAP) 2008-2013

The SNAP 2008-2013 was launched in 2008 to address the implementation of the Hyogo Framework for Action (HFA) in Cambodia. An inter-institutional task force co-led by the National Committee for Disaster Management (NCDM) and the Ministry of Planning (MOP) has been formed to spearhead the formulation of the strategy.

The primary motivation of the Royal Government of Cambodia in the formulation of an Action Plan for Disaster Risk Reduction (DRR) is to reduce the vulnerability of its people, especially the poor, to the effects of natural, environmental and human-induced hazards. This can best be achieved by strengthening the disaster management system in Cambodia and by incorporating a disaster risk reduction perspective into the policies, strategies and plans of government in all sectors and at all levels. The Action Plan was conceived and formulated to serve as the "road map" or guide for strengthening and undertaking disaster risk reduction in Cambodia. Implementation of the activities and projects identified in the plan can contribute significantly to the attainment of government's primary objective of poverty reduction. A strong emphasis is given towards strengthening subnational capacities, particularly at the community level, to fully support the government priority of poverty reduction as elaborated in national development plans and policies (i.e., the NSDP 2006-2010, the National Poverty Reduction Strategy (NPRS), the Cambodian Millennium Development Goals (CMDGs), the National Adaption Programme of Action to Climate Change (NAPA) 2006).

The six key disaster risk reduction components appropriate for Cambodia are identified as follows:

i. Ensure that disaster risk reduction is a national and a local priority;
ii. iStrengthen sub-national and community-based disaster risk management;
iii. Identify, assess and monitor hazard risks and enhance early warning;
iv. Use knowledge innovation and education to build a culture of safety and resilience;
v. Mainstreaming DRR into the policies and programmes of relevant government ministries; and
vi. Strengthen disaster preparedness for effective response at all levels.

5. National Adaptation Programme of Action to climate change (NAPA)

The NAPA was endorsed by the council of Ministers of the Royal Government of Cambodia (RGC) on October 20, 2006. The main goal of the Cambodian NAPA is to provide a framework to guide the coordination and implementation of adaptation initiatives through a participatory approach, and to build synergies with other relevant environment and development programmes. Cambodia's NAPA presents priority projects to address the urgent and immediate needs and concerns of people at the grassroots level for adaptation to the adverse effects of climate change in key sectors such as agriculture, water resources, coastal zones and human health.

Strategy for agriculture and water 2010-2013

This strategy, which was jointly developed by the Ministry of Water Resources and Meteorology (MoWRAM) and the Ministry of Agriculture, Forestry and Fisheries (MAFF) provides a single, transparent strategic framework that guides policy and planning processes in both ministries and the various departments and subsectors within both. The strategy aims at improving agriculture productivities and productions through sustainable uses and management of water resources and at improving coordination among these two ministries whose institutional setting in agriculture and water sector is complex. The strategy serves the most at the grass-root level because of the linkage of agriculture and water to rural affairs.

6. Practices to alleviate drought impacts

The Strategic Plan of Action is built in line with the Strategic National Action Plan for Disaster Risk Reduction (SNAP) 2008-2013 interpreted from Hyogo Framework for Action 2008-2015. The strategy consists of five priorities:

Priority 1: Strengthen institutional and technical capacities for disaster risk reduction and climate change in agriculture, and enhance coordination mechanisms;

Priority 2: Promote and enhance early warning systems for proactive disaster risk reduction and climate change adaptation;

Priority 3: Enhance knowledge management and innovation in support of disaster risk management and climate change adaptation in agriculture;

Priority 4: Reduce vulnerabilities to disasters by improving technical options and implementing community based disaster risk management and climate change adaptation measures in agriculture; and

Priority 5: Strengthen effective preparedness and response capacities and integration of disaster risk reduction and climate change adaptation into agriculture intervention.

Anticipated outcomes

The plan envisages achieving the results as below:

i. Law on Sustainable Land Management (SLM) revised and endorsed in view of Disaster Risk Reduction (DRR)/Climate Change Adaptation (CCA);
ii. DRR, CCA and SLM integrated into planning and activities of all relevant departments, institutions and stations within the General Directorate of Agriculture (GDA);
iii. Farmers make use of agromet information and Early Warning Systems (EWS) for decision-making on improving their cropping production systems and their livelihood;
iv. Capacity of sub-national planner/extension workers on resilient agriculture technique enhanced;
v. Documents and good practices on agriculture resilience available and widely shared; and
vi. Farmers received timely emergency response for agriculture.

Indicators:

i. Number of departments/institutions/stations of GDA developed DRR/CCA plan,
ii. Number of agromet bulletins issued/broadcasted/shared,
iii. Number of farmers that apply good practice and resilient agriculture technique,
iv. % of agriculture sector contributing to GDP growth,
v. % of farmers in disaster prone areas affected by food insecurity.

The need for knowledge and skills on drought management

Capacity development

Strengthening institutional and technical capacities is necessary for effective implementation of the priorities. Though capacity development is specifically addressed under the Priority I, this applies to all the Priorities based on need. The core areas of capacity development includes research and development, technology transfer, tools and methods for assessment, agriculture and crops services, policy advocacy, awareness raising and mainstreaming information.

Knowledge and communication

There is a lack of knowledge and awareness about disaster risk and climate change related measures and impacts at all levels. Communication between research and development in general and to the extension system in particular are the key to transfer new innovations to farmers. Generation, documentation, sharing and application of information directly contribute to meeting Priority III.

Partnership

Strategic partnerships promote an interdisciplinary approach in implementing the priority actions. The Strategic Plan of Action foresees partnerships at all levels and among other General Directorates and Administrations within MAFF and among other ministries, specifically MoWRAM and NCDM.

Gender

The gender dimension is crucial in DRM and agriculture sectors, where gender inequalities in access to and control over resources are persistent with regard to undermining a

sustainable and inclusive development of the sector. Leadership or women in the position of decision-making is rather small in these sectors. Gender roles and relations affect food security and household welfare, and are critical indicators of agriculture development. Integration and mainstreaming of gender priorities in all activities is a key for successful implementation of this Strategic Plan of Action.

References

The Department of Agricultural Land Resources Management (DALRM) of General Directorate of Agriculture (GDA) (2013). *Plan and Action for Disaster Risk Reduction in Agriculture in Cambodia for 2014-2018*. Ministry of Agriculture, Forestry and Fisheries (MAFF)

Vathana, S. and Sothea Oum, Ponhrith Kan, Colas Chervier (2013). I*mpact of Disasters and Role of Social Protection in Natural Disaster Risk Management in Cambodia*. ERIA Discussion Paper Series.

World Meteorological Organization (WMO). (2006). *Drought Monitoring and Early Warning: concepts, progress and future challenges*. Weather and climate information for sustainable agricultural development. ISBN 92-63-11006-9 (WMO-No 1006).

China

Mei Xurong[1] and Yang Xiaohui[2]

Background

Drought in China is the most serious natural disaster for the ecosystem and socio-economic development due to the domination of typical East Asian Monsoon climate. The temporal-spatial distribution of annual precipitation induces 26.7 per cent of national land territorial area to have an arid and semiarid climate, mainly in northwestern China where drought is normal and frequent. There is also a spring drought in northern China and a summer drought in southern China and spatially drought/flood fluctuates between south and north China.

In recent decades, due to global climate change, China has suffered a series of extreme droughts. This includes the spring-summer drought in northern China in 2000 and 2001, the spring drought in Yunnan in 2005, the spring-summer drought in Sichuan and Chongqing in 2006, the summer drought in southern China in 2007, the summer drought in Chongqing in 2008 and the spring-summer drought in five southwest provinces in 2010. It is obvious that drought occurrence in China has expansion trend to the south and southwest region which has a humid climate, and that drought is becoming severe more frequently.

Such drought occurrences have resulted in the deterioration of livelihoods and socio-economic losses, particularly in the agricultural, industrial and ecological sectors. Over the past decade (2000-2012), droughts affected 22.29 million hectares (18 per cent of cultivated land) of cropland annually and resulted in grain losses of up to 30.83 billion kilograms (6 per cent of gross production). More so, 24.75 million people and 16.62 million livestock had difficulty in accessing safe drinking water (The State Flood Control and Drought Relief Headquarters, 2012). Rural areas are the most drought-prone, and the rural poor are the most vulnerable group to drought.

1 Department of Research Management
2 Institute of Desertification Studies, Chinese Academy of Forestry

Drought monitoring and early warning systems

The national meteorology service has built a long-term meteorological monitoring network for temperature, precipitation, relative humidity, wind speed and soil moisture observation and assessment. In recent years, significant progress has been made on the application of satellite remote sensing for regional drought monitoring. China Meteorological Administration (CMA) has developed national drought grading indices and early warning and assessment systems. Based on the national meteorology service, China's Climate Observation System (CCOS, Beijing) and Arid Climate Observation System (ACOS, Lanzhou), the National Center for Arid Climate Monitoring and Warning (NCACMW) has built a unified, responsive and efficient drought warning system, including a drought warning model, a numerical weather prediction model, disaster assessment criteria and decision management. Currently, a daily report of soil moisture monitoring, a real-time report of integrated agricultural drought monitoring, and a weekly report of agricultural drought forecasting are released nationwide.

The national water resource service has set up a hydrological monitoring network for the ground water table, rivers and lakes' water levels, water flow discharge, rainfall, evaporation and soil moisture. The drought monitoring report is released based on the precipitation anomaly index.

China's Flood Control and Drought Relief Headquarters have organized national departments for meteorology, water, agriculture and civil administration to reduce impacts of drought as well as mitigation and relief of associated risks through a joint effort. As a result, data exchange and disaster consultation mechanisms are strengthened between the meteorological department and the water resource department, so that the two departments are able to cooperate in joint drought monitoring and early warning.

Vulnerability assessment

Drought has negative impact to almost all socio-economic sectors in China. In relation to their importance to socio-economic development, the most vulnerable sectors are food production, clean drinking water, forestry and grassland production, industry, service, hydraulic power, water and the environment.

The agricultural circumstance in China can be summarized by the "depend on heaven for food", since agriculture and food production is the most vulnerable sector to drought. For example, drought in 2000 induced 60 million tons of grain losses (over 10 per cent of GDP). In 2001, grain losses also reached 55 million tons.

Since 2010, drought-prone areas and grain losses showed a declining trend (figure 1a and b) due to the fact that the drought-prone area has been shifting to south-western China, where there is less cropland and grain production. However, the number of people and livestock who have difficulty accessing drinkable water has not changed significantly (see figure 2 a and b)."

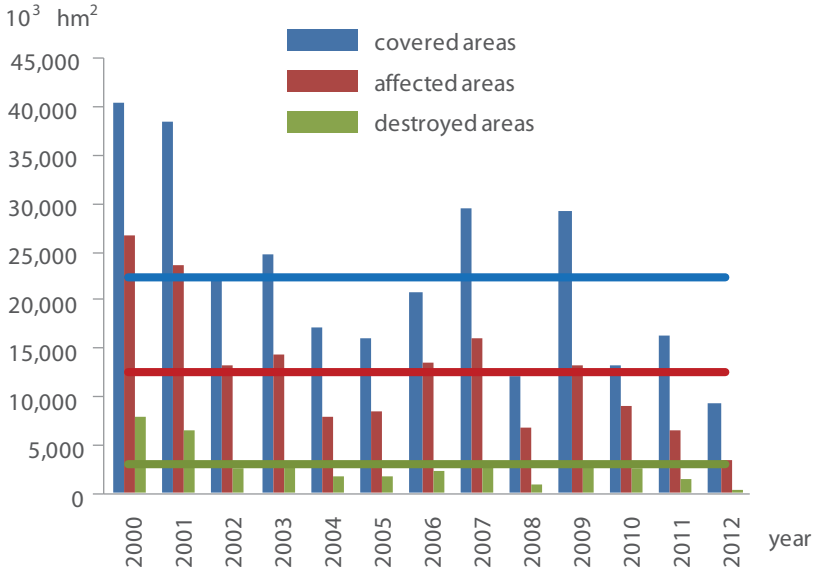


Figure 1a: Drought covered, affected and destroyed crop areas (2000-2012)

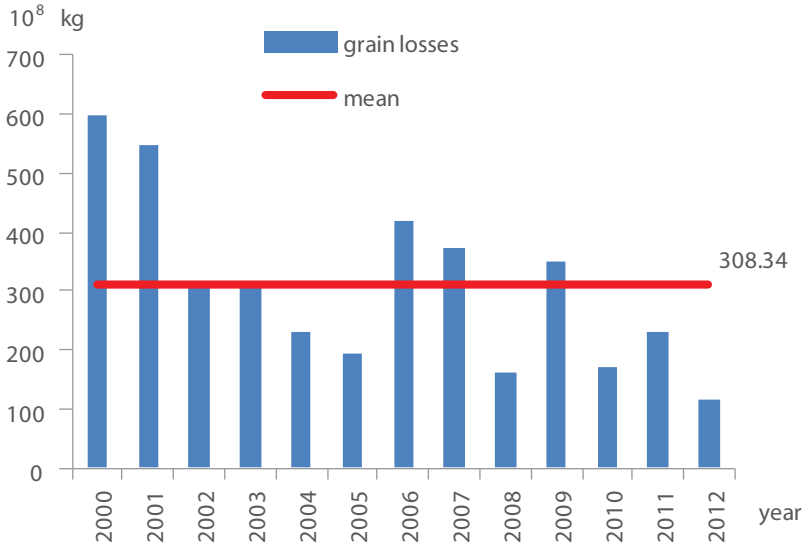


Figure 1b: Grain losses as a result of drought (2000-2012)

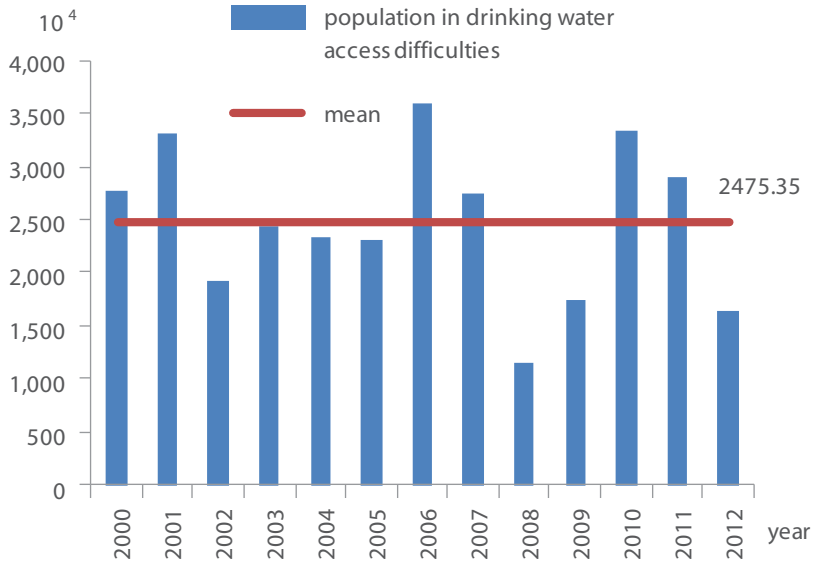


Figure 2a: Population with difficulties in access to drinking water (2000-2012)

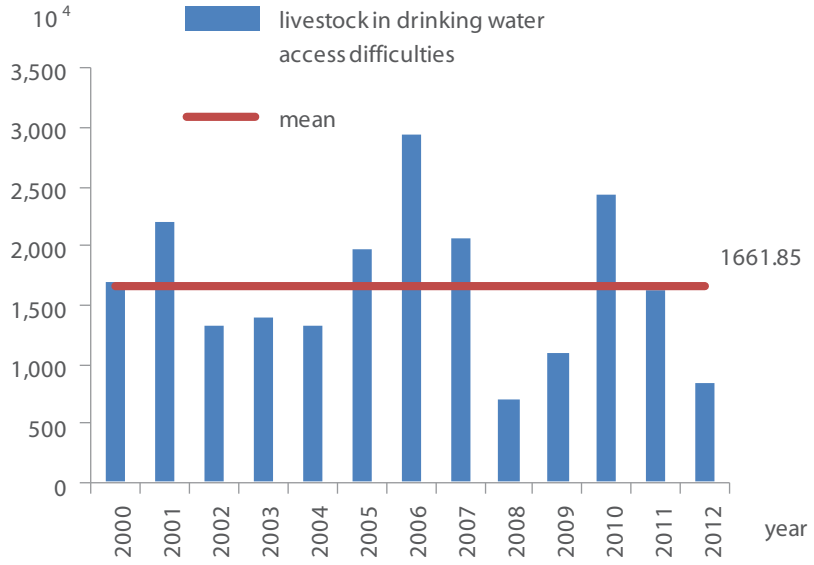


Figure 2b: Livestock with drinking water access difficulties (2000-2012)

In 2010, according to the Bulletin of Drought and Flood Disasters issued by the State Flood Control and Drought Relief Headquarters, severe drought caused 150.92 billion RMB (about USD $23.6 billion) of national immediate economic losses, of which five provinces in southwestern China accounted to 98.20 billion RMB (USD $15.3 billion), almost two thirds of the total and 2.1 per cent of local GDP. Drought in the region also induced 4.36 million tons of grain losses, temporal food shortages that affected 12.97 million people, the loss of 394.67 thousand hectares of cash crops and 20.15 billion RMB in economic losses. Meanwhile, the total number of people and livestock living in 'drinking-poverty' in China accounted for 70.0 per cent and 66.6 per cent of the whole nation respectively. In 2010, 14.22 million people in small villages had to transport potable water either by walking or using animal transport up to dozens of kilometers for more than half a year.

Drought impacts on forestry and grassland are not only the production side, but also increase the risk of fire. For other sectors, the major impacts have been a reduction in the capacity of production or services.

Emergency relief and drought response

There are various forms of disaster relief in China, including a central and local government disaster relief fund and commercial insurance, as well as public donations.

The central and local governments have major duties for emergency relief through the relief fund. The local government should have a dominant role with regard to emergency relief following the principle of hierarchical duties and responsibilities. For different natural disasters, and using the framework of mutual coordination led by the Ministry of Civil Affairs (MCA), the Ministry of Finance (MOF) and the National Reform and Development Commission (NDRC), the central finance department arranges the special relief fund for extreme disasters based on the actual expenditure of the last year according to the Budget Law.

Besides the relief fund, emergency goods and materials such as drinking water, food, cash, seeds, forages, agricultural machines, substances for drought resistance, technologies for disaster reduction and technical training are delivered by the government. As well, drought resistance allowances are used for maintaining living standards and restoring agricultural production.

To complement drought relief with regard to food production, in 2012 legislation that allows for agriculture insurance became available and was based on policymaking discussions dating back to 2004. From 2007 to 2011, a total of 26.21 billion RMB had been paid

by central finance for agricultural insurance premium subsidy. Meanwhile, commercial insurance was developed for agricultural disaster relief by using the insurance premium subsidy. As well, an advanced Weather Index methodology for agricultural insurance was developed and applied by the Institute of Environment and Sustainable Development in Agriculture (IEDA) of the Chinese Academy of Agricultural Sciences (CAAS), which supported and cooperated with WFP and IFAD. The emergency relief system is costly but effective in terms of recovering from disaster rapidly.

Practices to alleviate drought impacts

Government takes major responsibilities for alleviating drought impacts in concerted effort following the implementation according to the regulation guidance. In China, the Emergency Plans for national meteorological disasters, national disaster relief and reduction, major agricultural natural disasters, and National Flood Control and Drought Contingency Plan have been issued by the relevant pertinent departments.

Meteorological departments monitor and forecast drought occurrence and operate artificial precipitation in time. Agricultural and forestry departments guide drought management technology to promote production. Water departments respond by allocating water supply for irrigation and drinking based on soil moisture analysis. Health departments take measures to prevent and cope with public health emergencies due the lack of drinking water caused by droughts. The civil administration prepares rescuers and relief goods, and provides essential living relief.

Since 2008, efforts focused on drought impact reduction and mitigation for increased food production has been made through technology subsidies. The central government arranges for an annual budget for winter wheat drought prevention by spraying mixed liquid (pesticide, fungicide, plant regulator, and leaf feed and micro-element fertilizer) once; prevent pests and diseases, dry/hot wave, and lodging. Such efforts aim at reducing losses from various natural and biological disasters and function positively.

The need for knowledge and skills on drought management

Consequently, effective leadership of the government in China plays a key role in ensuring essential living conditions for vulnerable sectors of the population, reducing drought impacts and recovering production. But current drought management focuses on emergency, rather than pre-preparation management such as drought risk assessment and drought insurance products.

Since drought emergency and development take a relatively longer time, the hazardous impacts of drought on socioeconomic sectors are very often ignored. Therefore, the awareness of drought risk and its management should be strengthened. Historical drought scenarios and real-time occurrences, drought-prone-object based monitoring and risk assessment is essential knowledge, but it is still weak and needs to be better developed.

Furthermore, information, knowledge and experience exchange and sharing should be improved among meteorological, water, agricultural, civil administration and health departments, so that integrated assessment, early warning and preparation mechanisms can be perfected in order to improve drought risk management, and provide an accurate and timely service for drought reduction, mitigation and relief.

References

He Hui (2010). China gauging station network. *Advances in Water Science*, vol. 4, No. 005, pp. 460-465.

Ju W. M, Sun Han and Tang Zhicheng. (1996). *Application of meteorological satellite remote sensing to drought monitoring. Journal of Catastrophology*, vol. 11, No. 4. pp. 25-29.

Kuang Zhaomin and others (2007) *Application of Multi-sources Satellite Data in Monitoring Sugarcane Droughts. Chinese Journal of Agrometeorology*, vol. 28, No. 1, pp. 93-96.

Lin N and Tang J. (2001). *Study on the environmental evolution and the causes of desertification in arid and semiarid regions in China*. Scientia Geographica Sinica, vol. 21, No. 1, pp. 24-39.

Oron G. and others (1999). *Wastewater treatment, renovation and reuse for agricultural irrigation in small communities. Agricultural Water Management*, vol. 38, No,3, pp. 223-234.

Qiu Haijun and others (2013). *Relationship Between Frequency and Magnitude of Drought Damage in China in 1950-2010*. Science Geographica Sinica, vol. 33, No. 005, pp. 576-580.

Ministry of Water Resources of People's Republic of China. (2010). *The State Flood Control and Drought Relief Headquarters*. Bulletin of Flood and Drought Disasters in China.

Ministry of Water Resources of People's Republic of China. (2012). *The State Flood Control and Drought Relief Headquarters*. Bulletin of Flood and Drought Disasters in China.

India

Brij Mohan Singh Rathore[1], Ridhima Sud[1], Vivek Saxena[1], Laxman Singh Rathore[1], Venkata Godavarth Subrahmanyam[1], Tilok Singh Rathore[2] and Murari Mohan Roy[3]

Background

Drought affects all parts of our environment as well as our communities. Different types of droughts have varying economic, environmental and social impacts. Approximately 16 per cent of India's geographic area, mostly arid, semi-arid and sub-humid is drought-prone (Government of India- GOI, 2013a). Due to high temporal and spatial variability in rainfall and wide variations in physiographic and climatic conditions in the country, droughts are experienced in varying intensities (moderate or severe) almost every year irrespective of a good monsoon. Since 2001, India has experienced three major droughts, in 2002, 2004 and 2009, severely affecting the various sectors and overall economic development of the country. The National Commission on Agriculture classifies droughts as meteorological, agricultural and hydrological based on the concept of its utilization. While it is difficult to demarcate the onset and end of drought, the impacts can be severe affecting the poorest and most deprived sections of the society (NRSC, 2008). India is primarily an agrarian economy and while the sector's contribution to the national Gross Domestic Product (GDP) is gradually declining – from 51.9 per cent in 1950-51 to 13.7 per cent in 2012-13 at 2004-05 prices – it employs over 50 per cent of the population. Adding to the vulnerability is the fact that approximately 56 per cent of the total cropped area is rain-fed (GoI, 2013a). Although the country has experienced three major droughts between 2002 and 2012, the capacity to cope with the adverse impacts is steadily increasing due to improved technology and irrigation and partly due to diversification of rural economic activities away from pure farm activity (GoI, 2013a). Several policy measures undertaken by the Government of India help in building capacity for drought prevention, preparedness, mitigation and management. This has also led to a shift in perception of droughts from a 'crisis of an urgent nature' to a management issue (GoI, 2012).

1 Ministry of Environment and Forests
2 Arid Forest Rersearch Institute
3 Central Arid Zone Research Institute

Drought monitoring and early warning systems

A wide network of observatories routinely monitor rainfall situation over different spatial and temporal scales in the country. Since 1992, the India Meteorological Department, Earth System Science Organisation (ESSO-IMD) monitors the rainfall situation throughout the year in different spatial scales (districts/states/meteorological subdivisions) and all India in daily, weekly/monthly/seasonal scales. Based on this data, ESSO-IMD prepares rainfall reports for the use of different state/central government agencies. Until 2012, ESSO-IMD was monitoring drought by using two most important drought indices viz. percent deviation of rainfall from normal and Aridity Anomaly Index (AAI). The first one covers meteorological drought while the second one is used for agricultural drought by monitoring the incidence, spread, intensification and recession of drought. Since 2013, ESSO-IMD has been using the Standardized Precipitation Index (SPI) to monitor drought in the districts of India on a monthly scale. This is in accordance with the guidelines issued by the World Meteorological Organization which recommends SPI as the most useful drought monitoring index because of its versatility in covering all three forms of drought viz. meteorological, agricultural and hydrological. In addition to the standard monthly and cumulative SPI, weekly district SPI maps are computed and prepared to monitor progress, starting or ending of agricultural drought. In addition to the SPI and AAI, the Normalized Difference Vegetation Index (NDVI) is also used in drought monitoring. The Central Water Commission, National Centre for Medium Range Weather Forecasting, National Remote Sensing Centre and National Rainfed Area Authority are other key agencies that provide early warning.

The Drought Research Unit was established in 1967 by the ESSO-IMD to conduct studies on various aspects of droughts in India. The ESSO-IMD in collaboration with ICAR has set up 130 Agro-Meteorological Field Units (AMFUs) and provide medium range weather forecasts based on agro-advisories at district level (GoI, 2010). The Crop Weather Watch Group at the Central level, collects data from monitoring mechanisms of rainfall, water resources, crop growth etc. and assesses the status of these parameters on a weekly basis.

In order to overcome the limitations of drought monitoring, the National Agricultural Drought Assessment and Monitoring System (NADAMS) project provides near real-time information on prevalence, severity level and persistence of agricultural drought at state/district/sub-district level. The project currently covers 13 states of India which are predominantly agriculture based and prone to drought situation. The drought atlas for India is being developed by the National Atlas and Thematic Mapping Organisation (NATMO) which when integrated with the planning process would help identify and prioritize specific areas in risk management.

Vulnerability assessment

Vulnerability assessment considers the potential impact of loss caused by a disaster as well as the vulnerability of the drought area. India is vulnerable, in varying degrees, to a large number of disasters including drought. Drought adversely impacts the livelihoods and economies of a large section of population in the rain-fed, arid and semi-arid regions. According to the National Remote Sensing Centre (2008), about two thirds of the geographic area of India receives low rainfall (less than 1000 mm), which is also characterized by uneven and erratic distributions. Out of net sown area of 140 million hectares, about 68 per cent is reported to be vulnerable to drought conditions and about 50 per cent of such vulnerable area is classified as 'severe', where frequency of drought is almost regular. Agriculture is the immediate victim of drought disaster – impacting crop area, crop production and farm employment. According to Murthy et al. (2010) the 1987 drought in India damaged 58.6 million hectares of cropped area affecting over 285 million people. The 2002 drought reduced the sown area to 112 million hectares from 124 million hectares and the food grain production to 174 million tons from 212 million tons, thus leading to a 3.2 per cent decline in agricultural GDP (Murthy et al., 2010).

Since only 45.0 per cent (2009-10) of the total cropped area is under irrigation, any shortfall in rainfall adversely impacts crop production (GoI, 2013a). The dependency of the agricultural sector on the Indian summer monsoons is evident from the fact that despite a record production of food-grains (259.32 million tonnes in 2011-12), the delayed onset and deficient first half of the South West Monsoon in 2012 had an adverse impact on Kharif crop area coverage and yields (GoI 2013b).

Agricultural losses impact the income and purchasing power of farmers – converting small and medium farmers into agricultural labourers resulting in an increase in unemployment. Consequently, farmers and farm workers tend to migrate to urban areas in search of employment opportunities. The 2002 drought, one of the severest in India, affected 56 per cent of its geographical area, the livelihoods of 300 million people and 150 million cattle in 18 states. The GoI had to provide relief amounting to about USD $4500 million (Das et al., 2007). Shortage of drinking water supplies and food insecurity are the other consequences that emerge. Fodder deficit drives away the animals to distress sales. Thus, while climate is the initial causative factor for drought, its implications are governed by the human interactions with the situation.

For demarcating drought prone districts, a combination of variables including climatic, area under irrigation and source of irrigation are used. Developing vulnerability profiles

for regions and communities help provide critical information about the effected entity, the nature of risk and the reasons for such risk (GoI, 2010). In the context of increasing climate variability and climate change, there is growing recognition of a need for effective and efficient drought warning systems that rely on accurate and timely assessments of soil crop, micro-climate (because of slow onset nature of drought) and its linkage with livelihoods support programme to trigger mitigation and emergency response programmes at the grass-roots level (Bandyopadhyay, 2009).

Emergency relief and drought response

While early warning indicators for drought have a considerable degree of ambiguity, as they may or may not culminate in a full-blown drought, the government has in place the requisite and institutional and policy framework to address the challenge.

Legal and institutional framework

While the central government plays the role of a facilitator, the primary responsibility of managing drought (or any other natural calamity) is that of the respective State government. With the enactment of the Disaster Management Act in 2005, the National Disaster Management Authority (NDMA) was set up as the apex body for Disaster Management in India, with the Prime Minister as its Chairman. Further, Disaster Management Authorities at the State and District Levels are headed by the Chief Ministers and Collectors/Zilla Parishad Chairmen respectively.

There is growing awareness about the benefits of an integrated approach to disaster risk management because of its greater economic efficiency (Kull et al., 2013). For effective drought management, India has in place an institutional mechanism that ensures coordinated action across ministries. The Ministry of Home Affairs is a nodal authority for natural disaster management. The other coordinating agencies are ministry(s) of Agriculture, Rural Development, Drinking Water Supplies, Water Resources, Health, Science and Technology, Department of Space, Indian Meteorological Department, Relief Commission of state governments and non-governmental organizations (Gupta et al., 2011).The Department of Agriculture and Cooperation is mandated to coordinate relief measures necessitated by drought. The National Disaster Management Cell, at the Ministry of Agriculture monitors the drought situation in different states and the resources availability.

District-wise contingency plans are prepared by the Central Research Institute for Dryland Agriculture (CRIDA), in collaboration with State Agricultural Universities (SAUs) / Indian Council of Agricultural Research (ICAR) Institutes / Krishi Vigyan Kendras (KVKs)

(GoI, 2012). Research institutions like the International Crops Research Institute for Semi-arid Tropics, Central Arid Zone Research Institute, Indian Grassland and Fodder Research Institute, Central Soil Salinity Research Institute, Indian Council of Forestry Research and Education and those under the Indian Council of Agriculture Research provide information on various aspects of drought management (Gupta et al., 2011).

Policies and programmes

In 2009, India launched its National Policy on Disaster Management with a vision to build a safe and disaster resilient India. The policy aims to develop a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response (GoI 2009). Some of the major government programmes help mitigate the adverse impacts of drought and build resilience of people by encouraging efficient water management practices, ensuring livelihoods, ensuring economic access to food and supplying fodder among other measures. A major programme of the GoI, significant from a drought relief and management perspective, is the Mahatma Gandhi National Rural Employment Guarantee Scheme. The scheme aims to provide minimum job guarantee for 100 days in a year to adult family members of rural households below the poverty line. The days for wage employment can be increased in drought years to help stabilize incomes.

Finance

The National Disaster Response Fund (NDRF) and State Disaster Response Fund (SDRF), constituted under the 2005 Disaster Management Act, provide immediate drought relief to the affected people. For combating the adverse financial impacts of drought, the National Agricultural Insurance Scheme (NAIS) was introduced in 1999 and the Weather Based Crop Insurance Scheme in 2007. In 2003, the GoI also set up the Agriculture Insurance Company of India (AIC) to better serve the needs of farmers and facilitate a sustainable actuarial regime. Besides commercial and regional rural banks, the cooperative credit sector also makes financial credit available to the farmers on easy terms (GoI, 2010).

Practices to alleviate drought impacts

Several of the programmes of the GoI help build resilience of communities against drought. Since 2005, there has been a paradigm shift from the erstwhile relief-centric response to a proactive prevention, mitigation and preparedness-driven approach for conserving developmental gains and also to minimise loss of life, livelihood and property (GoI, 2010). The National Mission for Green India, one of the eight missions under India's National Action Plan on Climate Change, aims at improving the quality of forest cover in 5

mha and creating new forest cover in another 5 mha over a 10 year period with a project cost of about USD $8 billion. Currently, there is an outlay of USD $2.14 billion, from 2012 to 2017, to address 2.8 mha of predominantly degraded lands and help restore multiple ecosystem services as well as enhance livelihoods of the households dependent on these lands. The Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), a flagship employment guarantee programme with an annual outlay of approximately USD $8.23 billion has a strong focus on land, water and afforestation activities. Similarly the Integrated Watershed Management Programme (IWMP) has targeted development of 75 million hectares of rainfed/degraded area in a phased manner from 2007 to 2027. For the period from 2013 to 2014, the IWMP has an outlay of USD $0.88 billion. India's draft National Water Policy (MoWR, 2012) seeks to address issues such as the scarcity of water, inequities in its distribution and the lack of a unified perspective in planning, management and use of water resources. Other key programmes of the GoI that help build resilience of drought affected people include the National Watershed Development Project for Rainfed Areas, National Food Security Mission, National Horticulture Mission and Rashtriya Krishi Vikas Yojana, and National Mission on Micro Irrigation. The possibility of reorienting regular development programmes of the Central and State governments is also being explored.

There is tremendous potential for harnessing Indigenous Technical Knowledge (ITK) for alleviating drought impacts. India is endowed with a rich repository of knowledge relating to cloud formation, lightning, wind direction, rains and drought which has evolved over centuries to perceive and manage natural disasters and extreme weather events by disaster prediction, response, mitigation, and effects of weather on crops (Gupta and Singh, 2011; Pareek and Trivedi, 2011). The vast and time-tested ITK on natural resource management can be extrapolated to understand the modern concepts of disaster risk management in terms of early warning, preparedness, mitigation, response and relief (Gupta and Singh, 2011).

The need for knowledge and skills on drought management

While India has strong drought assessment capabilities, there is need to enhance capacity for early warning and impact monitoring, particularly in the light of climate change impacts, which can further compound the challenge of drought monitoring for early warnings because of wide variability in rainfall patterns even at local levels. Lack of adequate drought monitoring systems and the capacity to respond via appropriate political, institutional and technological frameworks, inhibit the development of integrated drought management plans or early warning systems. There is the need of a top-down

approach to provide national real-time drought monitoring and seasonal forecasting, and a bottom-up approach that builds upon existing regional and local systems to provide national coverage.

Drought management capabilities can also be further strengthened and several studies suggest measures for this purpose. For example Prabhakar et al. (2007) highlights that although agromet advisories to help farmers adopt appropriate agricultural practices are issued on a weekly and bi-weekly basis by the local governments, there is a need to enhance medium- and long-range forecast capabilities. Effective and timely coordination among various ministries/departments/organisations can enhance the drought management results (GoI, 2010). The measures that can be undertaken at the national and regional level are as follows:

National Level

1. Further strengthening of the observational network for drought monitoring to bridge the gap between the existing and desired meteorological and hydrological monitoring network;
2. Improvement in information and communication technologies in an integrated manner for tacking the multifaceted challenge of drought at various spatial scales;
3. Capacity enhancement for medium and long range drought forecasting;
4. Better coordination among ministries and departments; and
5. Developing mechanism for context specific and need based forecasting including local language for better understanding.

Regional Level

1. Enhancement of real time monitoring capabilities at a regional level through training and joint monitoring programmes;
2. Improvement in methodologies and analytical tools for drought analysis and vulnerability assessment at local and regional level;
3. Organization of joint training programmes to build human capacity in improved resilience towards drought;
4. Effective and collaborative implementation of drought relief programmes; and
5. Strengthening effective water and commodities supply system.

References

Bandyopadhyay S.K. (2009). *Linking future climate change with drought in development planning for preparedness and mitigation.* In Abstract of Second India Disaster Management Congress, New Delhi. National Institute of Disaster Management, New Delhi.

Das, S.K, R.K. Gupta and H.K. Varma (2007). *Flood and drought management through water resources development in India'.Bulletin.* The Journal of World Meteorological Organization, vol. 56 No.3.

GoI (2009). N*ational Policy on Disaster Management. Ministry of Home Affairs.* Government of India. Available from http://nidm.gov.in/PDF/policies/ndm_policy2009.pdf.

GoI (2010). N*ational Disaster Management Guidelines; Management of Drought, National Disaster Management Authority,* Government of India. Available from http://www.ndma.gov.in/en/ndma-guidelines.html. Last Accessed: 20th April 2014

GoI (2013a). R*eserve Bank of India Annual Report 2012-13*. Government of India.

GoI (2013b). *State of Indian Agriculture*, 2012-13. Ministry of Agriculture, Government of India.

GoI (2012). *Crisis Management Plan; Drought (National).* Ministry of Agriculture, Government of India.

Gupta, A.K. and A. Sing (2011). *Traditional Intellect in Disaster Risk Mitigation: Indian Outlook-Rajasthan and Bundelkhand Icons*, Indian Journal of Traditional Knowledge, vol. 10, No. 1, pp. 156-66.

Gupta, A.K., P. Tyagi and V.K. Sehgal (2011). D*rought disaster challenges and mitigation in India: strategic appraisal, Current Science*, vol. 100, no. 12, pp. 1795-806.

Kull, D., R. Mechler and S. Hochrainer-Stigler (2013). *Probabilistic cost-benefit analysis of disaster risk management in a development context.* Disasters, vol. 37, no. 3, pp. 374-400.

MoWR (2012). *Draft National Water Policy, 2012 as recommended by National Water Board in its 14th meeting held on 7th June 2012.* Ministry of Water Resources, Government of India. Available from: http://mowr.gov.in/writereaddata/linkimages/DraftNWP2012_English9353289094.pdf.

Murthy C.S. and M.V.R. Sesha Sai (2010). *Agricultural Drought Monitoring and Assessment'.* In Remote Sensing Applications, P.S. Roy, R.S. Dwivedi and D. Vijayan, eds. National Remote Sensing Centre, Indian Space Research Organization, Department of Space, Government of India.

NRSC (2008). *Agricultural Drought.* National Remote Sensing Centre, Indian Space Research Organization, Department of Space, Government of India. Available from http://www.dsc.nrsc.gov.in/DSC/Drought/index.jsp?include1=homelink2_b1.jsp&&include2=homelink2_b2.jsp. Last Accessed: 24th April 2014

Pareek, A. and P.C. Trivedi (2011). *Cultural values and indigenous knowledge of climate change and disaster prediction in Rajasthan, India*. Indian Journal of Traditional Knowledge, vol. 10, No. 1, pp. 183-9.

Prabhakar, S.V.R.K and R. Shaw (2007). *Climate change adaptation implications for drought risk mitigation: a perspective for India*. Climatic Change, vol. 88, pp. 113-130.

Indonesia

Nurhayati[1] and Yuli Utami[2]

Background

Meteorological drought occurs when there is a prolonged period of below average precipitation which creates a natural shortage of available water. Indonesia has two seasons, namely the rainy season which is associated with floods, and the dry season which in most cases is attributed to drought. Drought frequently occurs when there is El Niño phenomenon, but it did not always lead to a severe drought, since there were other factors triggering drought in Indonesia such as land cover change, land clearing and climate anomaly.

Severe drought events happen in Indonesia during the dry season when there is a moderate to strong El Niño, such as in 1997 when there were severe forest fires in both Sumatra and Kalimantan regions. The monthly rainfall distribution of Indonesia for June, July and August 1997 showed much less rainfall and dry conditions over south Sumatra, Java and central Kalimantan. In the last 10 years droughts have occurred in Indonesia, for instance, the 2002 drought caused dryness in rice field areas, which resulted in crop losses for 350,000 acres of farmland. A similar situation occurred in 2007. Land degradation and forest fires in Indonesia have also contributed to hydrometeorological disasters such as floods, droughts, landslides – which result in significant losses for agriculture and farming, and which in turn threaten national food security. The 2007 drought caused over 20,000 acres of paddy fields to experience crop failure.

Drought monitoring and early warning system

The Indonesia Agency for Meteorology, Climatology and Geophysics (BMKG) issues meteorological drought information on a regular basis using the Standardized Precipitation Index (SPI) method. The SPI is a WMO recommended tool showing an index calculated based on the probability of the recorded amount of rainfall; negative index values for drought, and positive for wet conditions. SPI can be used to monitor climate conditions on a range of time interval (monthly, three monthly, seasonal, annual) that can be utilized for agricultural and hydrological applications.

1 BMKG, Jakarta, Indonesia
2 Ministry of Forestry, Jakarta, Indonesia

In addition to its routine products one of which is averaging the one-month and three-month Standardized Precipitation Index (SPI) and monthly percentage of soil moisture content, BMKG has released a climate early warning system consisting of drought monitoring and prediction, which are based on dry season onset, consecutive dry days (CDD, updated every 10 days) and one-month SPI analysis.

The drought early warning information has been disseminated to the related stakeholders: Ministry of Agriculture, Directorate of Water Resources, local authorities and the National Board for Disaster Management. In addition, there is a national committee on water and river basin management and its function includes making formulations for fulfilling water consumption in Indonesia. This committee consists of the Directorate General for Water Resources, the National Meteorological Service, the Directorate of Groundwater and Earth and related NGOs who meet on a regular basis as a task team to make recommendations for policymakers at the national level on appropriate actions/programmes to be undertaken in water resources issues including drought. It was the Directorate General of Water Resources who issued the early warning system containing alert level based on water level height (this is however more about flood warning).

Practices to alleviate drought impacts

So far, the government has taken some actions in coping with drought impacts. For instance, in the agriculture sector this has included providing drought tolerance seeds, water pumps, and covering the climate index insurance premium. Additional training for farmers and extension workers has provided guidance through a crop calendar system on when to start sowing, what selection of crops should be planted and how to apply proper treatment during the growing phases of plants. To reduce shortage in the domestic water supply there has been effort to build 'embung' in areas prone to drought. An 'embung' is a small reservoir/artificial well which collects and stores water during the wet period for use if there is water shortage during the dry season. Accordingly, accurate and timely seasonal prediction is critically required by the agriculture and water sectors, as well as by the local authorities.

In order to cope with the annual forest and bush fires that occur in parts of eastern Sumatra and the Kalimantan region the Indonesian Government issued at national level the Presidential Decree No 45 on Forest Protection in 2004. In addition, at the provincial level, several Governor Acts on forest fire control were applied as instruments in which the degree of alert was defined by several drought trigger parameters such as rainfall, temperature and SPI. At the field level, the Fire Danger Rating Index (FDRS) delivers early

warning information valid for a one-week forecast. FDRS consists of both a fire weather index and a flammable level forecast and is based on the meteorological conditions at the time (air temperature, relative humidity and rainfall amount). It was implemented as a joint product of three national agencies, the Ministry of Forestry, the National Space Agency (LAPAN) and the Meteorological Agency (BMKG).

At the national level, there is a National Board for Disasters Management – however, it is mainly focused on emergency response and not particularly designated for drought management and preparedness.

The need for knowledge and skills on drought management

Producing a better seasonal climate prediction is an essential need for Indonesia to meet the requirement of climate sensitive sectors such as agriculture, water, health and forestry. Improvement of forecasters' skill and capacity is critical in order to enable them to produce more accurate and timely seasonal to sub-seasonal predictions for each part of the region with their local characteristics. Frequent climate anomaly evidence, such as in 2010 and 2013 have made it difficult to predict the seasonal onset and length of droughts for users.

Capacity building for vulnerability, risk and impact assessment is also a vital step to be undertaken for setting up National Drought Policy in the country. While the government's concern and awareness regarding drought needs has to be raised, there is also a need to enhance science-based analysis on recurring drought impacts, i.e. the need to improve knowledge and skills on drought management and delivery of early warning systems. Equally, campaigns for building public awareness on severe and cumulative drought impact are necessary to be carried out at a regional level. Coordination between relevant institutions is critically required for the establishment of National Drought Policy in Indonesia. Legal frameworks would help in fostering national institutions, sectors and NGOs to start their movement and to enable them to obtain a national budget for setting up meetings and for performing risk and impact assessment analysis as a starting point to establish the policy. Furthermore, top-down initiatives are recommended in order to better coordinate related institutions and local government toward the establishment of a National Drought Policy in Indonesia.

References

Indonesian Agency for Metheorology, *Climatology and Geophysics (BMGK)*, http://meteo.bmkg.go.id/prakiraan/jabodetabek

Ministry of Forestry, http://www.dephut.go.id/

Malaysia

Nor Adawiyah Abdulah[1] , Juhaimi Jusoh[2] and Abdul Rahman Kassim[3]

Introduction

The climate of Malaysia generally is characterized by uniform temperature, high humidity, abundant rainfall and light wind. The various regions of Malaysia experience different climate characteristics that are influenced by the summer and winter monsoons, locally termed as South West and North East Monsoons. These monsoon seasons and their transition periods, the inter-monsoon seasons, account for the various wet and dry seasons. Thus we have flood seasons, including flash floods seasons, as well as the dry and hazy seasons.

The annual and monthly rainfall amount and rain day variability in Malaysia is quite large. The wet and dry seasons with variable rainfall amount and rain days, at times extremes, together with episodes of extreme weather pose a great challenge to sustainable water storage and supply management, which generally relies on direct rainwater and rainwater stored in dams.

Malaysia has suffered a series of drought events of which the three most recent ones are those of 1992, 1998 and 2014. These drought events gained particular attention because they affected the whole nation. There are other smaller scale episodes that only happen in smaller regions of the country.

In 1998, the drought was associated with El-Niño which affected the whole world, including the South East Asia region, such as southern Viet Nam, southern Philippines, Malaysia and Indonesia. In Malaysia, the affected areas included Perlis, the northern states of Peninsular Malaysia, up to the state of Negeri Sembilan and Melaka. The worst hit region included the capital city of Kuala Lumpur and part of Selangor where water rationing had to be exercised affecting some 3.2 million users for about five months from April to September 1998. The whole episode was dubbed the "national water crisis". The health of the people was also affected as the whole country also experienced severe haze disaster due to forest fires, especially from peat land forest. The economy losses due to this drought episode are estimated to be USD $9 billion. The livelihood of thousands of farmers and plantations have been affected and shattered by recurring drought.

1 Malaysia Meteorological Department (MetMalaysia)
2 Department of Irrigation and Drainage, Malaysia (DID)
3 Forest Research Institute of Malaysia (FRIM)

Drought monitoring systems

Malaysian Meteorological Department (MetMalaysia) also uses the Standard Precipitation Index and rainfall anomalies to reflect the drought severity in Malaysia.

The Standard Precipitation Index (SPI) is a relatively new drought index based only on precipitation. It is an index based on the probability of precipitation for any time scale. Some processes are rapidly affected by atmospheric behavior, such as dryland agriculture, and the relevant time scale is a month or two. Other processes have longer time scales, typically several months, such as the rate at which shallow wells, small ponds, and smaller rivers become drier or wetter. Some processes have much longer time scales, such as the rate at which major reservoirs, or aquifers, or large natural bodies of water rise and fall, and the time scale of these variations is on the order of several years.

The purpose of SPI is to assign a single numeric value to the precipitation that can be compared across regions with markedly different climates. The standardization of the SPI allows the index to determine the rarity of a current drought. The Standardized Precipitation Index (SPI) was designed to show that it is possible to simultaneously experience wet conditions on one or more time scales, and dry conditions at other time scales. Consequently, a separate SPI value is calculated for a selection of time scales.

Drought disaster in Malaysia is managed according to a Standard Operating Procedure (SOP), which was formulated by all the relevant agencies and was led by the National Security Council of the Prime Minister Office. The SOP circular was first circulated in December 2011. The SOP was formulated following several drought events that had happened in Malaysia particularly those in 1992 and 1998. The SOP provided guideline on matters related to classification of drought, the responsible agencies to monitor drought, severity of drought, line of communication and roles and the responsibility of relevant agencies should the drought event to reach a dangerous level. The most recent drought event, which lasted approximately two months from mid-January 2014 to mid-March 2014, was the first time the SOP was put into practice.

MetMalaysia is responsible for issuing drought early warnings if there is a possibility of drought based on criteria such as weather and climate forecasting tools including numerical modeling and related indexes which indicate early signs of drought, like those resulted by El-Niño.

In the SOP, if the deficit for total rainfall for at least three consecutive months is above 35 per cent from normal and the latest SPI index is less than -1.5, or the deficit for six consecutive months is above 35 per cent and the latest SPI index is less than -1.5 MetMalaysia will issue for drought early warning to the responsible agencies.

MetMalaysia also provides seasonal forecasts, long range forecasts for relevant ministrys, policy-makers, disaster management agencies, national related meetings and the public (including the North East Monsoon, South West Monsoon and national climate forum).

MetMalaysia continuously monitors the number of consecutive days without rain at selected meteorological stations. The information for the districts in Malaysia that do not receive any rainfall for five consecutive days or more is circulated daily via e-mails to relevant agencies. The agencies that receive these cautionary dry weather updates include the National Security Council, the Department of Environment and the Department of Irrigation and Drainage. The number of no rain days is also tabulated and circulated to provide the members on the Committee of Disaster Management regular updates on the severity of the dry weather event. The most recent drought event saw that 17 stations posted record on consecutive rain free days with an average of 23 consecutive no rain days.

For the Department of Irrigation and Drainage (DID) Malaysia, its drought monitoring programme was initiated in 2001 as a result of the 1998 drought incident. Among its first initiatives was the establishment of a website wholly focusing on drought monitoring. Its objective is to assist relevant agencies to make early preparations to face drought events. In 2013, the website was further improved to include additional features to better reflect the drought situation in Malaysia. DID Malaysia is given the responsibility to report on river water and reservoirs water level. On the website, 21 water level stations were set up to monitor reservoirs level and another 23 stations for rivers.

DID Malaysia also use the Standard Precipitation Index and water level in rivers and dams as a tool to monitor hydrological drought. Hydrological drought is a term used to define the deficiencies in surface flow into reservoir, stream flow and rainfall. A hydrology drought situation occurs when any river discharge is reduced or any dam level decreases continuously. This situation can be defined by the changes as given below:

a) River Discharges

When the low flow exceed five years Average Recurrence Interval (ARI) continuously for three months, a drought event is considered to be occurring. On a daily basis, DID Malaysia reports the 7-day low flow for ARI of 2, 5 and 20 years for 23 stations throughout Peninsular Malaysia, and uploads the information via its website known as InfoKemarau.

b) Dam Levels / Storage Dam

Drought event is considered when a dam level falls below the normal level for three months continuously. DID Malaysia reports the water level in 23 dams and includes useful information such as maximum water level, percentage of balance of storage, danger and critical level. This information may also be derived from the InfoKemaru. The website proved to be useful reference during the last drought episode.

Vulnerability assessment:

The monthly and annual variability is quite substantial. Malaysia generally receives less rain when El Niño occurs. The most vulnerable sector of the economy during a drought event are smallhold farmers, especially paddy farmers. Due to the variability of rainfall during planting season, the government assists farmers by providing irrigated water for the rice bowl of Malaysia (north-west of Peninsular Malaysia) as well as other areas.

During the El Niño year of 1997/1998, many parts of Malaysia experienced many months of water rationing as well as transboundary haze caused by forest fires due to the extremely dry weather. Last year and early this year has not experienced El Niño, but many parts of the country did experience an extreme dry season for the past few months. This has caused water shortages in many parts of the country, especially in the Klang Valley. There was a lot of local burning resulted haze during that period which limited most of the outdoor activities, some schools had to close for a few days and hospitals reported increasing cases that affected public health. The Malaysian Palm Oil Council (MPOC) warned the drought impact on palm oil production could be felt for up to two years. The MPOC are expecting a severe reduction (in production) in the next two years.

Emergency relief and drought response

In the agriculture sector, there have been many forms of government aid to relieve the impacts of drought. For the recent 2014 drought, it was reported that the Malaysian Government through the Ministry of Agriculture and Agro Based Industries provided cash assistance to paddy farmers; an amount of RM 1,400* (equivalent to USD $400.00) was given to farmers for every hectare of crop damage due to drought.

For aquaculture practices, in 2014 the government assisted them by providing fish fries, fish food and equipment to repair the cages. The Ministry of Agriculture and Agro Based Industries are reported to have set up a fund solely for the purpose of providing assistance to the agriculture sector. Initially a sum of RM 10 million was allocated and it is reported that the sum will be subsequently increased to RM 50 million.

It is not known whether any other sector was compensated by the Malaysian Government due to drought incidences. In Malaysia, there have been many bush and forest fire incidents due to the hot and dry spells. All in all, more than 7,000 cases were reported between early February 2014 and mid-March 2014 with an average of about 300 calls daily. The Government of Malaysia mandated the Malaysian Fire and Rescue Department as the main agency responsible for combating and managing forest fires. The SOP for forest and plantation fires ensures coordination among all relevant agencies in effectively responding to the management and control of forest fire occurrence especially during drought season.

Practices to alleviate drought impacts

The main effort in times of drought is to create rain from cloud seeding operation. Met-Malaysia was given the task to decide on the suitability of operating cloud seeding following several factors that need to be considered especially the presence of suitable rain clouds, high humidity, and unstable weather conditions. The Disaster Management Section of the National Security Council will coordinate with the Royal Malaysian Air Force to provide the necessary asset for the operation. The focus is to create rain on water catchment areas.

On a community level, the common form of practices to alleviate drought impact is to distribute water tanks to support health, community and welfare institution. In the agricultural sector, farmers or farmers' associations are provided with small water pumps to save crops and prevent losses. If the extent of losses is significant and covers a sizeable number of farmers or area, then affected farmers can receive cash assistance.

Other avenues to alleviate drought impact include increasing and intensifying the communication of a drought event via a national electronic network to the public. Other mitigation measures that are now in place include connecting the pipeline network to allow for a cross states/border water supply. Other plans include channelling water from the newly completed Triang Dam in Negeri Sembilan to Selangor, Putrajaya and Kuala Lumpur. The deferred planned water transfer from the Relau Dam in Pahang to the Langat

River should be able to relieve the water supply situation in Selangor by 2018. The tunnel has a capacity to transfer about 1800 million liters per day and should be able to provide portable water supply for Selangor, Kuala Lumpur and Putrajaya by 2025.

The need for knowledge and skills on drought management

Government agencies, statutory bodies, private sectors and NGOs that are involved in disaster management:

- Identify, document, monitor and update areas that are risk prone and face drought according to drought type in each jurisdiction;
- Provide drought early warning system infrastructure according to each jurisdiction;
- Develop and stabilize capacity in terms of human resources and competency, equipment, networks and communication, technology, finance, etc., so that any response that is taken is coordinated and effective;
- Implement efforts to increase awareness on disaster at every level of society;
- Develop expertise and skill in drought management;
- Provide an Emergency Response Plan (ERP) and Business Continuity Plan respectively;
- Provide complete inventory logistics and updates from time to time to fasten disaster response; and
- Coordinate a drought drill to test the preparedness level to face drought.

The government could plan for an improved droughts management strategy in view of climate change impacts. Some of the suggestions that have been put forth and should be considered are listed below:

- Conjunctive use of ground water;
- Integrate and build water services to where it is needed most;
- Encourage the use and construction of water storage such as low dams and rainwater harvesting systems;
- Utilise water ex-mining pools, flood mitigation ponds and other ponds and provide linkage to rivers;
- Explore use of modular treatment systems using membrane systems; and
- Practice demand management of the water supply.

Other than that, public awareness should be raised in making sure that water is used wisely, by applying water restrictions to homes and businesses. Communities should prepare for droughts by carefully managing water by not filling up community swimming pools or watering sports fields, by planning homes and buildings that use less water and making sure that water is used wisely, and by applying water restrictions to homes and businesses. Families can prepare for droughts by making sure that water is used wisely in the home and around the garden, looking out for dripping taps, leaky pipes and reducing waste water, installing a rainwater tank, having shorter showers and following water restrictions during water rationing period. While lack of drinking water causes serious hazards during drought period in Malaysia, other drought-related hazards in the country also include heat waves, haze and forest fires.

References

Malaysia National Security Council (Majlis Keselamatan Negara) (2011). *Standard Operation Procedure for Drought Disaster*.

Oron G. and others (1999). *The Asean Users' Manual for The Asean Climatic Atlas and Compendium of Climatic Statistics*. Water Resource Management, vol. 2, pp. 21–45.

Myanmar

Tin Yi[1] , Wai Myo Hla[2] and Aung Kyaw Htun[3]

Background

The potential drought hazard level for Myanmar is described as "High" for the regions in dry zones, "Medium" in the Bago region and eastern mountain ranges, and "Low" in the remaining regions except for the Yangon and Taninthayi divisions. The dry zone, classified as the central area of Myanmar is the area most vulnerable to drought as compared to other parts of the country. The area of dry zone is 67,700 square kilometers and it constitutes 10 per cent of the total area of Myanmar. The region is characterized by low rainfall, intense heat and degraded soil conditions, affecting social and economic situations of the communities living in the region. Approximately 35 per cent of the cultivable land is located in the dry zone. The temperature of the dry zone is very high and April and May are the hottest months. The precipitation in the dry zone is controlled by the monsoon circulation system. The annual precipitation in the dry zone is less than 750 mm, while the national average precipitation is 2,353.06 mm.

According to the analysis of drought indices of Myanmar (1951-2000) as shown in Figure 1, the drought indices of Myanmar show a rising trend. According to the Annual Drought Report (2010-2013) prepared by the Drought Monitoring Center of the Department of Meteorology and Hydrology (DMH) in Myanmar, drought mostly occurred in the dry zone area during the pre and peak monsoon period of 2010, and it slightly occurred during 2011 whereas severe drought occurred in the dry zone area. Moderate drought also occurred in some regions of the dry zone area and also other regions and states, and mild drought occurred in some regions and states during 2012 and 2013. Droughts in Myanmar mainly impact agricultural fields, farmers, drinking water and livestock. According to an analysis of the annual lowest water level of the stations along the Ayeyarwady and Chindwin rivers in central Myanmar area (dry zone area) as shown in Figure 2, the annual lowest water levels of these stations show falling trends. The lowest annual water level was recorded in 2010 at Monywa station and Mandalay station.

1 Ministry of Transport
2 Ministry of Environmental Conservation and Forestry
3 Dry zone Greening Department

In Myanmar a significant drought occurred during 2010. An extreme temperature of 47.2 °C was recorded at Myinmu station in the dry zone area on 14 May 2010. Myanmar was hit by a drought in 2010, which was the most severe in several decades. Temperature was higher in this year than in previous years in Myanmar and rainfall was late, causing a severe shortage of water in many parts of Myanmar. In May, 20 stations in Myanmar had record high temperatures according to the observed data of the Department of Meteorology and Hydrology (DMH). In April, the temperature was as high as 40 degrees Celsius according to the DMH's data observations. In some parts of Myanmar, the temperature was as high as 43 degree Celsius. As a result, many streams and water reservoirs have dried up all over Myanmar. Inle Lake, which is a major tourist destination in the Shan State of Myanmar, has dried up in many parts. Water shortage is most severe in Ayeyarwaddy (Irrawaddy), Sagaing, Yangon (Rangoon), Mandalay and Bago Regions and Mon, Rakhine and Shan States. Most of the wells had dried up due to the depletion of underground water supply because of a late monsoon which has resulted in a scarcity of drinking water problems in Myanmar. Droughts impact the socio-economic, health, public, livestock and environment of Myanmar.

Drought monitoring and early warning systems

Drought monitoring work, over the years, has been undertaken mainly by the Ministry of Agriculture and Irrigation. The DMH has one center in Mandalay that is devoted to drought monitoring and forecasting and this can be further improved. Cooperative efforts between various concerned agencies such as agricultural planning, irrigation, health, dry zone greening, forestry, national conservation for environmental affairs and livestock breeding will also be encouraged for drought management in Myanmar.

In Myanmar, there are 63 meteorological stations, 28 hydrological stations, 17 agro-meteorological stations, eight aviation weather stations and one upper air station under the Department of Meteorology and Hydrology (DMH). The early warning system is the main responsibility of DMH for disaster risk reduction in Myanmar. DMH issues the daily, 10-day, monthly and seasonal weather and water level forecasts, news, warnings and bulletins for storms, floods, untimely rainfall and temperature as well as the Minimum Alert Water Level and Bulletin for seven stations in the dry zone area during low flow period. DMH also issues the 10-day agro-meteorological bulletins to support the agriculture. In these bulletins, the soil moisture water balance, rainfall, temperature, relative humidity and evapotranspiration of all regions and states of Myanmar are included. In 2010, the DMH also established a drought monitoring center at the upper Myanmar office (Mandalay office), which is located in a dry zone area. This center now prepares and issues

seasonal and annual drought reports based on rainfall conditions. However, the DMH cannot issue warnings for drought management. So the DMH needs to upgrade their drought monitoring center through capacity-building and also forecasting techniques, etc. The DMH is trying to upgrade the data observation networks, improve their forecasting techniques, increase capacity-building and ensure an early warning system in cooperation with international organizations. Other relevant departments such as the Forest Department has carried out dry zone rehabilitation activities since 1953, the Agricultural and Rural Development Corporation (ARDC) was formed and development activities were carried out in central dry zone of Myanmar from 1953-54 to 1963-64 (10-year period). By 1963, the Forest Department (FD) took on the responsibility of the task. Two 10-year work plans (from 1963-1964 to 1972-1973 and from 1972-1973 to 1981-1982) were drawn up for a period of 20 years (from 1963-1964 to 1981-1982) and implemented in the development of the central dry zone. At that time activities were mostly concentrated in Meikhtila forest district, particularly for reforestation of watershed areas, establishment of village-owned-forests and model forests in Mount Poppa watershed area.

After constitutional reform of the FD in 1982 (through withdrawal of district level administration) and after the 1988 disturbances, in 1994 a three-year pilot project called the 'Special Region - Nine District Greening Project' was adopted and carried out by the FD. By 1995-96 the project had extended from nine districts to 13 districts and the 'Watershed Mountain Greening Special Project' of Myingyan district started in 1996-97. In July 1997, the Dry Zone Greening Department (DZGD) was constituted under the Ministry of Environmental Conservation and Forestry. Its work covers the central dry zone of Myanmar including three regions (Sagaing, Mandalay and Magway Regions), 13 districts and 57 townships, covering 21.557 million acres of dryland forests. The headquarters of the department was inaugurated on 18 September 1997 at Patheingyi Township, Mandalay division. In accordance with a 2000-2001 amendment, the working area of dry zone greening department was reconstituted as three regions, 12 districts and 54 townships (excluding Gangaw District) with a total coverage area of 20.17 million acres.

Vulnerability assessment

The vulnerable sectors of society and the economy due to drought in Myanmar are: agriculture and food production, drinking water supply, health, livestock and fisheries, industry and environment. The largest vulnerable area is the dry zone area of Myanmar and the most affected societies are farmers and people and livestock in rural areas.

Emergency relief and drought response

The Government of Myanmar has established institutional arrangements for disaster management and has systems and procedures at the national, state/division, district, township and sub-township levels. The National Disaster Preparedness Central Committee under the Vice President was re-established in May 2013. 22 members are included and the members are the ministers of (19) concerned ministries; prime ministers of regions and states, the Deputy Minister of the Ministry of Social Welfare, Relief and Resettlement and the Director General of the Government Office. The National Disaster Preparedness Management Working Committee under the Minister of the Ministry of Social Welfare, Relief and Resettlement was also re-established in May 2013. Under this, the 10 sub-committees were established. The members of the National Disaster Preparedness Management Working Committee include the ministers and deputy ministers of concerned ministries, the ministers from regions and states, the Chairmen of 10 sub-committees and director generals of concerned departments. In Myanmar, these two committees, concerned departments and organizations are cooperating and working to ensure an effective disaster management. These disaster management committees and the Ministry of Social Welfare, Relief and Resettlement are responsible for emergency relief and responses to disasters in cooperation with other concerned departments and organizations. In summary, although these committees, concerned ministries and departments and organizations carry out the activities for relief and drought response, the emergency relief and drought response in Myanmar should be upgraded.

Practices to alleviate drought impacts

The practices to alleviate drought impacts in Myanmar are as follows:

1. DMH issues daily, 10-day and monthly weather and water level forecasts, news, warnings and bulletins for storms, floods, untimely rainfall, temperature and minimum alert water level, agro-meteorological bulletins and a seasonal and annual drought report. DMH aims to upgrade the forecasting and warning system for drought management,
2. The Agriculture Department is working in cooperation with international seed research centres in order to seek and identify drought resistant crops in Myanmar, and through conducting research on cultivation methods to be employed at a time of drought. The Ministry has been importing seeds that can survive with less dependence on water and is trying to nurse the crops and produce them in Myanmar,

3. The Irrigation Department under the Ministry of Agriculture and Irrigation carry out the construction, repair and maintenance of dams, reservoirs and water supply facilities,
4. The Ministry of Agriculture and Irrigation has not only built dams, reservoirs and a river water pumping project but is also helping the people to build drinking water supply works. It does so by feeding water to water tanks from dams and reservoirs, digging lakes and wells, installing water purifying systems and providing other technology,
5. The Ministry of Environmental Conservation and forestry (MOECAF) is responsible for implementing the afforestation and land rehabilitation in dry zone area through the use of projects as mentioned previously,
6. Local governments, the public and also NGOs are tasked with digging lakes for drinking water during drought periods, rainwater storage and distributing the drinking water during water shortage.

The need for knowledge and skills on drought management

Drought is part of weather patterns; it has occurred in the past and will continue to occur in the future. Any organizations concerned with drought management of drought prone areas need to seek comprehensive and complete data in order to forecast the likelihood of drought. Drought directly affects water, land and geographical conditions and the socio-economy of localities. The difference between drought and other natural disasters is that its duration is longer than that of others. Concerned departments need to work in cooperation and coordination to mitigate drought impacts. This includes i) ensuring proper networks to be able to gather measurements on meteorology and hydrology and facts that are vital for businesses dependent on weather and water resources; ii) the proper exchange of data among departments to prevent droughts, mitigate their impact and to respond to them; iii) conducting training of personnel to familiarize them with data to make better use of them when making decisions; iv) making arrangements for farmers and other organizations to make weather forecasts useful, clear and simple to understand while minimizing constraints; v) use of standard rainfall indexes to reliably calculate the beginning and end of droughts; vi) sharing and properly using facts about the drought and weather patterns and working together to be able to have better knowledge about the intensity and the vastness of the areas affected; vii) compiling facts and seeking methods to evaluate the drought impact in order to be able to respond to ill effect; viii) working harder to ensure that seasonal weather forecasts reach local residents

and organizations on time; and ix) seeking ways and means to obtain important local and global data on droughts useful to national and international NGOs.

The needs for drought management in Myanmar are as follows:

1. To set up a forecasting and warning system for drought management;
2. To develop forecasting techniques and increase capacity-building for drought management;
3. To set up a task force including authorities and experts in administration, relief, water resources, agriculture, forestry, meteorology, NGOs and INGOs;
4. To conduct drought risk assessments;
5. To develop a decision to support drought management;
6. To promote education and public awareness for drought mitigation;
7. To encourage community level plans for drought mitigation;
8. To ensure concerned departments and organizations cooperate, coordinate and collaborate for drought management;
9. To develop concerned departments' activities for drought mitigation; and
10. To develop drought policy and strategies for drought management in Myanmar.

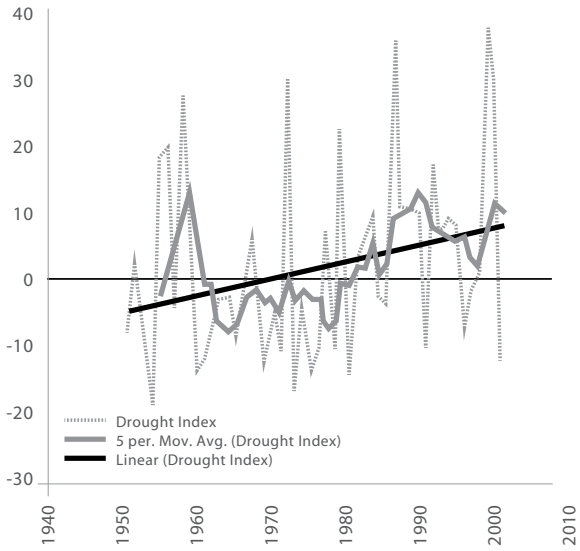


Figure 1: Annual drought indices of Myanmar (1951-2000)

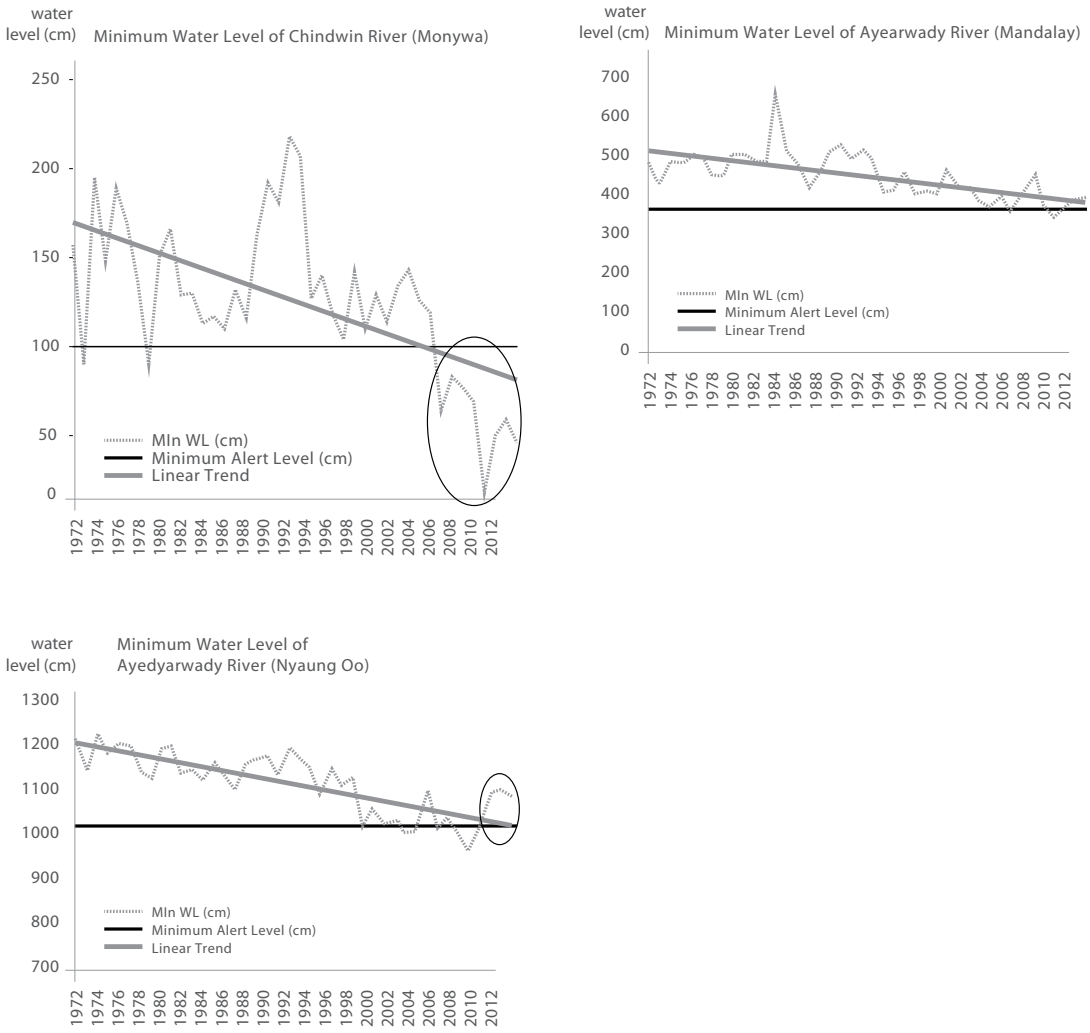


Figure 2: Annual lowest water levels of stations in central Myanmar area (1972-2012)

References

Ministry of Transport, http://www.mot.gov.mm/

Ministry of Environmental Conservation and Forestry (MOEACAF), Dryzone Greening Department,

http://www.moecaf.gov.mm/

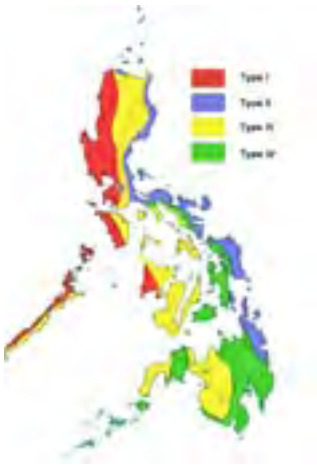
The Philippines

Silvino Q. Tejada[1], Vicente B. Tuddao[2], Jr. , Edna Juanillo[3] and Ernesto Brampio[4]

Background

The climate of the Philippines is influenced by the complex interaction of various factors such as the country's geography and topography, principal air streams, ocean currents, linear systems such as the inter-tropical convergence zone and tropical cyclones which are classified as tropical depression, tropical storm or typhoon, depending on their intensities.

The entire country, however, may be characterized by four types or classifications of climate based on the distribution of rainfall.



Type I: has two pronounced seasons: dry from November to April and wet throughout the rest of the year. The western parts of Luzon, Mindoro, Negros, and Palawan experiences this climate. These areas are shielded by mountain ranges but are open to rains brought in by Habagat and tropical cyclones.

Type II: characterized by the absence of a dry season but with a very pronounced maximum rain period from November to January. Regions with this climate are along or very near the eastern coast (Catanduanes, Sorsogon, eastern part of Albay, eastern and northern parts of Camarines Norte and Sur, eastern part of Samar and large portions of Eastern Mindanao).

Type III: seasons are not very pronounced but are relatively dry from November to April and wet during the rest of the year. Areas under this type include the western part of Cagayan, Isabella, parts of Northern Mindanao, and most of Eastern Palawan. These areas are partly sheltered from trade winds but are open to Habagat and are frequented by tropical cyclones.

Type IV: characterized by a more or less even distribution of rainfall throughout the year. Areas with this climate include Batanes, North-eastern Luzon, Southwest Camarines Norte, and west of Camarines Sur, Albay, Northern Cebu, Bohol, and most of Central, Eastern and Southern Mindanao.

Figure 1: Climate type in the Philippines based on distribution of rainfall

1 Bureau of Soils and Water Management, Philippines
2 GAE, OUFO, DENR, Philippines
3 Climatology and Agro meteorology Division, PAGASA, Philippines
4 Water Use Management Section, BSWM, Philippines

Seasonal and inter-annual extreme climate variability in the Philippines, as in many parts of the world, are significantly influenced by the El Niño Southern Oscillation Phenomenon (ENSO). Historical records from the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) show that major drought events in the Philippines are associated with the occurrences of El Niño events, which refer to the warm phase of the ENSO Phenomenon in the Eastern and Central Pacific Ocean (CEEP). During the last half century (1960-2010), there have been 15 weak to strong El Niño episodes which caused adverse socio-economic impacts in the country. The most recent El Niño episode was in 2010. Seasonal aridity in the Philippines is exacerbated by the increasing incidence of El Niño events, which now occurs at two- to three-year cycle from a previous five-year interval.

Looking at a future scenario, based on climate projections by PAGASA (i.e., under the mid-range emission scenario) for 2020 and 2050 indicate that all areas of the Philippines will get warmer, with the largest increase in temperatures in the months of March, April and May (MAM). Mean temperatures in all areas in the Philippines are expected to rise by 0.9 °C to 1.1 °C by 2020 and by 1.8 °C to 2.2 °C by 2050. Generally, there is a reduction in rainfall in most parts of the country during the summer (MAM) season. However, there is likely to be an increase in rainfall during the South West Monsoon season in June, July and August (JJA) until the transition months of September, October and November (SON) in most areas of Luzon and Visayas. Increase in rainfall is also likely during the North East Monsoon months of December, January and February (DJF), particularly in provinces/areas characterized as Type II climate. There is, however, a generally decreasing trend in rainfall in Mindanao, especially by 2050 (PAGASA, 2011).

Drought monitoring and early warning systems

Drought is a deficiency in precipitation that leads to deficits in water supply relative to human and environmental needs. It has physical components (i.e., deficiency in precipitation) and environmental, social or economic components (i.e., need or demand) (Adler, 2012). The government has put in place monitoring and early warning systems since the early 1980s, organized task forces and implemented relevant programmes and projects. These include:

- The Drought Early Warning and Monitoring System (DEWMS) was developed during the 1986-1987 El Niño. The main objective is to provide timely weather condition assessments and other information needed by various end-users particularly policymakers and decision makers, economic planners and others concerned with crisis management regarding food security, water and energy resources, among others, for purposes of mitigating potential adverse impacts of drought.

- An Inter-agency Task Force on El Niño was created in September 1997 to formulate an action plan and develop strategic programmes to help the affected population cope with the phenomenon and to minimize its adverse effects,
- Currently, there are two methods of monitoring drought in the Philippines: a network of meteorological stations established nationwide; and information that may be generated from other sources such as local information, drought indices and hazard map and use of empirical and statistical computer-generated prediction models. However, considering its high reliability, faster and larger range of visually monitoring drought incidence, the use of remote sensing is becoming a vital tool in estimating and forecasting spatial extent, intensity and duration of drought in a given area.

Meteorological observation networks such as agro-meteorological stations and meteorological and synoptic stations established in strategic sites in the country gather near-real time meteorological parameters such as ambient air temperature, relative humidity, solar incidence, evapotranspiration, wind speed and direction and other parameters. These data are compiled in databases and analysed for historical trends in order to develop forecasting or prediction computer models for spatial and temporal probability models of drought occurrence. From this information, drought forecasts, climate updates, drought advisories, the water supply condition and potential impact assessment reports are generated and transmitted to the end-users through modern communication technology.

Vulnerability assessment

Based on previous drought events caused by El Niño the most vulnerable sectors of the economy are listed below.

1. Agriculture and fisheries

According to Benson (2009), the toll of disasters in the Philippines has significantly affected agriculture. Between 1990 and 2006, agricultural damage alone stood at PhP[1] 12.431 billion per year (63 per cent of the total damage) of which about PhP 2.23 billion per year or 17.9 per cent are due to drought. The most affected crops are rice, corn, vegetables and fisheries which are usually being raised by small-holder farmers and fishers, due to crop failures and reduced irrigated areas. For instance, during the 1997-1998 El Niño, the growth of agriculture suffered a contraction or a negative growth of 6.6 per cent. Swine and poultry incurred huge losses during the period with a 79 to 67 per cent change in

1 $ USD 1 = 44.5 PhP

population while the fishery sector incurred losses amounting to about PhP 7.2 billion. There has always been a slump in rice production during every El Niño event (i.e., 1982, 1987, 1992 and 1998).

2. Domestic water supply and power sector

El Niño induces drought and delays the onset of monsoons. It may result in scarcity of drinking water in urban areas and shortfalls in hydroelectricity generation because of reduced water levels in major dams. During the period from 1989 to 1990, due to drought events, the country incurred a hydropower generation loss of PhP 348 million while the water production in Metro Manila was cutback. During a severe drought during the period from 1991 to 1992, there was a 20 per cent shortfall in Metro Manila's water supply.

From 1997 to 1998, about 70 per cent of the country experienced a severe drought due to El Niño. The water level went down to critical levels in major dams. In Angat Dam, the major source of water supply for Metro Manila, monthly inflows were just 31.6 per cent of the normal rate. Reduction in power generation from 26.4 to 58.9 per cent was experienced during the same period.

3. Environment and natural resources

Drought also had tremendous impact on the environment and natural resources. Marine resources were affected. Mass coral bleaching was observed during the 1997-1998 ENSO. The decrease in coral cover ranged from 46 per cent to as high as 80 per cent in Bolinao, Pangasinan (Guiang, 2004). The same ENSO caused extensive destruction of watershed areas through forest fire. Decreases in stream flow were observed during the 1997-1998 ENSO events in the Pantabangan-Carranglan watershed that serves a total area of about 103,000 hectares across 24 municipalities in Nueva Ecija, Bulacan and Pampanga provinces (Lasco et al., 2006). The environmental impacts also include degradation of soil, especially in areas where there had been prolonged drought conditions and high forest fire risk coupled with degradation in forest growth.

Due to the social and economic impact of drought, those most affected are the poor. During drought events, there is a disruption of normal human activities, migration to urban communities and human health problems brought about by scarcity of water. Unemployment due to significant reduction in production and revenue losses of a number of industries affects society as a whole but resource-poor communities will be the most negatively affected.

4. Emergency relief and drought response

An institutional structure was developed in 1987-1988 under the lead of the National Disaster Risk Reduction and Management Council (NDRRMC). When disaster occurs the recommendation of its Council Chairman is sent to the Philippine President, who is then responsible to declare that areas within the country affected by the hazard are declared under the State of Calamity (Lalap, 1991). This proclamation enables the government to immediately provide assistance by:

- controlling overpricing and hoarding of prime commodities;
- delaying payment of taxes and amortizations owed to the government; and
- the release of a budget for the calamity fund.

The Inter-Agency Committee on Water Crisis Management is responsible for water management during a drought situation including the setting up of priorities on water use. This committee was created in 1987 and meets regularly during periods of water crisis to monitor water supply and identify priorities. Reports are issued routinely on water supply or forecasts by existing government agencies such as the Weather Bureau or PAGASA are forwarded to this Committee for review and consideration. Recommendations are then transmitted to NDRRMC for future action. The media is a major partner of the government in the information and awareness campaign (Lalap, 1991).

The drought response plans are generally connected to food security programmes since agriculture is most vulnerable to climate change variability. Some of the drought response plans prepared by different concerned agencies include the following:

The Action Measures for Vulnerable Areas of the Department of Agriculture, El Niño Briefing Materials, Malacanang, Manila, 28 May 2002:

- Ensuring water availability in production areas through irrigation (shallow tube wells) and cloud seeding;
- Shifting of planting calendars or early planting;
- Planting early maturing crops that require less water and are more tolerant to drought;
- Livelihood assistance to compensate for farm/fishery income loss;
- Emergency food assistance;
- Provide insurance coverage to affected areas;
- Water rationing; and

- Promotion of alternative crops as replacement for major staples.
- In addition, action measures for less vulnerable areas (DA, El Niño Briefing Materials, Manila 28 May 2002) are:
- Providing seeds, planting materials and fingerlings;
- Fertilizer support (organic/inorganic); and
- Further irrigation development.

Practices to Alleviate Drought Impacts

The following measures and practices are applied by the government and other supporting institutions, including NGOs, prior to or during drought, in view of reducing drought impacts. This includes:

- Establishment of small rainwater harvesting structures like small water impounding projects and small farm reservoirs;
- Rehabilitation of upland small scale irrigation systems for upland productivity and natural resources sustainability;
- Distribution of pump and engine sets to lowland areas with shallow ground water and surface water;
- Community-based watershed management for sustainable water resources and livelihood development in critical watershed of selected irrigation systems;
- Establishment of agro-meteorological stations in highly vulnerable agricultural areas; a tool for climate change adaptation and development of local early warning systems;
- Promotion of farm wastes recycling and re-use for organic-based agriculture development in vulnerable upland and lowland areas;
- Promotion of water-saving technologies (WST) in irrigated rice production systems;
- Conducting cloud seeding operations especially when there is threat of a dry spell or drought that may affect standing crops and critical reservoir level;
- Recommending the planting of early maturing varieties and other alternative crops that consume less water;
- Crop insurance systems; and
- Information campaigns by tri-media.

The Need for Knowledge and Skills on Drought Management

Proper drought management can be realized through knowledge and skills development focused on the following:

- Knowledge and skill development to better understand the influences of climate variability/extremes particularly regarding drought in agricultural production, watershed management and biodiversity conservation;
- Analytical tools to describe the weather extremes and climate variability such as skills in developing drought forecasting mathematical or statistical stochastic models with a high level of adequacy and reliability and a decision support system;
- Development of more appropriate monitoring and early warning systems for drought and especially the use and application of remote sensing;
- Development of improved access capacity of the end users to early warning and advisories, to give enough lead time on possible occurrence of extreme events and seasonal anomalies;
- Application of early warning systems and forecasting in decision-making;
- Awareness of weather and climate extremes, variability and change as it impacts on agricultural production, watershed management and biodiversity management;
- Development of policy measures or an enabling environment in terms of access to new innovation and technologies to adapt to climate variability and extremes; and
- Capacity-building (human resource and infrastructure).

References

Adler, R. (2012). *Balancing Compassion and Risk in Climate Adaptation: U. S. Water, Drought, and Agricultural Law.* 64 Fla. L. Rev. 201 (2012). Available at: http://scholarship.law.ufl.edu/flr/vol64/iss1/

Benson C. (2009) *Mainstreaming Disaster Risk Reduction into Development: Challenges and Experience in the Philippines.* International Federation of Red Cross and Red Crescent Societies

Department of Agriculture (2002). *El Niño Briefing Materials*, Malacanang, Manila, 28 May.

Department of Agriculture (DA), the Department of Agrarian Reform (DAR), the Department of Environment and Natural Resources (DENR), and the Department of Science and Technology (DOST) (2010). *The Updated Philippine National Action Plan to Combat Desertification, Land Degradation and Drought* (DLDD) FY 2010-2020.

Department of Environment and Natural Resources (1998). *Annual Report on Task Force El Niño: A United Initiative*, Quezon City.

Jose, A.M. (1991). *Drought Early Warning and Monitoring System in the Philippines.* Drought Management and Preparedness Training Seminar for the Asia and Pacific Regions. Bangkok, Thailand.

Jose, A.M., F.O. Magmayon and F.D. Hilario. (1991). *Climate Impact Assessment for Agriculture in the Philippines.* National Workshop on Drought Planning and Management in the Philippines. Quezon City, Philippines.

Lalap, T.R. (1981). *Drought Mitigation and Response in the Philippines.* Drought Management and Preparedness Training Seminar for the Asia and the Pacific Regions. Bangkok, Thailand.

Parry, M.L. and T.R. Carter (1987). *Climate Impact Assessment: A Review of Some Approaches. Chapter 13*. In Planning for Drought: Toward a Reduction of Societal Vulnerability, D.A. Wilhite and W.E. Easterling eds. Boulder, Colorado: Westview Press.

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) (2001). *El Niño Southern Oscillation: Mitigating Measures.* Los Baños, Laguna: PCARRD.

Department of Environment and Natural Resources (DENR) (2010). *Philippine Climate Change Adaptation Strategy.* DENR.

Philippine Institute for Development Studies (2012). *Typhoons, Floods, and Droughts: Regional Occurrence and Value of Damages to Rice Farming in the Philippines*. In Policy Notes. ISSN 1656-5266. No. 2012-15, September 2012

Tibig, L. V. (2004). T*rends in Extreme Daily Temperatures and 24-hr Rainfall in the Philippines, Climatology and Agrometeorology Branch*. Technical Report, Philippine Atmospheric, Geophysical and Astronomical Services Administration, Quezon City.

Tuddao, V.B. (1990). *Effect of Meteorological Condition on Rate of Evaporation*. Master of Science Thesis. Master of Science in Agro-meteorology, University of the Philippines, Los Banos, Philippines.

National Water Resources Board (NWRB) (2009). *Water Sector Climate Change Adaptation Strategy*.

White, D.A. (1994). *Preparing for Drought: A Guidebook for Developing Countries.* Lincoln, Nebraska, U.S.A. Sponsored by United Nations Environment Programme. January.

Wilhite, D.A. and M. D. Svoboda (undated). *Drought Early Warning Systems in the Context of Drought Preparedness and Mitigation.* National Drought Mitigation Center, Lincoln, Nebraska.

Viet Nam

Nguyen Van Tinh[1]

Background

In Viet Nam, drought is one of the most frequent natural disasters, after floods and storms, and it has become more severe due to the impact of climate change. According to collected statistics, during the past 50 years, droughts have taken place in 40 of those years in different locations across Viet Nam. Drought has had many impacts on local agriculture and livelihood. In order to deal with the drought issues during the past years, the Vietnamese government has put in a lot of effort to develop effective drought management measures. However, the drought situation is still very complex.

Vulnerability assessment

Drought events in Viet Nam in terms of timing and the extent of damage can vary across different regions of Viet Nam. Some typical examples of drought problems in Viet Nam are:

i. In the northern mountainous area and the Red River delta: In this area, the rainy season ends in September or October; droughts often occur when there is a shortage of rainfall and a low water level in reservoirs, mainly during the winter-spring crop season. For example, the drought that occurred between the end of 1998 and April 1999 affected about 86,140 ha of rice paddy (severe drought in 17,077 ha), and 10,930 ha of vegetables and others. During the drought between January and February 2004, the water level of the Red River was the lowest in 40 years and the flood retention capacity of reservoirs were below the designed level; the local communities had to mobilize all possible resources to cope with this drought. Over the last 10 years, the water resources in Red River downstream have decreased substantially. The water level of Red River from December to May has been much lower (by 0.5 to 1.1 meters) than the average of previous years. Therefore it is not able to supply enough water for irrigation, especially for the winter-spring rice season. However, since there are additional water sources from hydropower reservoirs, the drought problems in this area have been mitigated significantly.

ii. In the central coastal lands area: Droughts occur most frequently in this area, during both the winter-spring and summer-autumn crop seasons. The droughts strike when there is a shortage in rainfall and low water retention capacity of reservoirs, combined with hot and sunny weather. For instance, in 1998, due to

1 Directorate of Water Resources

a decrease in rainfall during the dry season (it was about 30-70 per cent of the annual average) and a prolonged heat wave, many rivers, streams and small and medium sized reservoirs dried up. Across the central region, since the beginning of the year until August, this prolonged drought affected 253,988 ha of spring-winter rice paddies (30,739 ha destroyed), 359,821 ha of summer-autumn rice paddies (68,590 ha destroyed), 153,072 ha of seasonal rice paddies (22,689 ha destroyed) and 236,413 ha of fruit plants, including 50,917 ha destroyed. Moreover, salt water intrusion has become more serious and wildfires have occurred in many places. Around 3.1 million people have had to deal with domestic water shortages. In 2003, the drought in the north central region affected 22,350 ha of summer-autumn rice paddies (8,980 ha destroyed) and around 5,000 ha of vegetables and other crops were destroyed. During the winter-spring crop season of 2005, there was a shortage of rainfall and a prolonged heat wave in the central coastal southern provinces. This led to a substantial decline in water flow on river systems and reservoirs' water level. The resulting water shortage and drought situation was very severe. As a result, 30,000 ha of farm lands in Khanh Hoa, Ninh Thuan and Binh Thuan were unable to be cultivated and approximately one million people did not have enough water for domestic use, industrial and livestock production.

iii. In the central highland area and south-east region: Droughts in this area occur in all cultivation seasons, but more frequently in the winter-spring crop season. Since many farmlands do not rely on irrigation work systems, the drought situation is mainly affected by weather conditions. For instance, the drought that lasted from February to April 2012 affected 14,380 ha of crops, of which 6,767 ha were severely damaged. From May to August 2002, droughts in the central highlands destroyed 6,200 ha of summer-autumn rice paddies, 4,460 ha of seasonal rice paddies, 28,210 ha of vegetables and 1,360 ha of fruit and industrial plants. In 2005, the drought in the central highlands area occurred at the same time with the drought in the south-east central region. This drought damaged 11,000 ha of crops.

iv. In the Mekong River delta (the south-west area): Water shortages and drought situations that occur during cropping seasons in the south-west area most often lead to salt water intrusion. These problems significantly affect agricultural production and people's livelihoods. For example, the drought that occurred from the end of 1998 to April 1999 affected 4,420 ha of farmlands. From February to April 2012 droughts affected 50,000 ha of rice paddies, of which 13,000 ha were severely damaged.

The Causes of droughts

Meteorological conditions, hydrology, forest management, water resources management and the quality of meteorological and hydrological forecast are both objective and subjective factors that lead to drought problems in Viet Nam.

Objective factors

Located in South East Asia, and having a typical tropical and tropical monsoon climate, Viet Nam has both very diverse rainfall patterns and a significantly large volume of rainfall, forming many large rainy regions. Rainfall distribution is seasonal: The rainy season which accounts for 80-90 per cent of the annual rainfall is from April to October while the dry season which accounts for 10-20 per cent of the annual rainfall is from November to March.

As the weather conditions described above note, even though the average rainfall is quite high, the rainfall distribution is not even and in various places and times water shortage and droughts still occur. In recent years, due to the impact of climate change, the average temperature has increased leading to greater evaporation volume, especially during the dry season. The rainfall distribution has become more extreme and it is mainly focused during the rainy season with very high intensity which is then substantially reduced during the dry season.

The second objective factor is the natural flow and the flow distribution of streams and river systems. Vietnam has 2,360 rivers with a length of 10 km or more. Among the thirteen largest river basins with an area of more than 10,000 km2 such as the Red River (Đa, Thao, Lo), Thai Binh River, Ma River, Ca River, Đong Nai River and Mekong River, etc., there are 10 international river basins. Only three of the thirteen rivers originate from Viet Nam and have the downstream in neighboring countries, seven rivers originate from neighboring countries and flow into Viet Nam. This means that Viet Nam is subjected not only to many international constraints but also to various complex water sharing issues, especially when countries in upstream regions have increasingly exploited their water resources and constructed more large reservoirs to store water, leading to a reduction in water flow to downstream regions.

Subjective factors

Subjective factors are largely due to ineffective forest management and protection. Before 1945, 43 per cent of Viet Nam was forested, but by 1995 this area had decreased to 29 per cent. After "The new 5 million hectares of forest programme" and improvement of watershed conservation policies being carried out, the forest coverage now reaches nearly 40 per cent. However, the distribution of forested areas is not even across different regions and the quality of these forests is not good enough to effectively regulate the flow between the dry season and the rainy season, leading to less water flow during the dry season.

Secondly, the over exploitation and development of irrigation systems, hydropower systems and other water resources mining projects have led to the depletion of water resources, both surface and underground water. The coordination between relevant sectors in water use and multi-purpose water service is not efficient enough, for example, the issue of regulating the flow from hydropower reservoirs to the downstream during dry season is still very prevalent.

Thirdly, the quality of meteorological and hydrological forecasts is not good enough, resulting in ineffective planning and timing for crop production, and passive reservoir water storage planning, which puts a lot of pressure on irrigation water supply, especially during periods of water resource shortages.

Drought management measures which have been implemented in Viet Nam

a) Strengthening reservoir construction, maintenance and upgrading. Currently, hydropower reservoirs and irrigation reservoirs can store around 10 per cent of the total ground water volume in Viet Nam. Therefore, it is necessary to construct more water storage facilities. During few decades ago, the Vietnamese Government invested in the construction of various major reservoirs such as Cua Dat, Ta Trach and Krong Buk Ha, etc. In addition,"the Programme to ensure dam/reservoir safety" has been developed and implemented since 2003 in order to ensure major reservoirs' safety and maximize their designed capacity. Currently, the main achievement of this programme is that the repair of large reservoirs with a capacity of 10 million m3 and above has been completed while the repair for small reservoirs is still under implementation.

b) Increasing the ensued measure of irrigation systems. The designed ensued measure of existing irrigation systems is 75 per cent (a 75-year return period). In order to meet the demands of production and people's livelihood, the ensued measure of the existing fa-

cilities has been improved to 85 per cent (a 85-year return period). The maintenance and upgrading of the irrigation systems have to ensure this objective.

c) Managing and increasing the coverage of protected forest areas and forest watersheds. In 1995, the forest coverage of Vietnam was only around 28.2 per cent, a reduction of about 5 million ha in comparison with the coverage before 1945. "The 5 million hectares of forests Programme" was developed in order to effectively manage and conserve the remaining forest area, while reforesting 5 million hectares to increase the forest coverage and to protect and regulate water resources.

d) Improving the efficiency of the irrigation works systems. According to the current assessment, irrigation works used in agricultural production can only reach 60-65 per cent of their designed capacity. To overcome this challenge, the Ministry of Agriculture and Rural Development has developed" a scheme on improving management and utilization efficiency of the existing irrigation systems". One of its main objectives is to effectively use the irrigation systems, ensure water savings, improve the management modernization, prevent degradation and actively adapt to climate change.

e) Regulating water sources in the catchment area. In reality, water supply for agriculture production and management of drought is the responsibility of Ministry of Agriculture and Rural Development (MARD) and the Viet Nam Electricity Corporation who are tasked with coordinating and regulating water from the hydropower reservoir to supply downstream regions. For example, for the last 10 years, there has been additional supply of water for winter-spring rice cultivation in the Red River delta, supplying enough water sources for crop production. Nevertheless, reservoirs in the central coastal lands area have also been regulated in order to supply enough water for the lowlands during the dry season.

f) Crop restructuring to respond to the water shortage issue, especially in central coastal lands and central highlands areas. Rice has been replaced by other plants which use less water. This restructuring has been under close management of the Ministry of Agriculture and Rural Development and actively implemented at the local level.

g) Improving the implementation of water-saving measures. In order to save water, the "Canal Upgrading Programme" has been implemented in order to enhance the effectiveness of the irrigation system. Since the system has been standardized and stabilized, water loss has decreased from 20 to 25 per cent and the canal water level is high enough for gravity irrigation. Therefore, the irrigation time is shortened. The irrigation management

has become more effective and the cost of regular maintenance for the new system is only about 60 per cent of the cost for the previous soil canal system.

On the other hand, pilot research on the methods of rice cultivation has been done and innovative technologies have been implemented step by step in many different regions. The innovative methods may apply for 1,000,000 ha paddy rice in 2020 and have proven to be able to decrease 20-25 per cent of irrigation water, 70-90 per cent of rice varieties, 20-25 per cent of fertilizers, 50-70 per cent of pesticides, 20-25 per cent of greenhouse gas emissions, and rice yield could be increased by 9-15 per cent.

h) Dredging upstream of irrigation intake and canal system, installing mobile pumping stations to utilize water resources are some frequently used measures at the local level. In principle, the implementing costs for these measures are covered by the annual irrigation fee incomes of local irrigation management organizations.

Droughts and natural disasters take place in various regions in Viet Nam due to both objective and subjective factors. They can cause significant impacts on agricultural production and people's livelihoods. Even though droughts can be forecasted and are relatively slow-paced, drought management measures are not simple and there is a need for long-term measures alongside an immediate response. To deal with droughts, a long-term forecast can play a very important role and support the agriculture production planning such as effective and proactive crop restructuring, rescheduling the cropping season, and adjusting water supply and storage planning. To improve drought forecasts and warning systems, the quality of meteorological and hydrological forecasts needs to be strengthened in the future.

References

Reports on drought situation of the Directorate of Water Resources.

Provincial report on drought situation from 1995 until 2013

Decree no 143/2003/ND-CP dated 28/11/2003 of the Government to specify the provisions for Implementation of the Irrigation works Exploitation and Protection Ordinance.

National Technical standards for Irrigation work, mainly related to construction design. QCVN 04 - 05: 2012/BNNPTNT.

Thematic report: Study and analysis on the drought situation and drought management policies and institutions at the central and local levels in Vietnam – under the Project: *Scientific research on drought management and desertification to develop the integrated and strategic solutions and management system*; Case study on the Red River Delta and the South Central region. KC.08.23/06-10.

ANNEX: WORKSHOP PARTICIPANTS AND ORGANIZERS

Keynote Speech:

Prof. Donald Wilhite
Applied Climate Science School of Natural Resources, University of Nebraska
dwilhite2@unl.edu

Welcome Speeches:

HE Dr. Hoang Van Thang
Vice Minister, Ministry of Agriculture and Rural Development of Viet Nam

Dr. Jon-Ha Bae
FAO Representative in Viet Nam

Assoc. Prof. Dr. Nguyen Tung Phong,
Vice Director General of Vietnamese Academy of Water Resources

Participants:

Cambodia

Phaloeun, Chan
Deputy Director General
General Directorate of Agriculture
Ministry of Agriculture, Forestry and Fisheries (MAFF)
chanphaloeun@gmail.com

Bopreang, Ken
Chief Office Department of International Conventions & Biodiversity
Ministry of Environment
preangk@yahoo.com

China

Mei Xurong Professor
Department of Research Management,
Chinese Academy of Agricultural Sciences
meixurong@caas.cn

India

Rathore, L S
Director General of Meteorology
India Meteorological Department
ls.rathore@imd.gov.in

Rathore, BMS
Joint Secretary
Ministry of Environment and Forests
bms.rathore@nic.in

Subrahmanyam, GV
Adviser, Ministry of Environment and Forests
sv.godavarthi@nic.in

Indonesia

Nurjanah, Nurjanah
Researcher Agency of Meteology,
Climatology and Geophysics, Indonesia

Utami, Yuli
Head of Section, Ministry of Forestry
syaifula09@gmail.com

Nurhayati, Nurhayati
Director, Climate, Agroclimate and Marine
Climate Center, The Agency of Meteorology
Climatology and Geophysic (BMKG)
nurhayati@bmkg.go.id

Mala, Yanti
Staff, Center of Climate, Agroclimate and
Marine Climate
yanti_ml09@yahoo.com

Lao People's Democratic Republic

Chanseng, Phongpachith
Senior Expert
Agriculture and Policy Research Center
chansengp2011@gmail.com

Mahachaleun, Mayphou
Deputy of Climate and Agro-Meteorological Division, Department of Meteorology and Hydrology/Ministry of Natural Resource and Environment
mayphou66@yahoo.com

Hanephom,Savanh
Deputy Director General
Department of Planning and Cooperation
hsavanh@yahoo.com

Malaysia

Juhaimi, Jusoh
Deputy Director
Department of Irrigation and Drainage,
juhaimi@water.gov.my

Abdullah, Nor Adawiah
Meteorological Officer
Malaysian Meteorological Depatment
adawiah@met.gov.my

Bin Kassim, Rahman
Head of Geoinformation Programme
Forestry & Environment Division
Forest Research Institute
rahmank@frim.gov.my

Myanmar

Hla, Wai Myo
Director, Ministry of Environmental Conservation and Forestry
waimyohlla@gmail.com

Yi, Tin
Deputy Director, Ministry of Transport
tinyisw@gmail.com

U Aung , Kyaw Htun
Director, Dryzone Greening Department
Ministry of Environmental Conservation and Forestry
dzgd.sagaing@gmail.com

Kyaw, Min Oo
Deputy Director General
Water Resources Utilization Department
irdp2014@gmail.com

Philippines

Brampio, Ernesto Bilangel
Department of Agriculture-Bureau of Soils and Water Management
silvinotejada.bswm07@gmail.com

Tejada, Silvino
Director, Department of Agriculture-Bureau of Soils and Water Management
silvinotejada.bswm07@gmail.com

Juanillo, Edna
Officer in Charge, Climatology and Agrometeorology Division
ejuanillo@yahoo.com

Tuddao, Vicente B.
Jr. Director for Governance and Enforcement, Office of the Undersecretary for Field Operations, Department of Environment and Natural Resources
vbtuddaojr@yahoo.com

Thailand

Mapraneat,Varat
Section Director, Department of Disaster Prevention and Mitigation/Ministry of Interior
varatma05@gmail.com

Vietnam

Nguyen, Van Tinh
Deputy Director General, Directorate of Water Resources
tinhnvbnn@yahoo.com.vn

Vuong, Pham Quoc
Officer, VNFOREST-MARD
phamquocvuonghd@gmail.com

Dang, Thanh Mai
Deputy Director, Ministry of Natural Resources and Environment
thanhmaidang1973@gmail.com

Tran, Ngoc Cuong
Head of Ecological Division, Biodiversity Conservation Agency, Vietnam Environment Administration
tranngoccuong1962@gmail.com

Nguyen , Hung Anh
Head of Aquatic Ecology and Environment Department
Institute of Ecology and Biological Resources (IEBR)
lehunganh@gmail.com

Doan Doan, Tuan
Director, Institute for Water and Environment (IWE)
doandoantuan@gmail.com

Nguyen, Quang Trung Senior Expert
Institute for Water and Environment (IWE)
quangtrungcwe@gmail.com

Nguyen, Duy Hien
Director, Bac Hung Hai Irrigation Company
Vu, Van Hai
Vietnam Academy for Water Reources

Trinh, Ngoc Lan
Institute for Water Resources and Partnership

Dao, Ngoc Tuan
Deputy Director
Institute for Water Resources planning

The Organizers

Dr. Mohamed Bazza
Food and Agriculture Organization of the United Nations
Mohamed.Bazza@fao.org

Dr. David Coates
Secretariat of the Convention on Biological Diversity (CBD)
david.coates@cbd.int

Dr. Robert Stefanski
World Meteorological Organization (WMO)
Rstefanski@wmo.int

Dr. Daniel Tsegai
UN-Water Decade Programme on Capacity Development (UNW-DPC)
tsegai@unwater.unu.edu

Dr. Sergio Zelaya
United Nations Conventions to Combat Desertification (UNCCD)
szelaya@unccd.int

The Local Organizer

Prof. Dr. Nguyen Vu Viet,
Director General of Vietnamese Academy of Water Resources

Dr. Jon-Ha Bae
FAO Representative in Viet Nam

WORKSHOP AGENDA (6-9 MAY 2014)

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 statements by:
  - His Excellency Vice Minister, Ministry of Agriculture and Rural Development, Dr. Hoang Van Thang (10 min)
  - Assoc. Prof. Dr. Nguyen Tung Phong, Vice Director General of VAWR (5 min)
- Welcoming statement by FAO representative in Viet Nam Dr Jong –Ha Bae (10 min)
- A roundtable introduction of participants and their expectations (35 minutes)

10:00-10:30 Session1b: Overview
Overview of the initiative, objectives and scope of the Workshop (Daniel Tsegai)

10:30-11:00 Group Photograph/Coffee and tea break

11:00–18:00 Session 2: Setting the scene and country reports
(Chair: Chung Te Tzou)

11:00-12:30 Session 2a: Keynote (Donald Wilhite)

12:30-13:30 Lunch

13:30 -14:15 Session 2b: Biodiversity and drought (David Coates)

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.)

19:00 Welcome Dinner

Workshop Agenda: Day 2

09:00-13:15 **Session 3: Drought Monitoring and Early Warning Systems**
(Presenter: Robert Stefanski; Chair: Assoc. Prof Doan Doan Tuan, Director of the Institute for Water and Environment)

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? (Donald Wilhite)
- Group B: What are the meteorological and hydrological networks, data quality, sustainability needed? (David Coates)
- Group C: What mechanisms are in place for communicating and liaising drought monitoring and early warning information between national institutions? (Robert Stefanski)

11:45-12:15 Coffee and tea break

12:15 – 13:15 **Session 3c: 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 4: Vulnerability and Risk Assessment**
(Presenter: Sergio Zelaya; Chair: Dr. Do Manh Hung)

Day 2 cont'd

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

15:15–17:00 **Session 4b: Breakout groups:**

- Group A: Who/What is most vulnerable to drought in your country (Sergio Zelaya)
- Group B: Provide the causes/reasons of vulnerrability to drought in your country (Daniel Tsegai)
- Group C: What are the criteria you used for prioritizing vulnerability? (Chung Te Tzou/Mohamed Bazza)

17:00-17:30 Coffee and tea break

17:30-18:30 **Session 4c: Presentations of breakout group results and discussion**
(10 minutes per group and 30 minutes for discussion)

Workshop Agenda: Day 3

09:00 -13:15 **Session 5: Drought preparedness, mitigation and response**
(Presenter: Mohamed Bazza; Chair: Robert Stefanski)

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 (Donald Wilhite)
- Group B: Agriculture (Chung Te Tzou/Mohamed Bazza)
- Group C: Other (Robert Stefanski)

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**
(Presenter: Daniel Tsegai; Chair: Donald Wilhite)

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

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

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

Day 3 cont'd

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

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** (Chair: Mohamed Bazza)

09:00 – 11:00 **Countries' feedback**
(countries present the "take home "message from the workshop & their action plans and specific foreseen implementation challenges)

11:00 - 11:30 Coffee and tea break

11:30 – 12:00 **Closing**

- Closing Statements by Vice Director of VAWR, Assoc Prof Dr. Nguyen Tung Phong
- Synthesis and concluding remarks: (Organisers)

12:00 – 13:00 Lunch

13:00 Departure to field visit