UN WATER

A UN-Water initiative with the following UN-Water members:

WMO

UNCCD
United Nations Convention to Combat Desertification

FAO
FIAT PANIS

UNITED NATIONS UNIVERSITY
UNW-DPC

WATER FOR LIFE 2005-2015

UN WATER

Proceedings of the 1st Regional Workshop on

Capacity Development to Support National Drought Management Policies

for Eastern European Countries

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

A UN-Water Initiative

Proceedings of the 1st Regional Workshop on

Capacity Development to Support National Drought Management Policies

for Eastern European Countries

UN-Water Decade Programme on Capacity Development (UNW-DPC)
Published by UNW-DPC December 2013

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

AGeoM	State Geological Agency of Moldova
APF	Advocacy Policy Framework
ARSO	Agency for Environment of Slovenia
CEE	Central and Eastern Europe
DMCSEE	Drought Management Centre for South-Eastern Europe
ELD	Economics of Land Degradation
ETP	Evapotranspiration
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FHMI	Federal Hydrometeorological Institute in Sarajevo of Bosnia and Herzegovina
GDP	Gross Domestic Product
GFCS	Global Framework for Climate Services
GIS	Geographic Information System
GPCC	Global Precipitation Climatology Centre
GWP	Global Water Partnership
HMNDP	High-level Meeting on National Drought Policy
ICID	International Commission on Irrigation and Drainage
IDMP	Integrated Drought Management Programme
IEG	Institute of Ecology and Geography of Moldova
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
LRTAP	Long-range Transboundary Air Pollution
MAFI	Ministry of Agriculture and Food Industry of Moldova
NAPNAV	National Project of Irrigation and Management of Agricultural Land and Water in the Republic of Croatia
NAPs	National Action Programmes
NDMC	National Drought Mitigation Center
NDMP	National Drought Management Policies
NMA	National Meteorological Administration of Romania
NMHS	National Meteorological and Hydrological Service of Croatia
PDI	Palmer Drought Index
PNI	Percentage of Normal Index
RSHMI	Republic of Srpska Hydrometeorological Institute in Banja Luka of Bosnia and Herzegovina
SHS	Hydrometeorological Service of Moldova
SPEI	Standardized Precipitation Evapotranspiration Index
SPI	Standardized Precipitation Index
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNW-DPC	UN-Water Decade Programme on Capacity Development
USDM	United States Drought Monitor
WFP	World Food Programme
WMO	World Meteorological Organization

FOREWORD

Throughout history, drought has been a recurring phenomenon which has had untold effects on economies and livelihoods. Despite the awareness of the potentially devastating impacts of drought, few countries deal with the problem in a proactive manner, the majority choosing instead to react only after disaster has already struck. This is because the majority of drought-prone countries do not have comprehensive national drought management policies in place. As a consequence, drought is unnecessarily claiming lives in this modern day and age.

It is clear that concerted efforts must be made in order to help countries formulate and adopt effective, risk-based national drought management policies. Efforts to develop such policies must have at their core the aim to raise the capacity of stakeholders dealing with drought at all levels, including various ministries, relevant institutions, practitioners and the society at large.

It is therefore a great pleasure to report that in 2013 – the International Year of Water Cooperation, the World Meteorological Organization (WMO), the United Nations Convention to Combat Desertification (UNCCD), the Food and Agriculture Organization of the United Nations (FAO) and the UN-Water Decade Programme on Capacity Development (UNW-DPC) have joined hands to launch an initiative on "Capacity Development to Support National Drought Management Policies" (NDMP). The initiative is being undertaken under the umbrella of UN-Water, a United Nations inter-agency mechanism, and is coordinated by UNW-DPC.

Launched on 12 March 2013 on the ocassion of the High-level Meeting on National Drought Policy (HMNDP) in Geneva, the NDMP initiative has been scheduled to hold a number of regional capacity development workshops throughout 2013 and 2014, covering Eastern Europe, Latin America and the Caribbean, Asia and the Pacific and Africa. The present proceedings cover the outcomes of the first Regional Workshop, for Eastern European Countries, which took place in Bucharest, Romania from 9 to 11 July 2013.

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 a national 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.

The NDMP initiative thus provides a prime example of how successful collaboration can be carried out at different levels and in various forms. This kind of collaboration is essential if we are to holistically and sustainably develop national capacities to address the hazards and risks associated with frequent and severe droughts as currently experienced across the world.

In 2013, ten years after UN-Water was founded, the need for strengthened cooperation and coherence among the various UN entities dealing with water issues is clearly as great as ever. Together, it is our hope that by helping countries develop national drought policies based on the philosophy of risk reduction, we can alter approaches to drought management at the country level.

Further information on the initiative can be found at the initiative's online platform:
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 on "Capacity Development to Support National Drought Management Policies"

SETTING THE SCENE

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). This was a motivating factor that led to the "High-level Meeting on National Drought Policy" (HMNDP) which took place in Geneva from 11 to 15 March 2013. Accordingly, the World Meteorological Organization (WMO) Secretariat, the Secretariat of the United Nations Convention to Combat Desertification (UNCCD) and the Food and Agriculture Organization of the United Nations (FAO) organized the HMNDP in collaboration with a number of other UN agencies, the UN-Water inter-agency mechanism, international and regional organizations, and key national agencies. The theme of the HMNDP was "Reducing Societal Vulnerability – Helping Society (Communities and Sectors)".

Concerns about the spiraling impacts of drought on a growing number of sectors, the current and projected increase in the incidence of drought frequency and severity and the outcomes and recommendations emanating from the HMNDP are 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 towards 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 moni-

toring, building institutional capacity) and mitigation measures that are aimed at reducing drought impacts. This change in emphasis is long overdue. Mitigating the effects of drought requires the use of all components of the cycle of disaster management, rather than only the crisis management portion of this cycle. Typically, when drought occurs, governments and donors have followed with impact assessment, response, recovery and reconstruction activities to return the region or locality to a pre-disaster state. Historically, little attention has been given to preparedness, mitigation and prediction/early warning actions (i.e. risk management) and the development of risk-based national drought management policies that could reduce future impacts and lessen the need for government and donor interventions in the future. Crisis management only addresses the symptoms of drought as they manifest themselves in the impacts that occur as a direct or indirect cause of drought. Risk-based management, on the other hand, is focused on identifying where vulnerabilities exist (particular sectors, regions, communities or population groups) and addresses these vulnerabilities through systematically implementing mitigation and adaptation measures that will lessen the risk of 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 one.

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 their severity. Severity is also difficult to characterize since it is best evaluated on the basis of multiple indicators and indices, rather than on the basis of a single variable. The impacts of drought are also largely non-structural and spatially pervasive. These features make it difficult to assess the effects of drought and to respond in a timely and effective manner. Drought impacts are not as visual as other natural hazards, making it difficult for the media to communicate the significance of the event and its impacts to the public. Public sentiment to respond is often lacking in comparison to other natural hazards that result in loss of life and property.

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

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

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

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.

Donald Wilhite
University of Nebraska, USA

Chapter 1

BACKGROUND AND RATIONALE

Despite the availability of technological and scientific advances and the diverse impacts that droughts have on livelihoods and economies, many nations do not have drought management policies in place. Considering that droughts are largely preventable and that the human and economic costs can be reduced, assisting drought-prone developing countries in building national capacities to develop national drought management policies is timely. Such a coordinated approach through capacity development on drought issues would enhance food security, reduce the vulnerability of the poorer sections of society and promote economic growth.

For nations to be able to move from crisis to risk management strategies, they need to implement effective monitoring and early warning systems to deliver – in a timely and effective manner – appropriate information to decision makers, effective impact assessment procedures, proactive risk management measures, preparedness plans aimed at increasing the coping capacity and effective emergency response programmes directed at reducing the impacts of drought. Such an integrated approach can lead to greater resilience as well as to recovery strategies when severe droughts ensue. Risk-based drought management is, however, multi-faceted and requires the involvement of a number of stakeholders. Therefore, from a drought management policy perspective, capacities in various ministries and national institutions need to be effective and better coordination of relevant sectors is needed to establish task forces for developing drought policies. In order to support the development of such capacities, the World Meteorological Organization (WMO), the United Nations Convention to Combat Desertification (UNCCD), the

Food and Agriculture Organization of the United Nations (FAO) and the UN-Water Decade Programme on Capacity Development (UNW-DPC) jointly established the UN-Water initiative on "Capacity Development to Support National Drought Management Policies". The initiative was launched with an international kick-off on the occasion of the High-level Meeting on National Drought Policy (HMNDP) in Geneva on 12 March 2013.

1.1 Objectives of the Initiative

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

1. Raise awareness of the existing 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 scientific and technical levels;

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

3. Promote collaboration between sectors at country and regional level. 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. These are based on the identification of the capacity needs from national to local levels to develop such policies and implement risk-based management strategies.

1.2 Regional Workshops on National Drought Management Policies

After the International Kick-off Event, which took place on the occasion of the High-level Meeting on National Drought Policy (HMNDP) on 12 March 2013, in Geneva, Switzerland, the UN-Water initiative will address capacity development to support the development of national drought management policies in the following sequence of regional workshops:

Regional Workshops

- Eastern Europe (conducted in Romania, 9-11 July 2013)
- Latin America and the Caribbean (conducted in Brazil, 4-6 December 2013)
- Africa (scheduled for 2014)
- Asia-Pacific (scheduled for 2014)

There will be an international wrap-up conference at the end of 2014/beginning of 2015.

Based on the proposed elements in the Compendium of National Drought Policy (Sivakumar et al., 2011), all the regional workshops will include different sessions, structured following a set of key elements of national drought policy, including the following areas:

- Drought Monitoring and Early Warning Systems
- Vulnerability and Risk Assessment
- Drought Preparedness, Mitigation and Responses and
- Action Plan towards Developing Drought Management Policies.

Each session includes a thematic presentation, which is followed by extended roundtable discussions in breakout groups. As situations vary significantly from country to country, no prescriptive or stringent set of elements of a national drought policy is defined; rather a set of elements guiding the policy development in each country's individual and specific situation. Most importantly, participants are introduced to the generic 10-step process for formulating national drought policies.

The purpose of these workshop proceedings is to elaborate and document the workshop presentations and discussions in breakout groups which took place in Bucharest, Romania from 9-11 July 2013.

Chapter 2

THE WORKSHOP FOR EASTERN EUROPEAN COUNTRIES

The first in the series of planned regional workshops was held from 9-11 July 2013 in Bucharest, Romania. The three-day workshop was hosted by the National Meteorological Administration of Romania and attended by 24 participants from 10 countries in the Eastern European region: Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Moldova, Montenegro, Romania, Serbia, Slovenia and Turkey.

In the opening session, two high-level representatives of Romanian authorities, Elena Dumitru, Secretary of State at the Ministry of Environment and Climate Change, and Ion Sandu, Director General of the National Meteorological Administration of Romania, gave opening statements. Donald Wilhite, Professor at the University of Nebraska, U.S.A. gave a keynote speech on "Risk-based National Drought Policy: Background, Challenges and Opportunities".

After the opening session, participants presented and discussed the country reports, which had been submitted by the ten countries before the workshop. As part of the process, countries participating in the regional workshops are expected to prepare a country report covering the drought situation in their respective countries (see section five). Most of the countries were represented by two to three participants from different ministries, reflecting the interdisciplinary nature of drought. Country reports in the initiative assess the state of national drought management practices of the respective countries. Preparing the country report has given participants from the same country the opportunity to discuss with each other ahead of the workshop, creating a network among various ministries.

The UN-Water members engaged in this initiative were represented by Mohamed Bazza (Senior Land and Water Officer, FAO), Robert Stefanski (Chief of Agricultural Meteorology Division, Climate and Water Department, WMO) and Jamal Annagylyjova (Programme Officer, UNCCD). UNW-DPC was represented by two Programme Officers, Daniel Tsegai and Jens Liebe.

The workshop achieved the goals it had set out to reach:

- Raising the understanding of the participants in terms of the needs and strategies for national drought policies and preparedness plans that place emphasis on risk management instead of crisis management;
- Establishing a scientifically sound, comprehensive and integrated understanding of drought early warning systems, vulnerability and risk assessment preparedness;
- Creating networks to enhance knowledge and information sharing; and
- Promoting institutional and regional coordination at the national and sectoral level to ensure efficiency and effectiveness of measures to address drought.

A group photo of workshop participants and organizers in Bucharest

The workshop attracted the media of Romania: Interview with Donald Wilhite

Workshop organizers during the coffee break

Interview with Mohamed Bazza

Workshop in progress

Chapter 3

THEMATIC SESSIONS

3.1 Drought Monitoring and Early Warning Systems

Robert Stefanski, WMO

The first thematic session of the Eastern European regional workshop focused on the topic of drought monitoring and early warning systems, including background information on the regional workshops and the outcomes of the High-level Meeting on National Drought Policy (HMNDP). It also discussed the different drought indices and their 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 basis for this initiative were the outcomes of the HMNDP, which produced science and policy documents.

The science document noted that a 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 are organized along these five elements. Documents and other materials from the HMNDP can be found at **www.hmndp.org**.

With regard to drought monitoring and early warning, it was stated that scientists monitor drought for various reasons: it is a normal part of the climatic cycle; drought impacts are significant and widespread; many socio-economic sectors are affected and drought is expensive. One important point is that droughts cause more deaths and displace more people than any other kind of natural disaster. A drought-monitoring system is important since it allows for early drought detection, improves response (by being proactive), "triggers" actions within a drought plan, is a critical mitigation action and forms a foundation of a drought plan. The components of a drought-monitoring system include timely data and information acquisition, synthesis/analysis of data used to "trigger" set actions within a plan and an efficient dissemination network (web, media, extension, etc.).

It was noted that potential drought-monitoring system products and reports can include historical analysis (climatology, impacts, magnitude, frequency), operational assessment (cooperative data, SPI and other indices, automated networks, satellite and soil moisture data, media and official requests) and also predictions/projections (SPI and other indices, soil moisture, seasonal 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 and long-term rainfall (six months), number of days passed since a significant rainfall, 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 a specific value of the indicator that initiates and terminates a certain 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, including the following: proper and timely detection of drought, spatial and temporal sensitivity, supplies and demands, drought in/drought out, composite and multiple indicators, data avail-

ability, 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 audiences. They are also a quantitative assessment of anomalous climatic conditions such as intensity, duration and spatial extent. They also provide a historical reference (probability of recurrence) that can be used for planning and design applications.

The session also touched on the efforts of WMO in trying to determine if consensus might 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 which are based on a sound statistical and historical perspective: SPI (and percentiles). The group 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. Besides, a comprehensive user manual for the SPI should be developed that describes the index, computation methods, specific examples of current use, strengths and limitations, mapping capabilities and areas of application.

A recent variation of the SPI index was mentioned, called the Standardized Precipitation Evapotranspiration Index (SPEI) by Vicente-Serrano et al. (2010), which includes a temperature component. The required inputs to run the programme are precipitation, mean temperature and latitude of the site(s). More information 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 required. With data from fewer years, 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, affected crops (conditions, growth stages) and soil moisture (measurement/simulation/departure from normal). Also, gridded datasets can be used (i.e. GPCC - Global Precipitation Climatology Centre)

along with remotely sensed data and reanalysis of weather model data. It was noted that vulnerability and impact data are limited with regard to area and length of record and this needs to be improved.

The example of the US Drought Monitor (USDM) was used to show how an indicator and a trigger can be applied. The USDM has different levels that can be used as trigger and is applied by several US states.

Finally, two WMO initiatives were briefly summarized. The first one was the World Climate Conference-3, where it was unanimously decided to establish a Global Framework for Climate Services (GFCS), a UN-led initiative spearheaded by WMO to guide the development and application of science-based climate information and services in support of decision-making. The 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 the development and incorporation of science-based climate information and prediction into planning, policy and practice. The greatest value of the GFCS will occur incrementally through the delivery of a multitude of climate services at national or local levels.

The other drought 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 work of IDMP will start at the end of 2013 or early 2014 when the Technical Support Unit has been staffed.

At the end of the presentation, three breakout groups were formed, as clarified in the following sub-sections, to work on the three types of drought. Each group followed the methodology from the paper by Keyantash and Dracup (2002). This methodology uses the following criteria: robustness, tractability, transparency, sophistication, extendability and dimensionality.

3.1.1 Procedures and Challenges on Early Warning Systems

The first breakout group tackled the question: "What are the current procedures and challenges on early warning systems?" The participants emphasized the importance of understanding and analysing the current status of water resources as well as the historical trends. They highlighted the role of data on snow packs and precipitation amounts, given the presence of a melting process during summer in certain regions. As the countries differ in topography, climate and resources, some parameters are more important for certain regions than for others. However, the relevance of meteorological and hydrological data was stressed. Participants also shared their concerns regarding the quality of seasonal and long-term forecasts, since it is often the case that they are not completely reliable. It was also noted that the number of monitoring stations and their density – which are identified as extremely important for supporting early warning systems – is declining in the Eastern European region.

3.1.2 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 and sustainability needs?" The participants identified the calibration of automatic and non-automatic stations as a principal need to be addressed, given their importance in ensuring the quality of the meteorological data. They also elaborated on the relevance of where stations are located and on communication issues between different stations, which may arise because stations in different places do not always use the same measurements (e.g. some stations may focus on SPI while others apply the forest fire index). This underlines the need for homogenizing meteorological and hydrological historical data in order to make its analysis more efficient. Another need expressed by the participants was related to a mechanism for effective communication of drought issues to the wider public and to improved strategies of awareness-raising on the issue.

3.1.3 Communicating and Liaising on Drought Monitoring and Early Warning between National Institutions

The third group discussed the question: "What mechanisms are in place for communicating and liaising on drought monitoring and early warning information between national institutions?" The discussion focused on the issue of data exchange between national institutions, which has a tangible benefit but is often challenging due to the high costs of accessing data. The relevance of capacity for scientific research aimed at greater understanding of the drought issue and awareness raising was also discussed.

3.2 Vulnerability and Risk Assessment

Jamal Annagylyjova, UNCCD

The second thematic session addressed the topic of "vulnerability and risk assessment". The presentation covered methodological aspects and discussed the direct and indirect impacts of drought.

Understanding the concept of vulnerability has been the subject of vigorous academic debates. Vulnerability is the degree to which a system is likely to experience harm due to exposure to hazard (Turner et al., 2003). In other words, vulnerability is a function of exposure sensitivity and adaptive or coping capacity. Though exposure is a straightforward concept defined by magnitude and timing of drought, drought impact depends on how sensitive a system is to the shock. In this context, vulnerability refers to the characteristics of a social group or sector in terms of its capacity to anticipate, to cope with and to recover from drought. Vulnerability represents a combination of economic, environmental and social factors. By understanding the root causes of vulnerability, stakeholders can design proactive measures to minimize the potential impacts of drought, since the solution (management) depends on the problem (vulnerability).

Quantitative risk assessment should establish the related components of risk: (a) the magnitude of the potential loss and (b) the probability that the loss will occur. Impacts depend on the duration, severity and spatial extent of the precipitation deficit, but also on the environmental and socio-economic vulnerability of affected regions. Impacts of drought can be listed as economic, environmental or social. Drought produces a large number of impacts that affect the social, environmental and economic standard of living. Its effects spread far beyond the physical effects of drought itself. Water is integral to all aspects of life, and as such some direct impacts of drought are reduced crop, rangeland and forest productivity; reduced water levels; increased fire hazard; increased livestock and wildlife death rates; and damage to wildlife and fish habitats. A reduction in crop productivity usually results in less income for farmers, increased prices for food, unemployment and migration.

The effects of drought ripple through economic sectors, communities and ecosystems, leaving a variety of impacts in its wake. Understanding how drought affects individuals, communities or businesses is crucial, because then it can be figured out why drought creates those effects, and what can be done about them.

The relationship between drought and public health in Europe is weak. More effects are observed as a consequence of heat waves, and an indirect effect was observed as a consequence of forest fires.

The main conclusions for the Central and Eastern European (CEE) region are the following:

- The vulnerability and adaptive capacity of CEE countries to climate change over the next two decades will be dominated by socio-economic factors and legacy rather than by climate change itself (World Bank, 2009).
- Non-climatic factors, such as a legacy of inefficient water use and continued unsustainable demand, will be the main drivers of water stress in Europe over the next couple of decades (Vörösmarty et al. 2000).

Soil, land degradation and drought-related policies are interlinked and have recently received much attention in internal EU policies. There are examples of ongoing initiatives in Europe on drought vulnerability and risk assessment: the European Commission Communication "Addressing the challenge of water scarcity and droughts in the European Union (COM, 2007)" is the primary policy document guiding EU Member States' efforts to combat water scarcity and drought which defines overarching policy options, several of which are related to water economics and resource efficiency.

There are a few regional examples which could provide successful elements:

- Mediterranean Drought Preparedness and Mitigation Planning (since 2003) **(http://www.iamz.ciheam.org/medroplan/)**
- European Drought Center (since 2004) **(http://www.geo.uio.no/edc/)**
- Drought Management Center for South and Eastern Europe (DMC SEE) in Slovenia (since 2006) **(http://www.dmcsee.org/)**

UNCCD has a role in drought management: parties to the UNCCD COP 10 requested the Secretariat to develop an Advocacy Policy Framework (APF) on Drought:

- The APF on Drought provides the UNCCD secretariat with tools and approaches for assisting country parties in addressing key drought issues and concerns.
- The overarching goal of this APF is to promote the development and adoption of policies that reduce societal vulnerability to drought.
- COP 11 in Windhoek, Namibia took a decision to adopt the APF on Drought.

Economics of Land Degradation (ELD) is an initiative carried out by UNCCD in partnership with many international partners. The ELD will provide the standard methodology to assess economic costs and benefits of action on SLM and offer policy options through calculation of on-site and off-site damages and losses.

At the end of the presentations, the breakout groups were informed on the risk, vulnerability issues as discussed below.

3.2.1 Who is Vulnerable?

The first breakout group addressed the question: "Who is vulnerable (socially/economically) and why?" Women, the elderly and children as well as people with health issues were identified as the most vulnerable. Ecosystems, especially forests, are more susceptible to fires, which entails further consequences for the biodiversity. When it comes to productive activities, all sectors of the economy (in particular agriculture) are affected. In agriculture, drought affects yields and results in a decrease in livestock. The energy sector (hydropower) and the service sector, particularly tourism and transportation (naval), also suffer from drought. When trying to understand the underlying reasons, the participants pointed out the lack of infrastructure as a major deterring factor, which often leads to immense water loss and affects all aspects of social and economic activities. Other relevant issues discussed were low priority on education and low responsiveness of governments to the needs of vulnerable people.

3.2.2 Mitigation Policies

The second group tackled the question: "What are the mitigation policies and plans that reduce drought impacts/government intervention?" Table 1 summarizes the main conclusions of the discussions. From the experiences shared by the participants, governments are engaged in different strategies to mitigate the effects of droughts, but they are motivated by emergency response rather than prevention.

Table 1: Vulnerable sectors, groups and mitigation policies

VULNERABLE SECTORS	VULNERABLE GROUPS	MITIGATION POLICIES
AGRICULTURE	• Small scale farmers • Crop producers and livestock breeders • Migrants • Marginalized groups	• Efficient water use and rehabilitation and modernization of existing irrigation systems • Institutional measures • Capacity-building at all levels (water harvesting and other water saving techniques) • Introduction of drought-resilient crops • Insurance measures • Diversification of income
ENERGY	• Population (urban and rural) • Industrial consumers	• Increasing energy efficiency • Promoting renewable energy • Diversification of energy resources
FOREST	• Forest villagers (through fewer forest services and fires)	• Forest fire prevention • Monitoring of meteorological information relevant to fires • Action plan • Afforestation ration and forest protection belts • Introduction of drought-resistant forest species
TOURISM	• Tourism agencies	• Diversification of income

3.2.3 Who Plays Which Role in Developing the Mitigation Policies?

The third group discussed the question: "Who plays which role in developing the mitigation policies and plans that reduce drought impacts and vulnerability at all levels?" Generally, the participants identified the local authorities as decision makers (e.g. legislative bodies, local municipalities) and argued that political participation is critical, as is a strong leadership (a top-down approach). At the national level, different ministries, including for instance agriculture, environment, water management, transport, energy, etc., should share the responsibilities for mitigation. The research community and civil society should be included in the general discussions as should be cooperatives, associations and agricultural communities.

3.3 Drought Preparedness, Mitigation and Response

Mohamed Bazza, FAO

The session on drought preparedness, mitigation and response first recalled the following definitions, along the lines of the HMNDP Compendium on National Drought Policy and the National Drought Mitigation Center (NDMC) of the University of Lincoln, Nebraska:

- Drought Preparedness: established policies and specified plans and activities taken before drought to prepare people and enhance institutional and coping capacities, to forecast or warn of approaching dangers, and to ensure coordinated and effective responses in a drought situation (contingency planning);
- Drought Planning: actions taken by individual citizens, industry, government and others before drought occurs to mitigate impacts and conflicts arising from drought;
- Response to Drought: efforts such as the provision of assistance or intervention during or immediately after a drought disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term or protracted duration;
- Recovery from Drought: decisions and actions taken after a drought with a view to restoring or improving the pre-drought living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce drought risk;
- Drought Mitigation: any structural/physical measures (e.g. appropriate crops, dams, engineering projects) or non-structural measures (e.g. policies, awareness, knowledge development, public commitment and operating practices) undertaken to limit the adverse impacts of drought.

Traditionally, response to drought – and at times recovery from it – constitute the major action that countries take as an emergency measure after drought has been declared. Such response is unplanned and hastily applied after drought has taken its toll of damages and scourges. Response to drought, including recovery, remains an important component of proactive drought risk management; however, this time it is planned before drought occurs and constitutes an integral part of a drought plan. Together with monitoring and early warning and vulnerability and risk assessment, mitigation and response constitute the foundation of drought risk management. Numerous advantages and synergies result from the integration of response measures into a drought plan, as explained during the session.

The drought mitigation measures included in a drought plan are normally those among the results from the exercise of "Vulnerability and Risk Assessment" which have been identified as having high priority. They address the root causes of vulnerability and their implementation results in increasing capacities to cope with drought and reduce its impacts. The set of measures that can potentially be included in a drought plan (mitigation, response and recovery) are often referred to as Risk Management Options. These options are split into three categories based on the time of their action: long-, medium- and short-term.

Table 2: Drought mitigation measures

CATEGORY	LONG-TERM	SHORT-TERM	RESPONSE AND RECOVERY
OBJECTIVE	Resilience building	Drought mitigation	Impact reduction
IMPLEMENTATION FRAMEWORK	Regularly develop programmes	Drought plan	Response within drought plan
IMPLEMENTATION TIME	Continuous	Before, during, after drought	During, after drought

The short-term measures are implemented before, during and after drought in a timely manner, based on indices or triggers linked to drought indicators determined by "Monitoring and Early Warning". The three categories complement each other and constitute an integral plan of drought risk management. A long list of measures for all three categories was included in the presentation. Similarly, the procedure for linking actions to indices and drought indicators was exemplified. Finally, the presentation explained the institutional and operational arrangements of a drought plan, including the different committees, the way their members are nominated, their composition, their mandates and the reporting lines. After the thematic presentation, the participants were split into two groups.

3.3.1 Drought Preparedness Measures and Stakeholders

The discussion of the first group was on the topic of "Drought preparedness measures and stakeholders". They talked about issues regarding measures and implementation steps for drought preparedness. Table 3 summarizes the main points discussed.

Table 3: Measures and responsibilities of drought preparedness

SECTORS	ACTIONS/MEASURES	RESPONSIBLE AGENCIES
AGRICULTURE	Improve irrigation systems	Irrigation departments/ water agency
ENERGY	Diversification of energy sources	Private sector/ ministry of energy
FORESTRY	Plant fire resistant species	Forestry department
WATER	Leakage reduction	Water department

3.3.2 Drought Response and Recovery Measures and Stakeholders

The second group addressed the issue of drought response and recovery measures and stakeholders. The participants identified the need for establishing well-grounded drought management systems, which should include administrative and legal guidelines as well as a proper organizational structure. Early warning systems are an important part of national drought strategies and require reliable forecasts and availability of data. Concerning practical proposals, various alternatives were discussed, for example the significance of improving irrigation, and using pipe systems instead of open channels. Improved land use planning would minimize drought by a better use of allocated water resources. A sustainable development approach with regard to soil, water and the environment in general should be ensured by national legislation and subject to regular controls. The importance of cutting back water use and of implementing water saving measures was also highlighted. The participants also suggested prioritizing the use of fresh water, first for consumption and second for agricultural purposes, at the same time limiting industrial use of water.

3.4 Towards an Action Plan – Developing Drought Management Policy

Daniel Tsegai, UNW-DPC

The fourth thematic session addressed the topic of practical steps for developing drought management policy. During the introduction, the participants were reminded of the importance of drought policies, given the impact this natural hazard has on different sectors of society. The presentation underlined the main objectives such a policy should follow, for instance encouraging vulnerable economic sectors and population groups to adopt self-reliant measures which promote risk management, or promoting a sustainable use of the agricultural and natural resource base, among others.

The generic ten-step planning process to formulate national drought policies, developed by Wilhite et al. (2011), was elaborated on, focusing on the most relevant elements of each of the steps, which are as follows:

1. Appoint a national drought management policy commission/task force;
2. Define the goals/objectives of a risk-based national drought management policy;
3. Seek stakeholder participation;
4. 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 importance of relevant institutional arrangements for a drought policy was also presented. Political commitment, building strong institutions and appropriate governance, 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. More so, preparedness at all levels of government (individuals, community and decision makers, local and regional authorities) and having a legal or institutional framework with defined responsibilities and cross-institutional collaboration are preconditions for a successful national drought policy process. The presentation also highlighted some of the current challenges of developing national drought policies, including fragmented responsibilities for drought risk management, low priority given to drought by governments, weak drought risk governance capacities, conflict on water use and excessive water use.

The last part of the presentation introduced successful case studies of national drought policies. The first case presented the efforts of the Australian government, which has been attempting to move away from a crisis management approach to droughts towards an increased emphasis on climate risk management. The second country reviewed was the United States of America and its National Drought Policy Act. Brazil is another country which – through its drought policies – has reduced the economic and social vulnerability in the Northeast of the country. Spain is a good example of the successful implementation of different management actions for drought policy. Lastly, a process was presented in which China addresses its drought-related activities through monitoring, early warning, impact assessment, emergency response, hazard relief and recovery.

3.4.1 Institutional Arrangements Necessary for Developing a National Drought Management Policy

The first question for the breakout group covering the above topic was: "What are the institutional arrangements necessary for developing a national drought policy?" After an exchange of opinions, the participants concluded that one of the greatest priorities should be the establishment of a drought task force, whose leadership should rest with the ministry responsible for the most vulnerable sector (e.g. agriculture). However, they also highlighted the importance of identifying key responsibilities for all the agencies and ministries involved. The participants also mentioned that a national drought policy should be coherent with other national legislation and that countries could also explore the possibility of using broader frameworks which are comprehensive enough to consider all relevant sectors.

3.4.2 Challenges for Developing National Drought Management Policies

When facing the question of "What are the challenges for developing national drought policies?", the participants expressed the opinion that the lack of financial resources are often a major impediment. The existence of contradictory policies and conflicting responsibilities are also important challenges, among others. Often there is a lack of awareness about droughts, which may explain why it is not a top policy priority within many governments.

3.4.3 Steps Being Undertaken for Developing National Drought Policies

The last question to be discussed was "What are the steps being undertaken for developing national drought policies?", to which the participants provided examples from their own experiences. For example, Romania developed a strategy in 2008 that includes a national action plan, and although it has not yet been approved, a national committee for drought has been reactivated recently in order to revise the strategy. Turkey has an agricultural drought plan for a five-year period which is discussed and updated annually. In 2005, FYR Macedonia established a national board responsible for the obligations within the framework of the commitments to UNCCD, and a process for preparing a national action plan has been started. Croatia has already elaborated a national action plan, and Bosnia and Herzegovina, Montenegro and Slovenia are in the process of preparing their respective national plans.

Workshop organizers

Chapter 4

SUMMARY

The sessions assessed various thematic areas, including the importance of monitoring drought, the steps for assessing drought vulnerability and risk and the typologies of different drought risk management measures such as drought preparedness, mitigation, response and recovery.

The workshop achieved its goal in that it i) raised the understanding of the participants in terms of the needs and strategies for national drought policies and preparedness plans that lay emphasis on risk management instead of crisis management; ii) established scientifically sound, comprehensive and integrated drought early warning systems; iii) created networks to enhance knowledge and information sharing to improve public understanding and preparedness to drought; and iv) promoted institutional coordination at national level to ensure efficiency and effectiveness of measures to address drought. Finally, the cost of inaction and the economic impacts of drought were highlighted and the cost effectiveness of risk-based drought management strategies when compared with the cost of disaster response was underlined.

The workshop provided the participants an opportunity to analyse and reflect upon the drought situation and the vulnerability of CEE region. As could have been expected, the most vulnerable sector, according to the participants, is agriculture (rain-fed crop production), which has been severely affected by frequent events of drought within the last decade.

Despite the repeated drought events over the last two decades in the CEE region, awareness of drought impacts is limited among politicians and the wider public. The losses caused by drought and water scarcity have been assessed to some extent in each country, but have not been well communicated to the higher decision-making level. It is obvious that the CEE countries, which are predominantly economies in transition, prioritize the immediate economic and social issues. The governments continue to respond to drought in a reactive manner through relief programmes. According to the 2007 Communication from the Commission to the European Parliament and the Council (COM), "Addressing the challenge of water scarcity and droughts in the European Union", the costs evolving from drought and water scarcity amounted to €100 billion over the past 30 years. Strategic approaches and addressing adaptation and mitigation actions towards climate change provided additional dimensions for drought preparedness. Besides the fact that drought issues are ranked medium to low in CEE countries, the absence of a specific authority for natural resource management which results in a division of responsibilities among various government institutions is considered a permanent challenge for drought mitigation. In contrast, a relatively high level of research capacity in the field of drought monitoring and vulnerability and impact assessment has been observed in CEE.

Workshop organizers and high-level authorities of the Government of Romania during the opening

References:

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.

Keyantash, John, and John A. Dracup (2002). T*he Quantification of Drought: An Evaluation of Drought Indices.* Bull. Amer. Meteor. Soc, vol 83, pp. 1167–1180.

Sivakumar, M. VK., Raymond P. Motha, Donald A. Wilhite, John J. Qu (2011). T*owards a Compendium on National Drought Policies. Proceedings of an expert meeting*. World Meteorological Organization. Geneva.

Turner, B. I., Roger E. Kasperson, Pamela A. Matson, James J. McCarthy, Robert W. Corell, Lindsey Christensen, Noelle Eckley, Jeanne X. Kasperson, Amy Luers, Marybeth L. Martello, Collin Polsky, Alexander Pulsipher, and Andrew Schiller (2003). *A Framework for Vulnerability Analysis in Sustainability Sciences. Proceedings of the National Academy of Sciences*, Vol. 100, No.14, pp. 8074-79.

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, and 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 Wilhite (Ed) (2005) Drought and Water Crises: Science, Technology, and Management Issues. Boca Raton: CRC Press.

NATIONAL REPORTS (SELECTION)

Map of Participant Countries:


Moldova
Romania
Slovenia
Croatia
Bosnia and Herzegowina
Serbia
Bulgaria
Monte-negro
FYR of Mace-donia
Turkey

5.1 Bosnia and Herzegovina

Sabina Hodzic[1], Mihajlo Markovic[2], Hamid Custovic[3]

Background

Bosnia and Herzegovina (B&H) has a highly diversified precipitation pattern, as well as potential and real ETP, water run-off and percolation (see Table 4). The country has experienced dry periods in the last decades (i.e. the 2003 and 2012 droughts), which have increased the general awareness of the impact of dry weather. Nonetheless, droughts are not considered a primary threat to Bosnia and Herzegovina by the national authorities. The most vulnerable areas are the south-western and north-eastern part of the country.

Table 4: Scheme of spatial distribution of various hydrological parameters

HYDROLOGICAL PARAMETER (PER ANNUM)	B&H AVERAGE	SOUTH AREA	CENTRAL AREA	NORTH AREA
PRECIPITATION IN mm	1200	2000	1000	800
POTENTIAL ET (PET) IN mm	725	900	650	700
REAL ET (RET) IN MM	600	600	600	600
WATER DEFICIT IN mm	125	300	50	100
WATER SURPLUS IN mm	600	1400	400	200
DROUGHT COEFFICIENT	1.65	2.22	1.54	1.14
OUTFLOW COEFFICIENT	0.50	0.70	0.40	0.20

During the last decades, the country experienced several droughts in the years 2000, 2003, 2007, 2011 and 2012. This produced some severe consquences:

- In August 2000, Bosnia and Herzegovina suffered the worst drought in 120 years, where about 60% of the agricultural production was affected, resulting in extreme food insecurity.

[1]Federal Hydrometeorological Institute, Sarajevo, Bosnia and Herzegovina,
[2]Agricultural Faculty of University of Banja Luka, Bosnia and Herzegovina, UNCCD Focal Point
[3]Agricultural Faculty of Sarajevo, Bosnia and Herzegovina

- During the summer of 2003, some regions were hit by drought, which caused around €200 million in damages of agricultural output and affected close to 200,000 people.
- In the summer of 2007, extremely high temperatures and the resulting drought destroyed more than 40% of the agricultural production and caused forest fires, which affected about 250 hectares of land.
- In 2012, the country experienced a prolonged drought period, causing a loss of $1 billion in agricultural production, a 70% reduction of grains and vegetable yields and a 25% reduction of energy production.

The severity and frequency of droughts in Bosnia and Herzegovina has been increasing over the last few decades, and climate projections assert that the dramatic consequences of climate change will intensify in the coming years.

Climate change projections show a significant decrease of precipitation in the region, especially during summer, which could lead to an increase of drought frequency and intensity. This underlines the urgent need for assigning priority to addressing droughts.

Drought Monitoring and Early Warning System

Drought monitoring in Bosnia and Herzegovina is carried out by two hydrometeorological services in the two administrative entities of the country: the Federal Hydrometeorological Institute in Sarajevo (FHMI) and the Republic of Srpska Hydrometeorological Institute in Banja Luka (RSHMI). The roles and responsibilities of the two organizations include systematic observation and monitoring of hydro-meteorological parameters; provision and publication of information, forecasts, products and services related to weather, climate and water and supply of data related to drought-relevant parameters, indices and indicators. Currently, FHMI and RSHMI have their own separate meteorological and hydrological measurements, with the objective of monitoring only one administrative entity. There is at present no early warning system for drought at the national level.

Vulnerability Assessment

Compared to other natural disasters, droughts have been by far the most significant threat to Bosnia and Herzegovina, with huge economic, environmental and social costs. Activities such as agriculture, forestry and fishery depend heavily on water; any loss in crop yields or livestock production and any increase in insect infestations, wind erosion or forest fires have a negative effect on the national economy. The environment faces a huge threat from droughts; plants, animals and their habitats as well as fresh air and

water quality are all compromised. At the same time, there is often a loss of biodiversity, which leads to land degradation and soil erosion.

The agricultural sector is usually the first one affected by droughts, given its dependence on soil and water, which can be rapidly depleted during extended dry periods. When precipitation deficiencies prolong, other sectors relying on alternative water sources also start experiencing the effects of the scarcity. Sectors using surface water (e.g. reservoirs and lakes) and subsurface water (groundwater) are usually the last ones affected. A short-term drought of three to six months may have little impact on these sectors, depending on the characteristics of the hydrological systems and water use requirements.

The incidence of forest fires substantially increases during extended drought periods, which compromises the safety of both human and wildlife populations. Traditionally, droughts mainly impact the most vulnerable groups of society, small farmers, women and children. Other drought consequences observed are conflicts between water users and –more generally – a reduction in citizens' quality of life.

Emergency Relief and Drought Response

Different governmental bodies respond to droughts by providing relief to those most affected. Bosnia and Herzegovina is currently preparing National Action Programmes (NAPs) to identify the factors contributing to droughts and develop the necessary measures for combating desertification and land degradation, as well as for mitigating the effects of drought. Within this framework, NAPs would enhance national climatological, meteorological and hydrological capabilities and the means to provide a drought early warning system. This includes strengthening drought preparedness and management at local, sub-regional, regional and national levels. NAP also aim at incorporating long-term strategies to mitigate the effects of drought in line with the national policies for sustainable development.

Practices to Alleviate Drought Impacts

Some of the practices successfully implemented are the development of drought index calculation, treatment of data series, mapping (including use of GIS tools) and use of irrigation-scheduling software for drought analysis. Bosnia and Herzegovina still needs more training in drought vulnerability assessment and remote sensing techniques for drought monitoring management, mitigation strategies, planning and policy.

The Need for Knowledge and Capacity Development in Drought Management

The pressing need is to establish a drought early warning system at national and local level. Besides that, the country would highly benefit from the following:

1. Upgrading and modernizing the hydrometeorological observation networks, data management and forecasting system as well as supporting sustainable organizational, human and technical resources to maintain and operate them;
2. Training in drought vulnerability and risk assessment;
3. Enhancing the cooperation and networking between various hydrometeorological sectors, different stakeholders and end-users of this data, services and early warnings;
4. Strengthening the capabilities for drought preparedness and management, including contingency plans at local and national level; and
5. Developing sustainable irrigation systems.

References:

Custovic, Hamid, E. Alagic (n.d.). *Situation of drought in Bosnia and Herzegovina.* Available from httftp://ftp.fao.org/agl/emailconf/soilmoisture/t3_Custovic_1.doc.

Custovic, Hamid. (n.d.). *An overview of general Land and Soil Water conditions in Bosnia and Herzegovina.* European Soil Bureau – Research Report. Vol. 9. Available from http://eusoils.jrc.ec.europa.eu/esdb_archive/eusoils_docs/doc.html.

Markovic, Mihajlo (2007). *The First National Report on the implementation of the UNCCD in Bosnia and Herzegovina.* Banja Luka. Available from http://archive.unccd.int/cop/reports/centraleu/national/2006/bosnia_and_herzegovina-eng.pdf.

Markovic, Mihajlo (2012). *Land and Soil Resources, in State of the Environment Report in Bosnia and Herzegovin*a. Mostar: Federal Ministry of Environment and Tourism, available from http://www.unep.ba/soer-data-survey.html.

Markovic, Mihajlo, P. Begovic, and D. Pesevic (2009). *Ground Water Resources of Lijevce Field as a Potential for Irrigation in Agriculture.* In: Proceedings of the Eleventh International Symposium on Water Management and Hydraulic Engineering, Volume II. Paper: A95. 1-5 September. pp. 721-728. Ohrid, FYR Macedonia.

Markovic Mihajlo, I. Komljenovic, and T. Carkic (2004). *Components of soils water balance on Gradiska area*. In: Agroznanje, Vol. 5., No. 4. pp. 75-81.

Sivakumar, M. VK., Raymond P. Motha, Donald A. Wilhite and Deborah A. Wood (2010). *Agricultural Drought Indices –proceedings of an expert meeting 2–4 June 2010*. World Meteorological Organization, Geneva.

Vukmir, G., L. Stanišljevic, M. Cero, M. Cacan, M. Markovic, M. Rudež , O. Laganin, R. Kostic, S. Oprašic, and T. Lukic (2009). *Initial National Communication of Bosnia and Herzegovina under the United Nations Framework Convention on Climate Change.* Ministry of Environmental and Spatial Planning.

5.2 Croatia

Marija Culinovic Holjevac[4] , Darko Pavlovic[5], Kreso Pandzic[6]

Background

Compared to the pre-industrial era, the region of South-Eastern Europe has recently witnessed more frequent warm and dry periods, which is expected to continue during the 21st century (IPCC, 2007). Recent National Meteorological and Hydrological Service (NMHS) assessments for Croatia show that eight of the last twelve years were categorized as 'warm' years. Croatia's dry months in a year are steadily increasing. According to NMHS, the period between 2003 and 2011 has seen the highest frequency of dry months in recent history and was thus categorized as the driest period for Croatia.

The increase of dry seasons, which categorically translates to less rainfall and thus droughts, has implications for crop production. In Croatia, the impacts of droughts were felt particularly strongly in the years 2000, 2003, 2007, 2011 and 2012 (see Figure 1). Drought hits most smallholder farmers as they have no means to adopt and few fall-back options. Most of the agricultural production in Croatia takes place in small family holdings (the average farm size is 2.4 hectare).

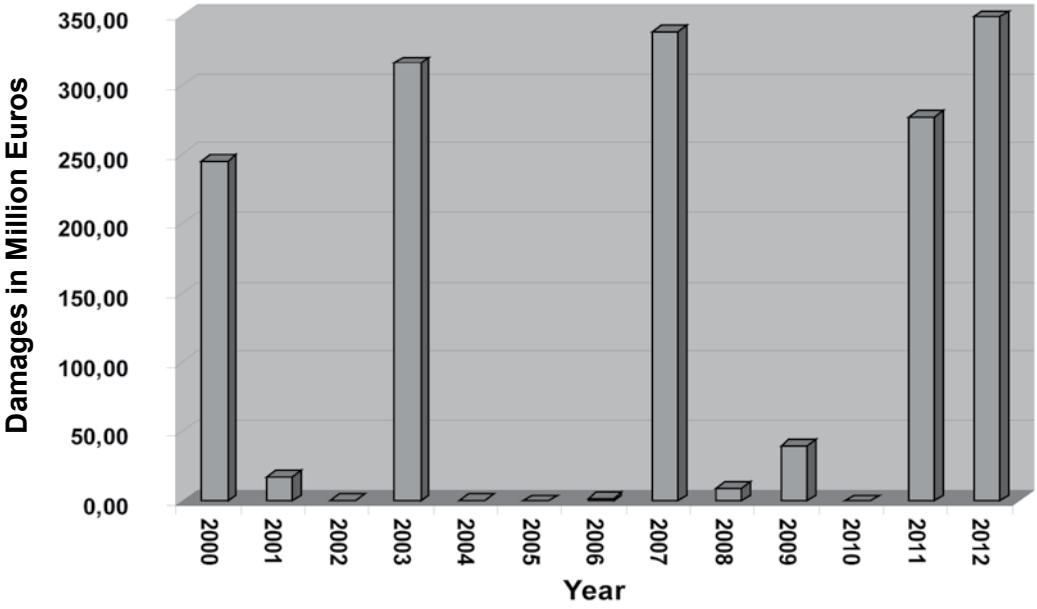


Figure 1: Damages (in million Euros) due to drought in Croatia during the period 2000–2012

[4] Meteorological and Hydrological Service, Zagreb, Croatia
[5] Ministry of Agriculture, Zagreb, Croatia
[6] Ministry of Environmental and Nature Protection, Zagreb, Croatia

Drought Monitoring and Early Warning Systems

The National Meteorological and Hydrological Service (NMHS) of Croatia is a key institution in the collection and processing of meteorological and hydrological data needed to guide monitoring on drought in vulnerable segments of the society as a whole. The NMHS operates under the umbrella of the Ministry for Environmental and Natural Protection of Croatia.

The NMHS has established drought monitoring and early warning systems in Croatia. Recent drought events in the country have been analysed and published on the website of the NMHS (2013a), including relevant temperature and precipitation levels. River discharges have also been published (*Ibid*, 2013b) and on the website of Croatian Waters (2013).

At the regional level, the Drought Management Centre for South-Eastern Europe (DMCSEE) (2013) was an important endeavour to improve drought monitoring and early warning systems in the South-Eastern European region, of which Croatia was a beneficiary. Several international organizations, including the International Commission on Irrigation and Drainage (ICID), UNCCD and WMO, participated in shaping the proposal to establish the centre in 2006. It was spearheaded by the Agency for Environment of Slovenia (ARSO). A final proposal and application for the DMCSEE EU project was prepared in 2009 by a consortium composed of representatives from national meteorological and hydrological services, the academic community (e.g. Faculty for Agriculture, University of Zagreb) and ministries responsible for the mitigation of impacts of drought and desertification (Ministry for Environmental and Natural Protection). The main aim of the DMCSEE project is to improve drought preparedness by performing risk assessment and establishing early warning systems and consequently help reduce drought impacts in the Central and South-Eastern European region.

Vulnerability Assessment

Intensified by climate change impacts, Croatia faces huge pressures on the safety of its food chain in terms of mycotoxin contamination and degradation of soil conditions, lowered groundwater levels, etc. As shown in Figure 2, the areas covered with vegetation in eastern Croatia are classified as "not vulnerable", "slightly vulnerable" and/or "moderately vulnerable". The North-Western inland area is mainly "not vulnerable", while the arable land and cultivated areas are "slightly vulnerable". "Slightly vulnerable" are also the Istria peninsula and Lika region, where only some smaller parts are categorized as "not vulner-

able" (mixed forests) and/or "moderately vulnerable" (cultivated land or pastures). Vulnerability rises when moving towards the northern Adriatic coast. In the middle Adriatic coast, the transitional woodlands are mostly "moderately vulnerable", while grassland and cultivated areas are "vulnerable".

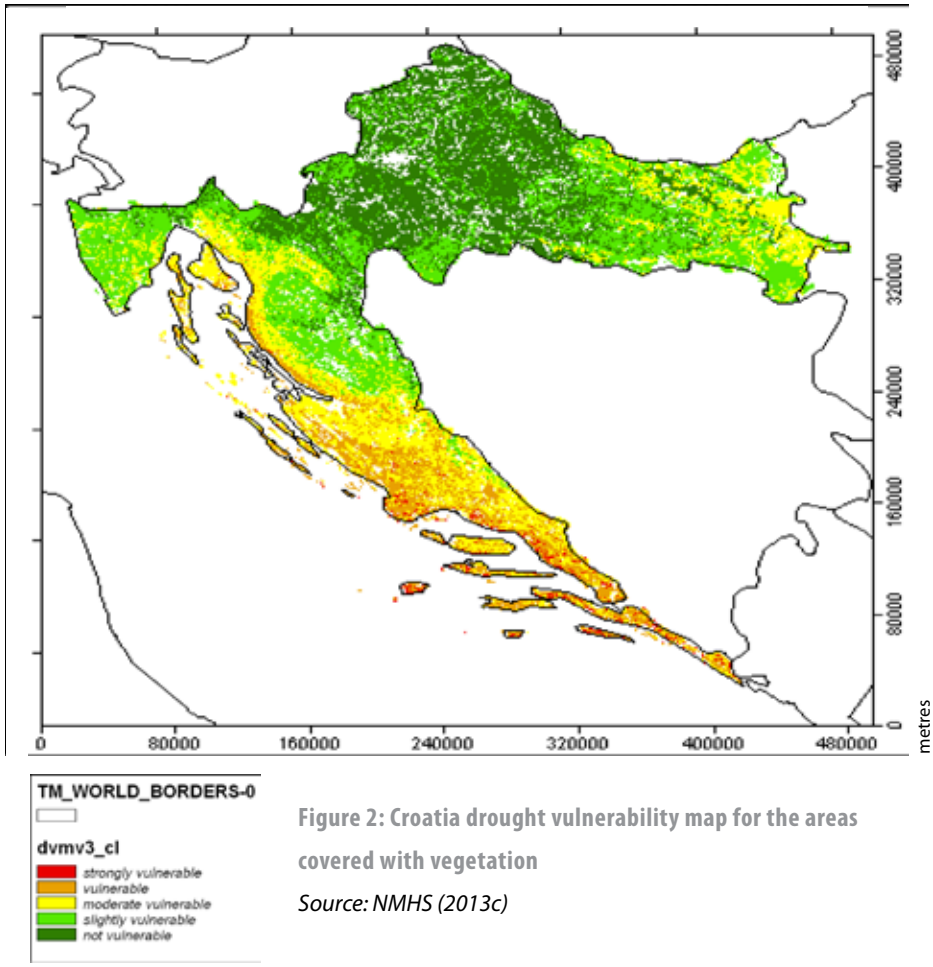


Figure 2: Croatia drought vulnerability map for the areas covered with vegetation

Source: NMHS (2013c)

Analysis of the current status and developmental needs show that Croatia possesses sufficient quantities of water for its own needs and that water resources, in terms of their quality and quantity, are not a limiting factor for economic development or food production. However, the lack of sufficient water – mostly during the summer months in dry years – usually affects agricultural production because small farms (the majority in Croatia) cannot afford irrigation practices.

Problems with water supply in extremely dry years occur more often in those parts of Croatia where public water supply does not exist. Problems with public water supply were present in the Istrian peninsula during the extreme drought of 2012.

Compensation for agricultural damage caused by drought is usually linked to a 'Declaration of Natural Disaster' and often supported by financial aid from the government. Based on the assessment of crop damage, local authorities allocate approved financial resources from governmental funds to drought-affected farmers as a measure of mitigation.

Irrigation of agricultural land is insufficient and uses only a negligible part of the water potential. For example, in 2003 only 9,264 hectares (0.86 percent of the agricultural land in Croatia) were irrigated. As the Republic of Croatia is endowed with good-quality soil and rich water resources, the underexploitation of the irrigation potential in the country is evident.

Emergency Relief and Drought Response

Regarding measures of drought response, the Government of the Republic of Croatia has taken a number of steps. For example, in October 2005 the Government adopted a strategy of 'development of irrigation' in Croatia with the aim of improving the management of natural resources, the organization of agricultural infrastructure and the marketing of agricultural products under the title of National Project of Irrigation and Management of Agricultural Land and Water in the Republic of Croatia (NAPNAV).

In addition, more than six existing irrigation systems have been totally or partially repaired (3,800 ha), five new systems were built (1,200 ha) and the total irrigable land increased to around 15,000 ha in 2012. According to NAPNAV, the construction of irrigation systems in Croatia is planned to increase to 65,000 ha of irrigable land by the end of 2020. With the increased drought prevalence, the government is almost compelled to increase the level of irrigated agricultural land in a sustainable manner. It is expected that the measures of systematic improvement of infrastructure in agriculture, consolidation of agricultural land and introduction of irrigation and new production technologies will result in more efficient and stable agricultural production.

In September 2011, the Croatian Government adopted a strategic plan for the development of a green economy. Croatia launched initial activities in the food sector which promoted information on good agricultural practice. The country also developed guidelines

for agriculture and the application of environmental measures in practice (in 2008), but still could not cover the full recommendations of sustainable development related to environmental protection.

These efforts have not achieved the expected results, and Croatia has to continue its efforts to make further achievements in terms of connectivity and the strengthening of institutional capacity for sustainable development in relevant line ministries and organizations of Croatia based on the recommendations of UNCCD, UNFCCC, the Convention on Long-range Transboundary Air Pollution (LRTAP), UNECE and other relevant institutions.

Practices to Alleviate Drought Impact and the Need of Raised Capacity for Drought Management

In accordance with the principles of sustainable development, keeping the application of pesticides, fertilizer and water use in line with laws to protect the environment requires a strengthened institutional capacity for environmental protection. To reduce the impact of drought on forests, soils, food production, loss of organic matter in soil and water, temperature and socio-economic indicators, it is necessary at the national level to implement the recommendations of 'sustainable development'. In order to do so, the institution members of the Fund of Environmental Protection and Energy Efficiency automate data which is then used as an open system of financial interventions for the implementation of environmental protection measures.

Highly complex IT programmes for soil and agricultural land data will be used to monitor deforestation, the level of soil organic matter, soil contamination levels, the correlation with the individual user, laboratory analyses, soil remediation, land registry, cadastre, etc. In the process of strengthening environmental and drought institutions, special attention has to be paid to the integration of all existing data into one database with the possibility of rapid issuance of certified data on the state of the environment – according to the "polluter pays principle".

References:

Croatia, National Meteorological and Hydrological Service (2013). *Monitoring the rainy and dry conditions at different time scales.* Available from http://klima.hr/klima.php?id=SPI

___(2013b).*Daily hydrological report.* Available from http://hidro.hr/hidro.php?id=hidro&param=Podaci

___(2013c).*Transnational South East Europe Programme 2007-2013 - IPA SEE 2008.* Available from http://meteo.hr/DMCSEE/

Croatian Water (2013). *Water Levels* Available from http://www.voda.hr/Default.aspx?sec=821

Drought Management Centre for South-Eastern Europe (2013). *Drought Bulletins and maps*. Available from http://www.dmcsee.org/en/drought_monitor/

5.3 Moldova

Valeriu Cazac[7]

Background

The Republic of Moldova is located in the South-Eastern part of Europe; it has a sub-humid and semi-arid climate and has been hit with droughts frequently in recent years. For most parts of the country, the average return period of drought varies from three to five years (Daradur et al., 2007). As Table 5 indicates, between the years of 2000 and 2012 alone, the country experienced four years of devastating droughts.

Table 5: Impact area, duration and economic losses from droughts, 2000-2012 (Republic of Moldova)*

DROUGHT YEAR	AFFECTED AREA, IN %	DURATION/ SEASONS	ESTIMATED ECONOMIC LOSSES	
			MILLION MOLDAVIAN LEI (MDL)	MILLION US DOLLARS (USD)
2000	75	Spring-autumn	2098, 1	169,7
2003	86	Summer-autumn	-	-
2007	78	Summer-autumn	11970,0	987,0
2012	80	Summer-autumn	2500,0	200,5

** Adapted from: Ministerul Agriculturii şi Industriei Alimentare, 2007; Ministerul Agriculturii şi Industriei Alimentare, 2012; Daradur et al., 2007; UN, 2012; World Bank & FAO, 2007.*

The reason for the frequency of recent droughts is less obvious. Most of the values from meteorological indicators (e.g. temperature, precipitation, soil moisture) were exceptionally high for the recorded time period (SHS, 2012). Some experts consider that the recurrence interval of severe drought has become shorter during the last decades, and climate change is likely to increase the severity of droughts (Daradur et al., 2007; MEDIU, 2012).

Drought Monitoring and Early Warning Systems

The State Hydrometeorological Service of the Ministry of Environment is the main institution responsible for monitoring and providing most of the early warning services for drought risk management in Moldova. Currently, the monitoring of key meteorologi-

[7] State Hydro-meteorological Service, Chisinau, Republic of Moldova

cal parameters for drought assessment (precipitation, temperature, soil moisture, etc.) is conducted by 17 weather stations and 20 agrometeorological posts.

The meteorological indicators mostly used in Moldova are the Hydrothermal Coefficient, the SPI, the SI Index, representing the difference in the standardized anomalies of the temperatures and precipitation, and the Z Aridity Index, which identifies and assesses droughts by including temporal distribution of the precipitation. Nonetheless, there is a lack of consistency in the statistical data, which compromises the assessment of drought conditions as well as the comparability of the drought categories among the indicators. As a result, it has become particularly challenging to achieve the desired drought management goals (Daradur et al., 2007).

The State Geological Agency (AGeoM) is responsible for monitoring and collecting data on groundwater levels. The Institute of Ecology and Geography (IEG) of the Academy of Sciences of Moldova undertakes integral monitoring of the environment and creates tools at high resolution for extreme weather and climate risks assessment. The Ministry of Agriculture and Food Industry (MAFI) manages the socioeconomic indicators used in assessing associated risks to droughts. The Department of Crops (under MAFI) compiles and analyses data sent by the different districts. MAFI also engages in the promotion of crop insurance against droughts and other natural hazards (frost, hail) (World Bank and FAO, 2007).

There is an overall positive assessment of the existing drought monitoring system. Nevertheless, the current network does not fulfil advanced requirements. Limited financial, scientific, technical and human capacities do not allow for the provision of comprehensive information based on the concept of drought risk management. More so, early warning systems are inadequate in Moldova, and the capacity to use advanced forecast tools in order to assess extreme climate is insufficient.

Vulnerability Assessment

Agriculture is the sector most vulnerable to droughts, which in terms of human and economic development is of vital importance for Moldova. The increase of frequency and severity of droughts, along with the overexploitation of the land and other natural resources during the last decades as well as the poor adaptability to water shortages of common agricultural practices, are elements that have promoted a dramatic decline in the resilience of the agricultural sector. Despite the fact that Moldova is endowed with

fertile soil and other favourable climate conditions, agricultural productivity is declining (Daradur et al., 2007; UNDP, 2009). Like in many other areas, poverty in Moldova is mostly prevalent in rural areas (28.1% compared to 9.9% for urban areas) (UNDP, 2011). Drought hits small farmers and agricultural workers the most, whose livelihood is closely related to weather conditions, with up to 40-70% stemming from agriculture (WFP, 2012). Droughts reduce their savings considerably and affect both the quantity and quality of food supply. In addition, in rural areas, where 45% of the population relies on wells as their main source of drinking water, the negative social effects of drought are exacerbated by reducing access to potable water, impacting people's health.

Emergency Relief and Drought Response

Recent droughts have attracted emergency interventions by different international institutions and national authorities. For instance, the FAO supported Moldova through the "Emergency Procurement and Distribution of Vegetable Seedlings and Maize Seeds to Drought-Affected Farmers" ($337,000) in 2001 and the "Emergency Supply of Winter Wheat Seeds to Frost and Drought-Affected Farmers" ($374,000) to partly relieve the country from the effects of the 2003 frost followed by drought (World Bank and FAO, 2007). In 2007, the Government of Moldova approved the allocation of $16.5 million to cover the costs of farmers for tillage and sowing of winter crops. During the fall of 2007, and through the project "Relief and Technical Assistance Response to the Drought in Moldova" managed by UNDP, Moldova, in partnership with FAO as well as several NGOs and local public authorities, distributed wheat seeds, fertilizers, diesel fuel, fodder, corn seeds and food packs to 383,000 drought victims (UN, 2008). At the same time, 22 communities in districts that were severely affected by drought received cash assistance to carry out public works in order to rehabilitate various facilities in these communities.

With the objective of mitigating the impact of drought in 2012, the government subsidized the production factors for sowing winter crops to support severely affected farmers (MAFI, 2012). The Ministry of Agriculture and Food Industry of the Republic of Moldova (MAFI), with the support of FAO, distributed 161.5 tons of seeds of winter wheat to farmers severely affected by droughts. The Moldova Red Cross, in cooperation with the Service of Civil Protection and Emergency Situations and the Ministry of Labour, Social Protection and Family, intervened in reducing the negative effects of drought in 2012 and provided assistance to the affected population (5,800 beneficiaries) in eleven regions (IFRC, 2012).

Practices to Alleviate Drought Impacts

Moldova mainly focuses on a practice where interested stakeholders implement a particular option for increasing current agricultural productivity (Daradur et al., 2007; World Bank, 2010). These measures do not consider effective medium- and long-term perspectives for farming and livestock systems under the various natural and socioeconomic conditions of the country. Currently, the agrotechnical measures that improve soil moisture retention, such as minimum tillage and maintenance of cover vegetation, are the most common practices to alleviate drought impacts. Other measures include the introduction of drought-resistant crop varieties, optimization of sowing and planting times in accordance with the agrometeorological information and the elimination of weeds, resulting in reduced evaporation and a more effective use of soil moisture.

The Need for Knowledge and Skills in Drought Management

Drought management practices in the Republic of Moldova used to mainly focus on reacting to crisis, through traditional hierarchical and 'command-and-control' management methods (Daradur et al., 2007). Some of the challenges the country is facing are the weak perception and underestimation of climate change and variability threats at all management levels, the lack of grass-roots activities in knowledge management and the dissemination and piloting of advanced skills that promote proactive principles with regard to drought management. The promotion of proactive drought management principles meets with a plurality of decision makers with different priorities regarding their objectives and policies. Therefore, there is a need for effective, accessible and understandable Drought Decision Support Tools for decision makers, in order to design a proactive drought response and facilitate the decision-making process.

Participants of the workshop actively contributed in the discussion

References

Daradur, M., V. Cazac, C. Mihailescu, and I. Boian (2007). *Climate monitoring and droughts.* Ministry of Ecological and Natural. Chisinau: Tanavius.

International Federation of Red Cross and Red Crescent Societies (2012). *Moldova 2012 Annual Report.* Available from http://reliefweb.int/sites/reliefweb.int/files/resources/SP567MDLTPF_12ar.pdf.

Ministerul Agriculturii și Industriei Alimentare (2007). *Evaluarea situației curente privind seceta în Republica Moldova.* Available from http://www.un.md/drought/Raportul%20MAIA_ Seceta%20in%20Moldova%20%202007.pdf.

Ministerul Agriculturii și Industriei Alimentare (2012). *Evaluarea impactului provocat de secetă în Republica Moldova.* Available from http://ncu.moldova.md/public/files/_FINAL_MINISTER_2012_Drought_Moldova_MAFI_Assessment_Report_01.09.2012_13_00_rom_2.pdf.

Ministerul Mediului al Republicii Moldova Programul Națiunilor Unite pentru Dezvoltare (2012). *Strategia Națională de Adaptare la Schimbarea Climei a Republicii Moldova.* Available from http://www.clima.md.

State Hydrometeorological Service of the Republic of Moldova (2012). *Recorduri înregistrate în sezonul de vară 2012.* Available from http://www.meteo.md/mold/nsnovosti_2012.htm.

United Nations (2012). *Moldova Situation Report – 2012.* Available from http://www.un.md/drought/2012 /MoldovaDroughtSitRep2012_1.pdf.

UNCCD (2013). *Preliminary Conference Report: the Synthesis and Recommendations. United Nations Convention to Combat Desertification 2nd Scientific Conference, 9-12 April 2013*, *Bonn, Germany.* Available from www.unccd.int.

UNDP (2009). *Climate Change in Moldova: Socio-economic Impact and Policy Options for Adaptation*. In: National Human Development Report 2009/2010. United Nations Development Programme, Chisinau: Nova-Imprim.

UNDP (2011). *Republic of Moldova: From Social Exclusion Towards Inclusive Human Development.* In: 2010/2011 Human Development Report. United Nations Development Programme, Chisinau: Nova-Imprim.

UNDP and the Ministry of Environment and Natural Resources of the Republic of Moldova (2009). *Second National Communication of the Republic of Moldova under the United Nations Framework Convention on Climate Change*. United Nations Development Programme, Chisinau: Bons Offices SRL.

WMO and GWP (2011). *Integrated Drought Management Programme.* World Meteorological Programme and Global Water Programme, available from http://www.wmo.int/pages/ prog/wcp/drought/idmp/.

World Bank and FAO (2007). *Rural Productivity in Moldova – Managing Natural Vulnerability.* World Bank and the Food and Agriculture Organization of the United Nations, available from http://sustainabledevelopment.un.org/content/documents/782Moldova_Report_RIO20_ENG_12-06-2012_final.pdf.

World Bank (2010). *The Republic of Moldova: Climate change and agriculture country note.* Available from www.worldbank.org/eca/climateandagriculture.

WFP (2012). *Moldova Rapid Food Security and Vulnerability Assessment*. World Food Programme, available from www.un.md/drought/2012/RapidAssessmentMoldova2012Final.pdf

5.4 Romania

Elena Mateescu[8] , Mihaela Smarandache[9], N. Jeler[10], Valentin Aposto[11]

Background

In Romania, droughts affect 7.1 million hectares, which represents 48% of the total land available for agriculture (RNIS, 2010). Every decade since 1901, Romania has witnessed one to four years of either extreme drought or excessive rain falls, and the frequency of droughts has been increasing recently, especially after 1981 (Table 6).

Table 6: Drought/rainy years in Romania, 1901-2012

DECADE	YEARS OF EXTREME DROUGHTS	YEARS OF EXTREME RAIN FALL
1901-1910	1907-1908	1910
1911-1920	1917-1918	1911, 1912, 1915, 1919
1921-1930	1923-1924, 1927-1928	1929
1931-1940	1934-1935	1937, 1939, 1940
1941-1950	1945-1946, 1947-1948, 1949-1950	1941, 1944, 1947
1951-1960	1952-1953	1954, 1955, 1957, 1960
1961-1970	1962-1963, 1964-1965	1969, 1970
1971-1980	1973-1974, 1975-1976	1972, 1974, 1975, 1976
1981-1990	1982-1983, 1985-1986, 1987-1988	1981, 1990
1991-2000	1992-1993, 1997-1998, 1999-2000	1991, 1997
2001-2010	2000-2001, 2001-2002, 2002-2003, 2006-2007, 2008-2009	2005, 2006, 2010
2011-2012	2011-2012	

A long drought season (8 months) was recorded during the agricultural year of 2011-2012, November 2011 being the driest month in the last 52 years in Romania, with a monthly average of only 1.2 mm of rain compared to the annual average of 43.9 mm. July 2012 was the warmest month in the last 52 years in Romania, the monthly mean temperature being 23.7°C, compare to the multi-annual mean of 19.2°C – a positive deviation of 4.5°C.

[8] National Meteorological Administration, Bucharest, Romania
[9] Ministry of Environment and Climate Change
[10] Ministry of Environment and Climate Change
[11] Ministry of Agriculture and Rural Development

Drought Monitoring and Early Warning Systems

The National Meteorological Administration (NMA) is the authority in charge of meteorological and climate-related issues, in continuous service since 1884. It operates under the authority of the Ministry of Environment and Climate Change (MECC). The NMA is responsible for carrying out weather forecasts and warnings, as well as disseminating available information to decision makers and all other users. The National Meteorological Observation Network within the NMA includes seven regional meteorological centers. The network provides weekly in-situ monitoring; the information is collected, analysed and compiled by the Agrometeorological Service. The monitoring is done daily for agrometeorological parameters, such as the changes in soil moisture content at the plant level. It also identifies periods and agricultural areas seriously affected by extreme events, elaborates weekly bulletins and carries out long-term agrometeorological forecasts upon soil moisture reserves. Modeling and GIS techniques are used to monitor the spatial extent of extreme weather phenomena, including drought, and to assess the most vulnerable areas.

The available capacities in the NMA include

- Synoptic and climatological observations and measurements: 159 stations;
- Automatic weather stations: 126;
- Agrometeorological observations and measurements stations: 55;
- Radar network: 8 radars (5 C-band and 3 S-band Doppler radars);
- Pluviometric observations and measurements: 67 stations.

Some of the agrometeorological indicators used by NMA are soil moisture, heat waves and ETP. Regarding climate indicators, the most commonly employed are SPI and Aridity Index, among others. Drought indicators are based on satellite-derived products, such as NDWI, fAPAR, NDVI, CWSI and LAI.

Vulnerability Assessment

The current climatic data highlight the increase in frequency and intensity of droughts, the potential effects on the most vulnerable sectors (agriculture, water, forests, biodiversity, energy and transport, among others) and required specific adaptation measures to the limiting environmental conditions.

The following are potential hazards associated with climate change:

1. Human health (a higher frequency and longer duration of heat waves have an impact on the health of the elderly);
2. Food security (problems in agriculture, caused by drought and by a non-sustainable approach regarding land cultivation at subsistence level);
3. Biodiversity (forest fires, disturbance of the ecosystems' dynamics due to high temperatures and the modification of precipitation distribution patterns);
4. Energy security (drought may influence both the hydroelectric power plants and the nuclear power plants, which is relevant given that almost 36% of the country's electricity production comes from hydro sources and 19% from nuclear sources).

One of the most visible effects of this situation is noticeable in agriculture, where the vegetal yield varied largely from year to year, in the context of variable climatic conditions. According to data from the Ministry of Agriculture and Rural Development, the excessively dry agricultural years 2011-2012 strongly impacted about 5.9 million hectares, the level of losses varying across different areas. The most affected crops include corn, wheat, barley, two-row barley, sunflower, rape and soya.

Practices to Alleviate Drought Impacts

Different authorities have engaged in the development of studies and actions seeking to mitigate the effects of drought. For instance, the Climate Change Adaptation Guide was elaborated and endorsed by the Minister for the Environment through the Ministerial Order 1170/2008. One of the most relevant national projects named "CLIMHYDEX – Changes in climate extremes developments and associated impacts to hydrological events, 2012-2015", quantifies and assesses the impact of extreme climate events to hydrological regime and drought condition. The results of the European project entitled "Mitigation Drought in Vulnerable Area" of the Mures Basin-MIDMURES, 2010-2012" contributed to improving agricultural water saving and drought forecasting in the Mures pilot area through the combination of various technical approaches. The specific objectives refer to modeling long-term agroclimatic data in order to establish the risk factors, in order to spot the areas with high vulnerability and provide timely drought forecasts; assessing the impact of climate change on soil fertility and water availability for crops cultivated in the area of the Mures River basin most vulnerable to drought and water scarcity and rainwater conservation in soil for optimizing water availability according to the plant needs throughout the growing season and in the period with high deficit. The National Climate Change Strategy for 2013-2020 adopted in July 2013 (HG 529/2013)

addresses two main components: reduction in the concentration of greenhouse gases (mitigation) and adaptation to climate change (adaptation). The strategy encompasses a comprehensive overview and proposes key measures and actions for various sectors falling under mitigation and adaptation objectives. It has two main directions for action:

1. Reduction of the greenhouse gas emissions and depletion of soil carbon stock
2. Adaptation to the negative effects through actions at national and sectoral level

In this context, the integration of adaptation in sectoral strategies will help to achieve a comprehensive approach and select appropriate measures for the direct and indirect effects of climate change, including droughts.

The Need for Knowledge and Skills on Drought Management

The need to improve national drought monitoring and management policies with the goal of strengthening preparedness and reducing drought impacts will be based on two main topics:

1. Monitoring and prediction, which should contribute to a more comprehensive early warning system;
2. Mapping and assessing the impacts of droughts, promoting adaptation of best practices and developing infrastructure for irrigation, based on scientific knowledge (climatic data, soil and crops data).

Accurate diagnosis of agrometeorological conditions is a crucial process needed for understanding the risks caused by extreme weather events and for sustainable development actions. Due to the complex nature of drought as well as its large spatial and temporal scale, drought risk management systems should be developed across sectors at national and regional level. There is a major need to elaborate the risk maps for drought hazards. Drought maps will illustrate the most vulnerable and low water areas at different spatial and temporal scales, including the impacts of drought on agriculture, forest, water supply, energy and the environment. There is a need for a more detailed description of the current situation regarding the conditions and the forecast of water deficit and drought in order to elaborate the disaster management plan in a timely manner.

The second topic will be realized by selecting and assembling drought-related data and information concerning drought formation, exposure to drought and impacts of drought as well as developing a set of drought indices for various applications calculated in a timely manner and based on the information that is readily available.

Concerning the set of drought indicators (climatic indicators like SPI and Aridity Index or agrometeorological indicators such as soil moisture, ETP, heat weaves, etc.), a set of national and international indicators specific to the field of meteorology and agrometeorology should be considered (i.e. climatology, hydrology and soil indicators).

Workshop participant from Bulgaria presenting results of breakout group discussions

References

Busuioc, Aristita, V. Cuculeanu, P Tuinea, A Geicu, C. Simota, Marica Adriana, A. Alexandrescu, N. Patrascanu, V. .Al. Stanescu, P. Serban, I. Tecuci, Simota Marinela, and C. Corbus (2003). *Impactul Potential al Schimbarii Climei in Romania, Ed. ARS DOCENDI*, Academia Romana-Comitetul National pentru Modificarile Globale ale Mediului. Bucharest

Christensen, J. H., B. Hewitson , A. Busuioc , A. Chen, X. Gao, I. Held, R. Jones, R. Kolli R K, W. Kwon , R. Laprise , Magaña Rueda , L. Mearns , C. Menéndez, J. Räisänen, A. Rinke, A. Sarr, and P. Whetton (2007). *Regional Climate Projections.* In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, in (eds) Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor and H.L Miller, Cambridge, and New York: Cambridge University Press.

European Comission (2012). *Gap Analysis of the Water Scarcity and Droughts Policy in the EU*. European Commission.

IPCCC (2007). *Summary for Policymakers.* In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge, New York: Cambridge University Press

Mateescu, Elena, N. Tanislav , and V. Vatamanu (2004). *Impactul conditiilor de seceta asupra culturilor de grau si porumb din Campia Caracalului*. Editura Sitech, Craiova.

Mateescu, Elena, and D. Alexandru (2010). M*anagement recommendations and options to improve the crop systems and yields on South-East Romania in the context of regional climate change scenarios over 2020-2050.* Scientific Papers, Series A LIII - Agronomy, University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Agriculture, ISSN 1222-5339, pp. 328-334.

Mateescu, Elena (2012). *Drought Monitoring in Romania, Proceedings of the Joint Workshop JRC/DMCSEE/ Biotechnical faculty. Different approaches to drought monitoring – towards EuroGEOSS interoperability model, Ljubljana, 23rd – 25th November 2011*. In: Towards EuroGEOSS interoperability model in drought monitoring in SEE region, ISBN 978-961-6275-43-9, pp. 16-27.

Paltineanu, C., E. Chitu and E. Mateescu (2011). *Changes in crop evapotranspiration and irrigation water requirements, International Agrophysics*. Polish Academy of Sciences, Vol 25, pp. 369-373.

Paltineanu, C., E. Chitu, and E. Mateescu (2012). *New trends for reference evapotranspiration and climatic water deficit, International Agrophysics.* Polish Academy of Sciences, vol. 26, pp. 159-165.

Sandu, I., C. Ionescu and M. Ursache (2004). *A Pilot system for environment impact assessment of pollution urban development and urban air pollution forecast, Proceedings of NATO Advanced Research workshop.* In: Advances in air pollution modeling for environmental security, May 8-12, 2004, Borovets, Bulgaria.

Stancalie, G., and E. Mateescu (2012). *Guide to good practices for preventing drought and water scarcity in Mures River Basin*, EU- DGE, Halting Desertification in Europe Programme, MIDMURES Project – Mitigation Drought in Vulnerable Area of the Mures Basin, pp: 64.

Stancalie, G., and E. Mateescu (2012). *MIDMURES Project - Mitigation Drought in Vulnerable Area of the Mures Basin, Proceedings of the Joint Workshop JRC/DMCSEE/Biotechnical faculty/ Different approaches to drought monitoring – towards EuroGEOSS interoperability model.* Ljubljana, 23rd – 25th

5.5 Slovenia

Gregor Gregorič[12]

Background

Slovenia has a humid climate with an annual precipitation ranging from 800 mm to more than 3,000 mm in the mountainous areas. Nonetheless, droughts are among the most damaging natural disasters. The reason lies with vulnerable agricultural practices, which operate under the assumption that all water needed for crop development is ensured by precipitation throughout the growing seasons. Droughts normally occur in late spring and summer and typically last between two to three months. This period is characterized by a decrease in precipitation and an increase in ETP, caused by heat waves and dry winds. Both phenomena cause a surface water balance deficit.

Droughts are the most damaging natural disasters. They caused damages equaling close to €250 million in total during the years 2000, 2001, 2003 and 2006 (Figure 3). According to preliminary assessments, damages in 2012 reached €100 million. The greatest contributor to the total damages is the yield losses. A low percentage of the damages can be attributed to the costs of distributing fresh water to small communities during the most intense heat waves as well as the increased costs attributed to fisheries and tourism. Figure 3 shows damages caused by natural disasters in Slovenia between 1994 and 2008. Notwithstanding, the most vulnerable segment of the population remains the farmers.

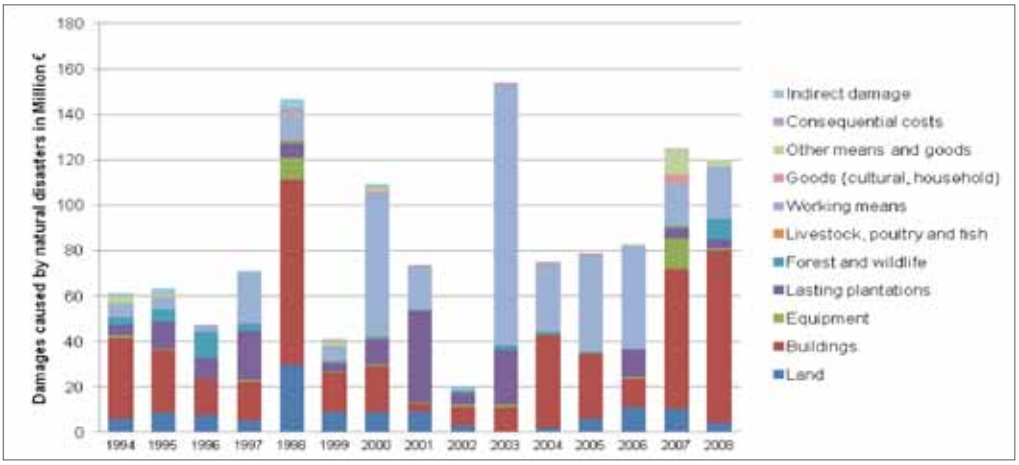


Figure 3: Damage caused by natural disasters from 1994-2008 (in Million €)

Source: based on data from country STAT (2013)

[12] Slovenian Environmental Agency, Vojkova 1b, Ljubljana, Slovenia

Drought Monitoring and Early Warning

The currently available source of information is the Agrometeorological Bulletin, issued in a ten-day interval and published on the web page of the Slovenian Environmental Agency. The content of the bulletin depends on the situation and available data. It usually contains a general description of the weather development over the past week, the past ten days or the past month. In addition, the agency provides maps of temperature and precipitation deviations as well as SPI maps for one-month and three-month accumulations published once every month. If needed (in case of warning of possible water stress), more detailed information is provided on the surface water balance and available soil water, and water requirements for plants are stated for commonly used crops (maize) and other crops, should specific conditions require this. Calculations are performed with a local irrigation-scheduling model, which simulates water consumption during the growing period. For each of the weather stations, calculations are performed for all selected crops and for at least three types of soil (light, medium and rich). More precise calculations are not performed in real time due to lack of data. Such calculations, which can also be used for the assessment of damages, are performed post-blossoming in case an in-depth analysis of drought is needed.

Vulnerability Assessment

According to records of past drought impacts, agriculture is a highly vulnerable sector. Other potentially susceptible sectors (tourism, energy etc.) have not been analysed yet, since in most cases they mitigate impacts by, for example, acquiring additional fresh water needed for the supply of tourist resorts, adjusting power production to lower discharges of rivers and bringing in power from alternative sources. This situation might change, mainly in light of climate change, and will need future attention. However, it is likely that farmers will remain currently identified as the group most vulnerable to droughts.

Farmers represent only 5% of the population in Slovenia and contribute 2% of the total Gross Domestic Product (GDP). Therefore, damages which do not seem catastrophic in terms of GDP (all damages attributed to droughts from 2000 until now represent around 1% of GDP in Slovenia) can be devastating for the local agricultural economy. Vulnerability of agriculture was studied in more detail in recent years, which resulted in risk assessment based on natural geophysical factors such as soil type, exposure to increased ETP and distance to available water sources (Slejko et. al. 2010). Although the results were not very satisfactory (in terms of combining the factors and assigning them to different

vulnerability classes), it is generally accepted that these factors contribute mostly to the final risk and exposure to drought. The combination of an unfavourable soil type with small water holding capacity, exposure to high ETP (due to high insolation and exposure to dry winds) and high cost of irrigation due to large distance to available water sources or established irrigation systems results in a high risk of drought. Coupled with unsustainable agricultural practices (e.g. ignoring information and advice on time of plowing and sowing), an occurrence of drought can lead to significantly high damages and can diminish the income and welfare of farmers and the rural communities at large.

Emergency Relief and Drought Response

Typically, responses to droughts in Slovenia are reactive. In cases of high drought impacts (exceeding a few percentage points of GDP), political action is triggered, which results in the formulation of an intervention bill (allocating funds from the national budget, which do not compensate for more than 30% of assessed damages). In case an intervention bill is passed, detailed analysis of the drought situation is required. Following a preliminary assessment of damages, commissions are set up within municipalities in order to compile a full assessment and set priorities for compensations. The whole process can take more than a year. Apart from direct compensations, there are also possibilities of tax reductions and exemptions from social services' costs.

Practices to Alleviate Drought Impacts

Practices to alleviate drought impacts are mainly advanced agricultural practices such as the promotion of irrigation (only 3-5% of the water used in agriculture is provided through irrigation in Slovenia). The promotion of actions aimed at establishing an irrigation infrastructure has been more successful in some communities and less successful in others. Apart from irrigation, other practices (mainly optimization of selected cultures including diversification and optimization of other practices such as optimal plowing, application of shade nets, etc.) are also promoted.

The Need for Knowledge and Skills in Drought Management

There are no obvious gaps in knowledge and skills with regard to agricultural practices. There are many success stories of drought periods mitigated through an optimal combination of technology and carefully scheduled irrigation. The main challenge remains the planning of optimal infrastructure in terms of combining large and small water reservoirs and irrigation systems. There is a need regarding the management and organizational support of stakeholders and the distribution of responsibilities.

References

Slejko, M., Gregor Gregorič, K. Bergant and S. Stanič (2010). *Assessing and mapping drought vulnerability in agricultural systems – a case study for Slovenia.* In: Proceedings of the 8th European Conference on Applied Climatology (ECAC), Zürich, Switzerland.

Statistical Office of the Republic of Slovenia (2013). E*stimated Damages Caused by Natural Disasters.* Available from http://pxweb.stat.si/pxweb/Database/Environment/27_environment/05_disasters/27089_estimated_damage/27089_estimated_damage.asp.

Workshop participants

5.6 Turkey

Erdogan Özevren[13], Metin Türker[14], Bekir. Engurulu[15], Şule Özevren[16], Mehmet Üna[17]

Background

Agriculture is one of the key economic sectors for Turkey. In 2011, for example, the agricultural gross domestic product (GDP) of the country was $62.7 billion and agricultural per capita income was about $3,600. Turkey has the seventh biggest agricultural economy in the world (OECD, 2011). The rate of population employed in agriculture is 25.5%. Turkey is a member of the Organization for Economic Cooperation and Development and also a candidate country for the European Union (EU). Agriculture is a sensitive and strategic sector owing to its close link and dependence on natural conditions. Also, agriculture is an important resource for nutrition, employment and development. Though the boost in agricultural productivity and the use of technology-intensive production models continues, natural disasters and the frequency of their occurrence as well as their severity level have been steadily increasing, exacerbated by climatic changes. According to scenarios developed by the Intergovernmental Panel on Climate Change (IPCC), threats that will probably increase are heat waves, forest fires, droughts, heavy rains and tropical storms. Drought is the natural disaster which is most difficult to manage when compared to other natural disasters. Disasters can result in losses in agricultural production (plant, animal and aquaculture production). This is a risk that can threaten the sustainability of agricultural production.

Drought is a natural threat that has huge negative effects on human lives and leads to severe ecological problems, limiting various activities of human beings. The effects of this natural event that occurs over a given period of time may gradually reach a dangerous extent as the period extends. At present, drought, which is one of the most serious problems on a global scale, affects all parts of our lives, including the physical and natural environment, city life, development and economy, technology, agriculture and food, clean water and health. Drought develops gradually compared to other extreme events; it often continues for a very long time, and with its wide-ranging effects, it is the most difficult natural disaster to assess.

Like in many other countries, climate change is taking its toll on Turkey, resulting in increased drought and a growing water demand. The effects of drought are foreseen to affect mainly the region in the Mediterranean basin.

---

[13] Ministry of Forestry and Water Affairs

[14, 15, 16, 17] Ministry of Food and Agriculture

Applications of the Strategy for Combating Agricultural Drought and Action Plans

In order to mitigate the effects of agricultural drought and determine measures to be taken to this end, the government is attempting to ensure the coordination of activities which can be realized with the participation of related ministries, universities, local governments and non-governmental organizations, regulating procedures and principles with regard to duties, authorities and responsibilities in the context of these activities. Decisions on procedures and principles of activities for combating agricultural drought and drought management were published in the Official Gazette on 8 July 2007. After this decision, the "Regulations on Agricultural Drought Management Duties and Working Procedures and Principles" were published in the Official Gazette of 2 March 2008. In line with these regulations, a five-year "Agricultural Drought Combating Strategy and Action Plan" (2008-2012) was implemented.

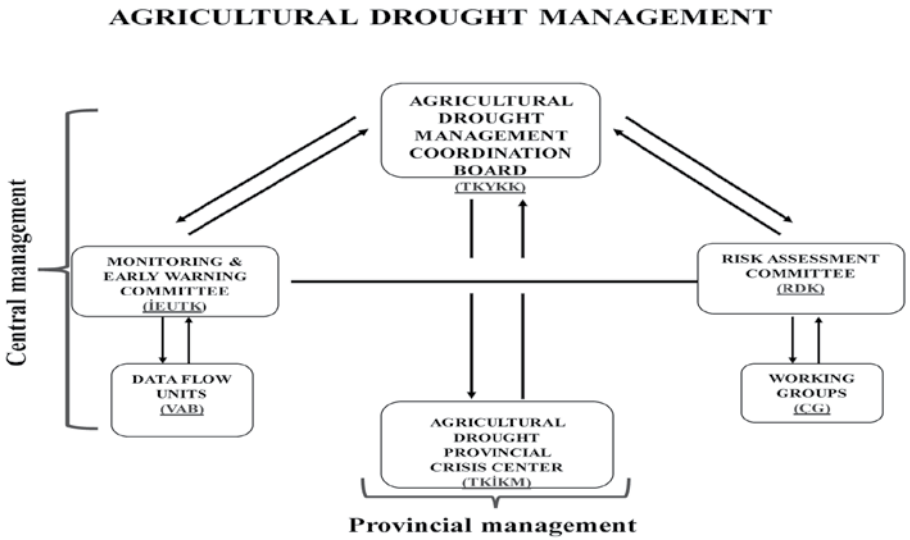


Figure 4: Management chart of agricultural drought management in Turkey

Due to the restructuring of the Ministry of Agriculture and some further ministries that have responsibilities within the Agricultural Drought Management Coordination Board, as well as the expiration of the five-year Agricultural Drought Combating Strategy and Action Plan, studies leading to new legislation have been undertaken and the Cabinet Decision on Activities for Combating Agricultural Drought and Drought Management was published. In accordance with this Cabinet Decision, Regulations on Agricultural

Drought Management Duties and Working Procedures and Principles have been developed. Consequently, the Agricultural Drought Management Coordination Board has been established under the leadership of the Undersecretary of the Ministry of Food, Agriculture and Livestock with the participation of representatives from related directorates, non-governmental organizations and universities and has taken up its activities.

Since drought – like any natural disaster – might occur at any moment, another five-year Agricultural Drought Combating Strategy and Action Plan for the period of 2013-2017 was prepared under the coordination of the Ministry of Agriculture with the participation of ministries, universities, local administration and non-governmental organizations as determined by the Cabinet, and this Decision and has been put into effect.

Main strategies for combating agricultural drought include the following

- Developing an institutional structure with sufficient capacity;
- Combating drought within an integrated and comprehensive plan;
- Achieving a structure which reduces the effects of drought on the agricultural sector to a minimum.

Activities under the Action Plan have been prepared by grouping them along the lines of defined strategy, main development center and priorities. Measures for which related institutions are responsible have been identified and duties have been allocated. These activities are listed in more detail below.

1. Drought risk estimation and crisis management:
    - Crisis management on agricultural drought estimation will be applied

2. Provision of sustainable water supply:
    - Potential water holding capacity will be increased;
    - Water delivery channels will be modernized, investments in maintenance and renewal of water storing and delivery channels will be realized in a timely manner;
    - Taking measures for collection of wastewater; use of treated wastewater in agriculture and industry will be ensured;
    - Effective management of underground water will be ensured; and
    - Land-using techniques will be developed that increase preservation of water in the soil, and land usage plans will be prepared for protecting and developing soils that are the most important natural storage for water.

3. Effective management of agricultural water demand:
    - In the specified agricultural basins, the most suitable cultivation areas for agricultural products will be identified by taking water availability into consideration, and effective water usage will be ensured;
    - Water delivery systems will be modernized;
    - Effective use of underground water for agriculture will be ensured; and
    - Incentive programmes providing guidance for sectors and productions that are most affected by drought, including plant production, animal production, bee-keeping and domestic aquaculture will be established. Plant production and livestock production policies will be implemented by taking drought risk into consideration.

4. Accelerating research and development activities (R&D) and increasing training/extension services:
    - R&D activities to support the combating of drought will be accelerated and
    - Training and extension services for the affected farmers and related parties

5. Developing institutional capacity:
    - Necessary legal regulations for effectively combating agricultural drought will be made and institutional restructuring will be strengthened and
    - Necessary institutional capacity to deal with forest fires will be developed.

The duties of the related institutions have been determined; they will be asked to report on their activities with regard to the priority/measure for which they are responsible in order to assess them at the end of the year.

Establishment of Committees and Agricultural Drought Provincial Crisis Centers

Duties are divided into two groups in order to carry out the Agricultural Drought Combating Strategy and Action Plan in a coordinated manner. There are duties to be performed at the central level and duties to be performed at the provincial level.

At the central level:

- the Monitoring, Early Warning and Estimation Committee,
- the Risk Assessment Committee and
- the Data Flow Unit have been established under the coordination and secretariat of the Agricultural Insurance and Natural Disasters Department under the General Directorate of Agricultural Reform.

At the provincial level, Agricultural Drought Provincial Crisis Centers have been established under the coordination of Provincial Directorates of Food Agriculture and Livestock.

Regarding the Monitoring, Early Warning and Estimation Committee, the Agricultural Insurance and Natural Disasters Department is responsible for coordinating calls for a monthly meeting which is held between the 15th and the 20th of every month. Basic data is gathered from the responsible institutions under the Data Flow Unit and the Monitoring, Early Warning and Estimation Committee report is prepared. The aim of this activity is to monitor drought risk on a regular basis. This committee consists of experts from related Directorates.

Phenological observation reports for agricultural products cultivated in the 81 provinces are gathered from the Provincial Directorates for preparing the report of the Monitoring, Early Warning and Estimation Committee, while also collecting information on reservoir levels of dams for irrigation from the General Directorate of State Hydraulic Works, quarterly estimation maps from the Mid-term Weather Forecast Center, regional, monthly and cumulative precipitation analysis, watershed precipitation analysis, agricultural basin precipitation analysis, temperature analysis and monthly and cumulative precipitation assessment charts by regions from the General Directorate of Meteorology.

For the drought analysis, the following indeces are used:

- PNI: The Percentage of Normal Index is the simplest index of drought indices and principally obtained by dividing precipitation in a given period by average precipitation and presenting the result as a percentage.
- SPI: The Standardized Precipitation Index is obtained by dividing the difference between precipitations in a given period and the average standard deviation.
- The PDI is calculated on a monthly basis. Precipitation, temperature and field moisture capacity are used as data in the calculation. By these data, evaporation, loss in moisture due to absorption by soil, surface flow and also loss in moisture on the surface can be determined.

Different drought analyses realized in Turkey are considered for a general assessment; however, phenological observation reports coming from Provincial Directorates of Food, Agriculture and Livestock are more robust in detecting agricultural drought. PNI, Palmer and SPI maps are used in our reports, ensuring the indication of drought. Annual and biennial SPI maps are used in our reports.

The data stated above are gathered and the Monitoring, Early Warning and Estimation Committee Report is prepared and signed after approval by the committee members. The Monitoring, Early Warning and Estimation Committee Report is submitted to the Risk Assessment Committee for evaluation.

The Risk Assessment Committee works under the Drought Management Coordination Board. The committee, the coordination and secretariat of which are carried out by the Agricultural Insurance and Natural Disasters Department, met from 20-25 July 2013 and examined the report submitted by the Monitoring, Early Warning and Estimation Committee. The Risk Assessment Committee consists of experts from related Directorates and NGOs.

The Risk Assessment Committee prepares precipitation scenarios for the future and estimates the drought risk for the subsequent six months by using estimation maps prepared quarterly and semi-annually by the Medium-term Weather Forecast Center and prepares its report in this context. Three scenarios are considered:

1. Best-case scenario (situation where precipitation is 20% higher than normal)
2. Normal scenario (situation where precipitation is at seasonal normal measures)
3. Worst-case scenario (situation where precipitation is 20% less than normal)

In the report, territorial and regional drought estimations are made according to these scenarios. Depending on the results of the report, the Agricultural Drought Provincial Crisis Centers are warned if this is considered necessary.

The Agricultural Drought Provincial Crisis Centers are established in the provinces under the leadership of governors, and each province prepares its Agricultural Drought Action Plan in accordance with its own conditions. An Agricultural Drought Provincial Crisis Center consists of provincial representatives from relevant ministries, local representatives from related General Directorates, the Provincial Director of Health, district governors, representatives of provincial special administrations, representatives of municipalities, mayors of districts, university representatives, the President of the Chamber of Agriculture, drinking water utilities and producer groups, chairmen of cooperatives and representatives from other NGOs.

Measures taken in years without drought conditions are becoming more important than measures to be taken in drought years. Activities to be carried out in years without drought include the following:

1. Developing and ensuring the sustainability of a provincial drought action plan or plans,
2. Reviewing activities in accordance with the laws, regulations and rules and eliminating deficiencies,
3. Developing farmers' registration systems continuously,
4. Developing early warning systems of drought,
5. Continuing to carry out rangeland rehabilitation and developing project implementations in rangelands, summer pastures and winter pastures,
6. Research and development activities:
    a. Developing crop varieties less affected by drought
    b. Developing techniques of water harvesting
    c. Accelerating studies for determining product patterns according to regions
    d. Realizing simulation of activities and modeling by working under controlled conditions
    e. Accelerating activities for a more intensive use of GIS under monitoring and evaluation studies
    f. Increasing awareness via realizing trials and demonstrations of results under producer conditions
7. Basin erosion control activities to direct basin rain water to soil and underground, and building stone terraces alongside streams,
8. Terracing on graded lands,
9. Afforesting all unprotected hills, and
10. Land use planning

Four steps have been determined for activities on irrigated and dry agricultural lands under the current Provincial Drought Action Plan. These are (1) preparation for drought, (2) drought alert, (3) immediate action and (4) limitation. There is a coordinated action with Provincial Directorates in order to follow these steps regularly. Every Agricultural Drought Provincial Crisis Center prepares its report by making an annual evaluation of whether drought may occur or not and sends its decisions taken during their meeting to the General Directorate of Agricultural Reform that is in charge of the coordination and secretariat.

Final Remarks

During the action plan period covering the years 2008-2012, important steps were taken and awareness raised with regard to drought throughout the country. Provincial crisis centers have been established in provinces and provincial action plans have been prepared.

The Agricultural Drought Management Coordination Board has initiated its activities and both the Risk Assessment and the Monitoring, Early Warning and Estimation Committees working under this board have been established and prepare their reports during their monthly meetings.

We have the experience and institutional capacity for gathering the necessary data and improving techniques in combating agricultural drought. The country's natural resources are adequate for meeting the needs of its population compared to its neighbors and most of the country's rivers are reliable, which puts the country at an advantage in terms of drought risk. However, the small scale and fragmented structure of agricultural enterprises and the continued use of traditional production techniques are hindering drought combating activities. To overcome these difficulties, training and extension services in particular have been accelerated and government subventions have been given for the transition to modern irrigation systems.

Erosion of natural resources and pollution due to unplanned urbanization and industrialization as well as the demand for water from other sectors due to industrialization have increased in the country. Jurisdiction and the division of responsibilities for water and soil management continue to be other problems in combating drought.

As a result, combating agricultural drought will continue in an effective manner in the framework of a Strategy for Combating Agricultural Drought and Action Plan prepared to cover the period of 2013-2017 according to current conditions in order to ensure uninterrupted activities of the Agricultural Drought Management Coordination Board, the committees and provincial crisis centers established for combating agricultural drought.

ANNEXES

High level authorities of the government of Romania

Mrs. Elena Dumitru
Ministry of Environment and Climate Change
Secretary of State
elena.dumitru@mmediu.ro

Dr. Ion Sandu
National Meteorological Administration,
Director General
sandu@meteoromania.ro

Invited Keynote Speaker:

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

Workshop Participants:

Bosnia and Herzegovina
Ms. Sabina Hodzic
Federal Hydrometeorological Institute Sarajevo, BiH
sabinah@fhmzbih.gov.ba

Bosnia and Herzegovina
Dr. Mihajlo Markovic
University of Banja Luka, Faculty of Agriculture,
Institute of Agroecology and Soil Sciences
mmarkovic963@teol.net

Bulgaria
Prof. Vesselin Alexandrov
National Institute of Meteorology and Hydrology
vesselin.alexandrov@meteo.bg

Bulgaria
Mrs. Tatiana Dimitrova
Ministry of Environment and Water
urbansoil@moew.government.bg

Croatia
Mrs. Lidija Chadikovska
Ministry of Agriculture Forestry and Water Economy
cadikovska.lidija @mzsv.gov.mk

Croatia
Mr. Darko Pavlović
Ministry of Environmental and Nature Protection
darko.pavlovic@mzoip.hr

Croatia
Dr. Kreso Pandzic
Meteorological and Hydrological Service
pandzic@cirus.dhz.hr

Croatia
Mrs. Marija Čulinović Holjevac
Ministry of Agriculture
marija.culinovicholjevac@voda.hr

FYR Macedonia

Mrs. Suzana Alcinova Monevska

Hydrometeorological Service of FYR Macedonia

smonevska@meteo.gov.mk

FYR Macedonia

Dr. Vlado Spiridonov

Faculty of Natural Sciences and Mathematics

vspiridonov@meteo.gov.mk

FYR Macedonia

Mr. Kosta Trajkovski

Ministry of Environment and Physical Planning

k.trajkovski@moepp.gov.mk

Moldova

Mr. Valeriu Cazac

State Hydrometeorological Service

valeriucazac@hotmail.com

Montenegro

Mr. Momcilo Blagojevic

Ministry of Agriculture and Rural Development

moblagojevic@gmail.com

Montenegro

Mrs. Mirjana Ivanov

Institute of Hydrometeorology and Seismology /

Ministry of Sustainable Development and Tourism

mirjana.ivanov@meteo.co.me

Romania

Mr. Sergiu Ioan

National Meteorological Administration,

Translator - NMA

sergiu.ioan@meteoromania.ro

Romania

Ms. Laura Gheorghe

Ministry of Environment and Climate Change,

Adviser

laura.gheorghe@mmediu.ro

Romania

Ms. Gabriela Popescu

Ministry of Environment and Climate Change,

Adviser

gabriela.popescu@mmediu.ro

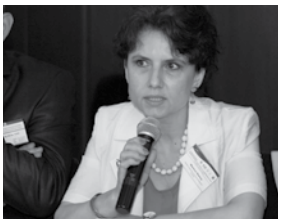
Romania

Mrs. Mihaela Smarandache

Ministry of Environment and Climate Change,

Director

mihaela.smarandache@mmediu.ro



Romania

Mrs. Monica Staicu

Ministry of Agriculture and Rural Development

monica.staicu@madr.ro

Romania

Mr. Mircea Tuas

National Agency for Land Reclamation

tuasmircea@yahoo.com

Serbia

Ms. Snezana Kuzmanovic

Ministry of Energy Development and Environment Protection

snezana.kuzmanovic@merz.gov.rs

Slovenia

Dr. Gregor Gregoric

Slovenian Environmental Agency

gregor.gregoric@gov.si

Turkey

Mr. Mustafa Berk Duygu

Flood and Drought Management Department

Ministry of Forestry and Water Affairs

mbduygu @ormansu.gov.tr

Turkey

Mr. Erdogan Özevren

Ministry of Forestry and Water Affairs

eozevren@ormansu.gov.tr

Turkey

Dr. Metin Türker

Republic of Turkey, Ministry of Food, Agriculture and Livestock, General Directorate of Agrarian Reform

metin.turker@gmail.com

Organizers:

Dr. Jamal Annagylyjova

United Nations Convention to Combat Desertification

Central and Eastern Europe regional Coordination

JAnnagylyjova@unccd.in

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

Dr. Jens Liebe
UN-Water Decade Programme on Capacity Development - United Nations University
liebe@unwater.unu.edu

Dr. Robert Stefanski
World Meteorological Organization
Agricultural Meteorology Division, Climate and Water Department
Rstefanski@wmo.int

Dr. Daniel Tsegai
UN-Water Decade Programme on Capacity Development - United Nations University
tsegai@unwater.unu.edu

Local Organizer:

Romania
Dr. Elena Mateescu
National Meteorological Administration
Executive Director
elena.mateescu@meteormania.ro

Workshop Agenda: Day 1

8:30-09:00 Registration

9:00-12:30 Session 1: Opening session

9:00-10:15 Session 1a: Opening statements and introductory remarks

- **Mrs. Elena Dumitru,** State Secretary, Ministry of Environment and Climate Change (5 minutes)
- **Mr. Daniel Botanoiu**, State Secretary, Ministry of Agriculture and Rural Development (5 minutes)
- **Dr. Ion Sandu**, Director General, National Meteorological Administration of Romania (5 minutes)
- Welcoming statement (UNW-DPC, on behalf of organizing partners) (10 minutes)
- A roundtable introduction of participants and expectations (50 minutes)

10:15-10:45 Group photograph and coffee break

10:45-12:30 Session 1b: Setting the scene

10:45-11:15 Overview of the initiative and scope of the Regional Workshop

11:15-12:30 Keynote address "Risk based National Drought Policy: background, challenges and opportunities"

14:00-17:00 Session 2: Country reports

14:00-15:30 Country reports on drought status and management strategies

16:00-17:00 Session 2 (continued)

Workshop Agenda: Day 2

09:00-12:30 **Session 3: Drought monitoring and early warning systems**

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

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

10:00-11:15 **Session 3b: Roundtable discussions based on the findings of Session 3**

Breakout groups:

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

11:30-12:30 **Session 3c: Presentations of working group results and discussion**

(10 minutes per group and 30 minutes for discussion)

13:30-17:15 **Session 4: Vulnerability and risk assessment**

13:30-14:30 **Session 4a: Thematic presentation (examples):**

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

14:30-15:45 **Session 4b: Roundtable discussions based on the findings of Session 4**
Breakout groups:

- Group A: Who is vulnerable (socially/ economically) and why?
- Group B: What are the mitigation policies and plans that reduce drought impacts/government intervention?
- Group C: Who plays which role in developing the mitigation policies and plans that reduce drought impacts and vulnerability at all levels?

16:00-17:15 **Session 4c: Presentations of working group results and discussion**

Workshop Agenda: Day 3

09:00–12:30 **Session 5: Drought preparedness, mitigation and responses**

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

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

10:00-11:15 **Session 5b: Roundtable discussions based on the findings of Session 5**
Breakout groups:

- Group A: Drought preparedness measures and stakeholders
- Group B: Drought mitigation measures and stakeholders
- Group C: Drought response and recovery measures and stakeholders

11:30–12:30 **Session 5c: Presentation of working group results and discussion**

13:30–16:45 **Session 6: Towards an action plan – Developing Drought Management Policy**

13:30-14:15 **Session 6a: Thematic presentation:**

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

14:15-15:30 **Session 6b: Roundtable discussions based on the findings of Session 6**

Breakout groups:

- Group A: What are the challenges for developing national drought policies
- Group B: What are the institutional arrangements necessary for developing national drought policies
- Group C: What are the steps being undertaken for developing national drought policies

15:45-16:45 **Session 6c: Presentations of working group results and discussion**

(10 minutes per group and 30 minutes for discussion)

16:45 –17:30 **Session 7: Wrap-up and concluding session**

- Synthesis and concluding remarks
- Briefing on follow-up and expectations
- Countries' representatives feedback