Global Water Partnership
Central and Eastern Europe

WORLD METEOROLOGICAL ORGANIZATION

Integrated Drought Management in Central and Eastern Europe

Compendium of Good Practices

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Global Water Partnership
Central and Eastern Europe

The Global Water Partnership Central and Eastern Europe (GWP CEE), is an international network, which comprises 12 Country Water Partnerships in Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Moldova, Poland, Romania, Slovakia, Slovenia and Ukraine and more than 160 partners located in 15 countries. Its mission is to advance governance and management of water resources for sustainable and equitable development. GWP CEE is a part of global network that consists of thirteen regions across the world.

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WORLD METEOROLOGICAL ORGANIZATION

The World Meteorological organization (WMO) is a specialized agency of the United Nations. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interactions with the oceans, the climate it produces and the resulting distribution of water resources. WMO has a membership of 191 countries and territories.

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Integrated Drought Management Programme

Integrated Drought Management Programme for Central and Eastern Europe (IDMP CEE) supports the governments of Bulgaria, the Czech Republic, Hungary, Lithuania, Moldova, Poland, Romania, Slovakia, Slovenia and Ukraine in the development of drought management policies and plans. It also builds capacity of stakeholders at different levels for proactive integrated drought management approach and tests innovative approaches for future drought management plans. It is part of the Integrated Drought Management Programme (IDMP), which was launched by WMO and GWP at the High-level Meeting on National Drought Policy in March 2013. Further information on the IDMP is available at www.droughtmanagement.info

www.gwpcee.org

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CONTENT

LIST OF ABBREVIATIONS

ACPDR	Administration of the Republic of Slovenia for Civil Protection and Disaster Relief
ARSO (SEA)	Slovenian Environment Agency
CAFS	Chamber of Agriculture and Forestry of Slovenia
CEE	Central and Eastern Europe
DMCSEE	Drought Management Centre for Southeastern Europe
DMP	Drought Management Plan
EDO	European Drought Observatory
FPMP	Flood Protection Management Plan
GIS	Geographic Information System
GWP	Global Water Partnership
GWP CEE	Global Water Partnership of Central and Eastern Europe
HFA	Hyogo Framework for Action
HM	Hydrometeorological
IDMP CEE	Integrated Drought Management Programme of Central and Eastern Europe
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
IWRM	Integrated Water Resources Management
JRC	Joint Research Centre of the European Commission
NCD	National Consultation Dialogues
NUV	National Water Management Plan
NWRM	Natural Water Retention Measures
RB	River Basin
RBMP	River Basin Management Plan
RCP	Representative Concentration Pathway
RS	Remote sensing
UN	United Nations
UNCCD NAP	United Nations Convention to Combat Desertification National Action Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNISDR	United Nations Strategy for Disaster Reduction
VNC	Virtual Network Computing
WCP	Global Water and Climate Programme
WFD	Water Framework Directive
WMO	World Meteorological Organisation

1. Introduction

This Compendium is the final publication of the first phase of the GWP/WMO Integrated Drought Management Programme in Central and Eastern Europe (hereafter **IDMP CEE**). It provides an overview of the programme's outputs and accomplishments achieved in the period from 2013 to 2015.

The Programme's main goal is to increase the capacity of the CEE region to adapt to climatic variability by enhancing resilience to drought. The Programme attempted to address this goal through the following specific objectives:

- map and assess the impact of droughts, incorporate risk mitigation/reduction and develop drought policies based on scientific knowledge;
- support and facilitate national governments to incorporate drought management into their national programs and policies;
- raise awareness about severe drought conditions through efficient dissemination mechanisms;
- synthesize country findings and develop regional drought policy, a monitoring framework, and a regional drought management platform; and
- initiate demonstration projects involving local communities.

The focus of the IDMP CEE was to support policy makers through activities which incorporate drought management into their existing documents, especially their River Basin Management Plans. In order to observe how drought management plans are developed and made functional outside CEE, there is a collection of existing drought management plans (DMPs) added to the Compendium, together with some successfully implemented EU-funded projects, as additional good practices which CEE countries can learn from or use in preparation of their own DMPs.

2. Background information

2.1. Integrated Drought Management Programme in Central and Eastern Europe

In recent years, drought planning has been generally moving from a crisis management approach, based on national or regional drought emergency programmes, to a risk management approach, based on the development of comprehensive, long-term drought preparedness policies and plans of actions intended to significantly reduce the risks of, and vulnerabilities to, extreme weather events.

Over the past thirty years, droughts have dramatically increased in number and intensity in the EU. The number of areas and people affected by droughts increased by almost 20% between 1976 and 2006. The total cost of droughts across the EU in the past thirty years amounts to 100 billion Euro (European Commission, 2012). Central and Eastern Europe (CEE) is one of the European regions most vulnerable to drought events. This vulnerability has further alerted the public, governments and operational agencies (such as meteorological offices) in the CEE region to the many socio-economic problems accompanying water shortage.

In response, in 2013, the Global Water Partnership Central and Eastern Europe (GWP CEE) initiated the Integrated Drought Management Programme (IDMP CEE) within the framework of the joint, global WMO/GWP Integrated Drought Management Programme. The scope of this programme (WMO/GWP, 2011) is "to support stakeholders at all levels by providing them with policy and management guidance through the globally coordinated generation of scientific information and sharing best practices and knowledge for integrated drought management".

In 2011, the Regional Council of the GWP CEE initiated the Inception Phase of the GWP IDMP and established an IDMP Task Force charged with preparing an **Inception Report** (mapping study). This report provided a review of existing drought risks, policies and strategies in the CEE region, and confirmed that drought and water scarcity issues were widely recognized as relevant phenomena in the CEE region. In terms of water resources management and climate change adaptation, the report found that CEE countries are sensitive to changing precipitation patterns. Future climate scenarios for the region forecast increases in the frequency and severity of extreme weather events, which will result in an increase in droughts (IPCC, 2007). In addition, it was observed that droughts tend to raise similar issues across the region, such as: the level of damage inflicted, on whom, and where; who should pay for damages; and how to prevent, or at least reduce, damages and their costs in the future. A central goal of the IDMP was therefore to increase the capacity of CEE countries to enhance their resilience to drought, and thereby better adapt to climate change.

In February 2013, the IDMP CEE was launched with the involvement of over 40 organizations from 10 CEE countries. The Programme is structured to provide both policy advice and practical solutions in drought management. The value added of this programme is that it focuses on integrated approaches rather than fragmented solutions. The Programme has four main components:

1. **Investments in regional and national development:** to advance regional/transboundary cooperation in drought management by integrating water security and drought resilience into national development planning and decision-making processes.
2. **Demonstration projects:** to develop and implement several innovative solutions for addressing critical drought management challenges. Project implementation is driven by institutions working at the local level with support and technical assistance from regional and country teams.
3. **Knowledge and capacity development:** to organize regional and national workshops, publish policy briefs, work with social media, and implement other activities focusing on increasing awareness among water managers, farmers and other water users.
4. **Partnerships and sustainability:** to ensure that the network facilitating IDMP CEE is strengthened, as well as to enhance the further fundraising of programs promoting water security and drought resilience within the framework of sustainable development.

The primary beneficiaries of the IDMP CEE are government institutions and agencies responsible for developing drought management policies and/or implementing systems for drought monitoring and prediction and drought risk mitigation and response, at multiple time scales and regional, national and local spatial scales. The secondary beneficiaries are decision makers and managers whose task is to implement these policies, including drought mitigation and adaptation. These secondary beneficiaries also include non-governmental institutions involved in regional and national drought advocacy, awareness and response efforts.

More about the IDMP CEE:

- **Inception report**
- **Programme framework**
- **General brochure**
- **Video**
- **Poster**

3. Drought management

In 2013, following up on its Inception Phase, the IDMP CEE conducted an additional review of current status with increased attention to assessing the integration of drought issues into the first RBMPs and collecting the following information:

- **Situation analysis:** information about the current status of Drought Management Plans within RBMPs or National Water Resources Management programs in each country; drought management planning and measures adopted according to, or under other, national plans; and implementing obligations as stipulated in the UNCCD.

- **Institutional analysis:** identification of regional and national entities that are or should be involved in drought management.
- **Analysis of management measures/good practices:** review of the planned and already implemented measures for preventing and mitigating drought effects in each country.

The results of a questionnaire survey completed by all 10 CEE countries were summarised in the **Report on review of the current status of implementation of the drought management plans and measures.** This report showed that the majority of countries had not produced a DMP in accordance with the EU's general guidelines, which are provided in the EU Technical Report Drought Management Plan Report Including Agricultural, Drought Indicators and Climate Change Aspects (European Commission, 2007). Furthermore, substantial shortcomings were found in the implementation of all key elements of the DMPs, such as: indicators and thresholds establishing different drought stages, measures to be taken in each drought stage, and the organizational framework for drought management.

The problematic areas identified in the above report were found to be a good basis for developing a guidance document on how to produce a Drought Management Plan that was concise, tailor-made for the CEE region, and based on existing relevant documents, such as guidelines and communications (Chapter 3.1).

The preparation of DMPs within the IDMP CEE is directly linked to EU Water Framework Directive (WFD) criteria and objectives and River Basin Management Plans (RBMPs). According to the WFD, a DMP should be part of an RBMP. Moreover, as all CEE countries are signatories to the United Nations Convention to Combat Desertification (UNCCD, 1994) they are required to prepare National Action Plans. However, it was observed that national efforts towards fulfilling the WFD and UNCCD were usually divided: the WFD was managed by the national water sector while the UNCCD was managed by the national agriculture sector. In response, the IDMP CEE sought to unite all main experts and stakeholders working on the WFD and UNCCD, to support a national process of preparing a DMP, by organizing National Consultation Dialogues (Chapter 3.1) in each of the 10 countries participating in the programme.

Besides the Guidelines for preparation of the DMP, some examples of existing Drought Management Plans (or National Action Plans) currently in use are presented below (Chapter 3.2) to support the exchange of experiences, good practices and knowledge.

In addition, one of the IDMP CEE demonstration projects has started to prepare a Drought Management Plan (or more specifically, a functional framework for drought management plan). Here, a drought risk management scheme that includes measures and methods for developing maps for drought hazard and drought vulnerability, as well as a drought risk mapping strategy, were prepared (Chapter 3.3.).

3.1. Guidelines for Drought Management Plans and National Consultation Dialogues

Main objective

To develop practical Guidelines for (and with) the national level to support the timely production of Drought Management Plans within the development of the RBMPs.

Background

The IDMP CEE focuses mainly on current gaps in the implementation of the EU Water Framework Directive (WFD). One of the WFD requirements for a RBMP is to develop a DMP as a supplementary measure, in case obligatory measures are not sufficient to avoid water scarcity. However, this requirement was not fulfilled in any of the participating CEE countries.

Many actions at the EU level resulted in the development of EU drought policy, documented in several policy and technical documents which are tackling the preparation of the Drought Management Plan: however, these documents are not centralized and are in some cases too general. All of these documents were taken as "background documents" in preparation of the Guidelines:

- **Drought Management Plan Report Including Agricultural, Drought Indicators and Climate Change:** general guidance for the production of a Drought Management Plan in accordance with the RBMPs.

- **Communication from the Commission to the European Parliament and the Council – Addressing the challenge of water scarcity and droughts in the European Union:** drought strategy providing policy options and a set of key actions to tackle drought and water scarcity problems.
- **A Blueprint to Safeguard Europe's Water Resources:** policy document aims to tackle obstacles hampering action to safeguard water resources. A part of the document is dedicated to vulnerability problems and solutions, including those related to drought.
- **GWP/WMO National Drought Management Policy Guidelines**

An important step in the preparation of the Drought Management Guidelines was the National Consultation Dialogues (NCD) which were conducted twice, in 2013 and 2014/15, in each of the 10 participating countries. The main objective of the NCD was to support the process of development of the Guidelines for the DMP. The intention was to involve all key actors dealing with drought issues at all levels – policy, professional and stakeholder.

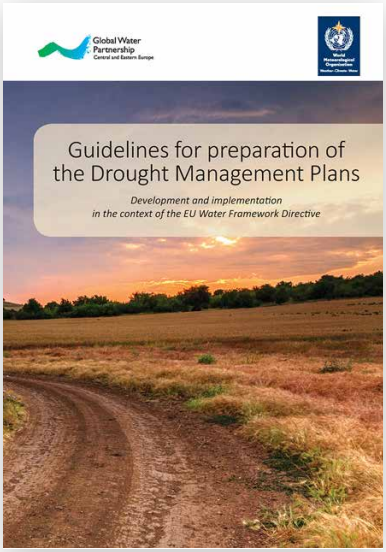
Implementation process and methodologies applied

The development of the Guidelines was based on existing guidance documents and relevant policy papers relating to drought management adopted at the global, EU, regional and national levels. The results from other IDMP CEE activities and demonstration projects were also taken into account and incorporated into the Guidelines.

The first phase included the execution of a Slovak case study that was implemented with the aim of providing a practical example on how to develop key components of a DMP, and the development of the draft Guidelines. During the second phase, the final version of the Guidelines was developed based on comments and national experiences received from the participating CEE countries. The national experiences were collected during the second National Consultation Dialogues (NCDs) organized in ten countries – these were a valuable source of information that were used as a basis for the development of the national DMPs. The information collected from countries was separated into six sections representing the key elements of DMPs. This information should be used in the future as a basis for the harmonization of national approaches and methods needed for the development of DMPs at the river basin level.

Output/results

Guidelines for preparation of the Drought Management Plans



aim to provide a better understanding of how to integrate drought management into RBMPs in CEE. They focus on seven steps that relate specifically to the environment of CEE countries.

Translations of the Guidelines to **Hungarian**, **Lithuanian**, **Romanian**, **Ukrainian**, **Slovakia**, **Slovenian** language.

Added value

At the beginning of the IDMP CEE, the main obstacle in developing drought plans was identified as a lack of methodology. As the Guidelines provide a detailed methodology for DMP development, describing basic steps in a very concise way, a lack of methodology should no longer be an obstacle. In addition, examples are presented for each step to increase the clarity for how a specific part of a DMP functions in practice.

The IDMP CEE Guidelines were developed specifically for EU countries, and are built on guiding principles derived from EU legislation, EU drought strategy and other water policy documents. The Guidelines are also based on WMO/GWP Guidelines which provide a template for action that countries can use in the development of a national drought management policy and drought preparedness/mitigation plans: therefore, the Guidelines are usable for countries outside the EU which are trying to develop proactive drought policy. The added value is also that many different policy documents were collected and analysed during the development of the Guidelines.

Two rounds of National Consultation Dialogues (NCDs) opened communication and discussion on drought issues among different sectors, institutions and stakeholders, focused on the creation of effective organizational structures for drought management in the individual countries. The NCDs provided an opportunity for participants to influence the Guidelines' structure and content in order to assist and simplify DMP development. The NCDs also revealed gaps and uncertainties in drought management in the individual countries and discussed solutions and next steps.

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3.2. Drought risk management scheme: a decision support system (demonstration project)

The primary purpose of this demonstration project was to present a planning process, or "scheme", that: facilitates the preparation of decision support systems for drought risk management; and provides a Framework for Drought Risk Management that presents the main components, their content, interrelationships and functional linkages between these elements. After having prepared a Guideline for drought management plans, this activity entails the transfer of theoretical knowledge into practise.

Main objective

Drought is recognized as one of the most complex natural hazards with serious negative impacts on society, the economy and the environment. Approaches to managing drought may vary, depending on the phase of water-related shortage within the hydrological cycle (e.g. meteorological, soil moisture or hydrological), drought impact category (e.g. social, economic or ecological), and the national legal framework. Recommendations take the form of a framework that defines the main principles of drought management that can be applied to various drought aspects. The introduction of a common framework leads to compatibility and complementarity among different drought-related systems within a country as well as at the international level.

Background

Risk management for droughts is defined as the process of identifying and understanding the relevant components of drought risk, and analysing alternative strategies to manage that risk. Risk management involves the application of analytical tools for decision making, as well as the development of management strategies that appropriately deal with uncertainty and the perception of risk.

This demonstration project collected drought hazard and vulnerability assessment measures and management strategies that were developed and applied in the participating countries of Poland, Lithuania and Romania. An overview of essential concepts, definitions and methodologies associated with drought risk management, at the national, sub-national and sectoral levels, was the subject of the outputs of this project. The challenge was the integration of different approaches and concepts arising from various national, regional, sectoral and drought impact contexts in order to develop an integrated drought risk management scheme.

The set of recognized main elements that constitute a drought risk management scheme included: a monitoring network, drought indicators, drought hazard assessment, drought early warning, drought prediction, impact assessment and risk assessment. In order to ensure the functionalities, these elements had to be configured into a functional framework with institutional, methodological, public and operational components.

Institutional component – responds to drought management and describes the set-up for institutional coordination and key institutional capacities required to develop drought risk management systems.

Methodological component – outlines the necessary procedures for assessing drought risks. This entails the analysis of climate and hazard trends and other underlying vulnerability factors.

Public component – addresses drought prevention measures and presents the interventions that depend on the risk profile. It provides an overview of the types of drought risk management options that can be adopted for ensuring immediate responses, enhancing short-term preparedness, and promoting long-term resilience.

Operational component – provides guidance and recommendations for developing and implementing a decision-support system that is based on indicators that are achievable in a given timeframe to support drought risk management.

Outputs from this activity address part of the specific objective of the IDMP CEE and are an important contribution to IDMP CEE components:

- Knowledge base: compilation of information and knowledge about recorded practices for drought planning and management. The aim of this output was to elaborate a common approach in methodology for drought hazard and risk mapping that can be applied in the participating countries of Poland, Lithuania and Romania. This included an inventory of methods for assessing the impacts of droughts for key sectors vulnerable to drought, and methods for assessing the risk of droughts.
- Guidance on technical and institutional aspects: tools and methodologies developed to support and improve drought risk responses. This output included an inventory of institutional frameworks and information content relevant to drought assessment and management in the countries participating in this activity.
- Capacity building: raising awareness and understanding about drought risk through vulnerability assessments and associated risk mapping in order to develop preventive actions against drought. The provision of integrated guidelines for drought risk management to the CEE countries will be a step forward in establishing a common drought management policy.

Implementation process and methodologies applied

1. (Institutional component) The **Institutional framework** presents the structure for institutional coordination as well as key capacities required to develop the drought risk management systems.
2. (Methodological component) The **Framework for drought risk assessment** outlines the necessary procedures for assessing drought risks. This entails the analysis of climate and hazard trends and other underlying vulnerability factors.
3. (Public component) The **Framework for drought prevention measures** presents the types of actions to be undertaken depending on the risk profile and impact category. It provides an overview of the types of drought risk management options that can be adopted for ensuring immediate responses, enhancing short-term preparedness and promoting long-term resilience.

4. (Operational component) The **Framework for decision support tools** provides guidance and recommendations for developing and implementing decision systems to support drought risk management, based on indicators achievable within specific time periods.
5. **Appendix:** Provides practical recommendations for the development of a decision support system, and the identification of actions that can be taken, to reduce potential agricultural drought-related impacts and risk in Poland. The system was launched to run operationally for the Odra River and Vistula River basins.

Outputs/Results

Measures for the assessment of susceptibility and vulnerability to drought

This report contains an inventory of drought measures (indicators) that are applied to evaluate susceptibility, drought impacts and vulnerability to drought in countries involved in Activity 5.4. The inventory includes methods that are applied in each country to characterize drought impacts and methods for vulnerability assessment. It also includes a review of national sectors that are most vulnerable to drought, the identification of stakeholders, measures for drought assessment that are deployed in national drought monitoring and early warning systems, as well as the identification of end-users and their needs for information on drought at the national level.

Methods for drought hazard and risk management

The overall goal of this output was to develop a concept of drought hazard and vulnerability mapping as a tool for drought risk management for selected regional contexts. Drought hazard and vulnerability assessment was streamlined into the following steps: the selection of drought hazard indices that can be used for drought detection and monitoring for regions and economic sectors under analysis; the development of drought hazard assessment methods, taking into account drought frequency and severity analysis; the identification of drought impacts within the given regional and sectoral context and vulnerability estimation methods; and the integration of the resulting drought hazard assessment with the drought vulnerability analysis in order to categorize the areas subject to drought risk. The selected indices were investigated in terms of providing information on drought hazard for agriculture and water resource sectors within different regional contexts. Drought risk elements identified in each regional context were investigated in terms of building vulnerability functions that represent the relationship between potential damage or loss to a given element at risk against a specified event intensity.

Framework for Drought Risk Management Scheme

This output has two parts. The goal of the first part provides the assumptions and requirements for framework development and demonstrates the operational risk assessment system that is applied for the region of the Middle and Upper Odra River Basin. The second part presents a planning process, or scheme, that can facilitate the preparation of decision support systems for drought risk management. The framework defines the main principles for drought management that can be applied to various drought aspects.

Short **Technical note** on presenting achievements of this demonstration project.

Added value

The challenge in developing the drought risk management scheme is the integration of different approaches and concepts arising from different national, regional and sectoral contexts. Project realization allowed for the recognition of drought vulnerability and management strategies that were developed and applied in the participating countries. An overview of the essential concepts, definitions and methodologies associated with drought risk management, at the national, sub-national and sectoral levels, was the main output of this project. Other outputs included a basic roadmap for integrating, developing and planning drought risk management tools at different levels, based on best practices, lessons learned and experiences introduced by project partners.

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4. Drought monitoring and forecasting

One element of a mitigation strategy is drought monitoring. Although most CEE countries have well developed meteorological and hydrological monitoring systems, these systems are not translated into concerted efforts to support decision makers in various sectors of the national economy, such as the agriculture and energy sectors. Having in mind that drought episodes have local and regional characteristics, there is currently no existing suitable mechanism to share information and knowledge among countries. In spite of the fact that several basins in the region are transboundary, regional integration of drought monitoring and early warning is currently not at the level desired.

The first step to monitor drought at the international and regional level is to establish communications with and between national authorities. Almost all countries have operational products used for drought monitoring. Some of the countries use many different data sources while some rely on only one indicator. For this reason, IDMP CEE partners first prepared a review of existing national data (SPI and any other indicators used in partner countries for identifying or forecasting drought). The second step is to improve interoperability through the integration of information services. In IDMP CEE, we decided to use the existing drought platform, the European Drought Observatory, and inputs of integrated data collected from CEE (Chapter 4.1).

In one of the demonstration projects, partners also used remote sensing data to provide early warning of drought effects on agriculture and to predict potential yield loss (Chapter 4.2).

4.1. Drought data exchange platform

Main objective

Partners were expected to collect existing national data (Standardized Precipitation Index, or SPI) and any other indicators used in partner countries to identify or forecast drought, and to make them available through the European Drought Observatory (EDO). This information was either data (raster or vector), links to documents (e.g. field reports, bulletins) or national web pages that provide drought information. Real-time or near real-time information was preferred.

Background

Several options for the selection of a data exchange platform for the IDMP CEE project were studied. The main consideration related to the decision to develop new services or to attach the IDMP CEE project to an existing system. Given available time and resources, the decision was to use an existing system – the European Drought Observatory (EDO), developed by the European Commission's Joint Research Centre (JRC). The main goal was achieved, and satisfactory feedback on metadata and 18 products from 8 countries were received and imported into the Drought Metadata Catalogue.

Implementation process and methodologies applied

Phases of implementation:

- This Activity started with the preparation of the Implementation Guide providing a detailed description on how to prepare metadata for the Drought Metadata Catalogue. This was the starting point for all partners to prepare their own data.
- A survey about existing operational products for drought monitoring in the countries was prepared and completed by all partners.
- Training was organized to help partners prepare data which was later incorporated into the EDO. This occurred during the 2nd IDMP CEE Workshop in Ljubljana, based on surveys and a draft version of the Implementation Guide.
- All data provided by the partners were integrated into the EDO and made available in their **Drought Metadata Catalogue**.

- The Activity finished with the preparation of the Implementation Report which gives a short description of selected data. It also reports on which data have been added to the platform from contributing partners.

Output/Results

Implementation Report: Metadata for 18 drought-related products from 8 countries were prepared, added to, and described in the **Drought Metadata Catalogue**.

Implementation Guide: The Implementation Guide defines the most feasible platforms. It is built on success stories with platforms, such as the Helpdesk developed by WMO/GWP Associated Programme on Flood Management. The guide also identifies links between drought management platforms and the existing databases of international organizations (e.g. UNECE, international river basin commissions). There are several options for selecting a data exchange platform for an IDMP programme. The main consideration is the decision to develop new services or to attach the IDMP programme to an existing system. The 26-page guide includes information and guidelines on how to integrate new data into the European Drought Observatory (EDO). The guide should provide partners (who also serve as data contributors) with information on the IT platform and its use and technical details:

- Introduction and overview of existing platforms
- Basic properties of proposed IDMP platform (contents, standards, requirements)
- Technical specifications for contributors

Added value

This activity builds on knowledge and experiences from the previous projects dealing with interoperability, particularly the **EuroGEOSS** project. **EuroGEOSS** demonstrated the added value to the scientific community of making existing systems and applications interoperable and using them within the GEOSS and INSPIRE frameworks.

Similar to many continental and global monitoring platforms, the European Drought Observatory (EDO) intensively uses modelling systems for drought status assessment. However, many meteorological variables, especially the amount of precipitation, are very difficult to accurately simulate using only remote sensing and conventional measurements. Country drought products prepared from local measurements are therefore crucial for drought status assessment. Moreover, the integration of existing national data into the EDO increases the visibility of data and enables countries to justify requests for assistance in case of major natural disasters.

The Implementation Guide can be used in similar future projects which involve the integration of existing or new data into the EDO.

While some progress has been observed, major efforts to unify drought monitoring systems is still needed in the future. However, it should be achieved without unnecessary pressure on national regulations – for example, individual countries should continue to choose their own sets of drought indicators. A good example of service integration and unification of information is **MeteoAlarm**. A similar approach is needed for drought monitoring.

The EDO has proven to be an appropriate platform for the exchange of data that is relevant for drought analysis in Europe because of its:

- serving as a central point or platform for drought in Europe
- long-term commitment to European countries (not limited to EU members) and users
- continuous provision of project outcomes (i.e. data are available after the end of the project)
- large past investments into infrastructure: the platform has been extensively tested and is stable with many features
- relative ease to integrate, and support from JRC staff

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4.2. Policy-oriented study on applying remote sensing in agricultural drought monitoring methods *(demonstration project)*

The policy-oriented study on applying remote sensing in agricultural drought monitoring methods focused on developing a framework for a proactive drought risk monitoring system. Such a system can indicate drought hazard based on remote sensing data and provide early warning of drought effects on agriculture by predicting potential yield loss. This system can provide farmers and stakeholders with early responses to drought effects.

Main objective

The demonstration project addresses agricultural drought monitoring and yield loss forecasting which applies five remote sensing-based drought risk (threshold) levels.

Background

Among different drought types, agricultural drought is the least quantified and thus the most uncertain. Agricultural drought is influenced by several complex factors: measurement is complicated and time- and resource-intensive; and its impact, such as yield loss, is measurable only indirectly or post-drought. Remote sensing (RS) of crop biomass is one of the most important solutions for measuring agricultural drought and its effects, although the accumulated knowledge about RS is now only slowly being implemented into practice. This activity supported filling knowledge gaps in this field through the development of agricultural drought-related decision parameters and its application in practice from raw spectral datasets. Signalling levels developed in this activity, and freely available homogenous remote sensing data (i.e. MODIS NDVI spectral indices) as well as land use datasets (from the CORINE database), can also be applied at the national and regional CEE scales.

Implementation process and applied methodologies

The methods and databases explored in this activity include the application of remote sensing data to assess land use and biomass production to better integrate and understand cropping patterns that are influenced by hydrology and soil types. To determine yield loss thresholds and soil-water retention capacities, the following were processed and integrated: internationally available land use remote sensing data (i.e. CORINE database, topographic maps), MODIS NDVI spectral indices, soil data (e.g. agro topographic map, soil water management properties, map of water management properties of soils), hydrology (i.e. soil water table), and digital elevation model results. The newly developed RS toolbox integrates land use, soil, meteorological and satellite data into a model, which can be a feasible tool for plant-specific drought risk evaluation. Remote sensing data were calibrated against yield data and validated with other drought index data from the European Drought Observatory (EDO). The main aim of this activity was to establish a decision support system for agricultural drought monitoring and yield loss forecasting by concrete identification of remote sensing and GIS data tools, which eventually provides information on drought risk levels.

The objectives of this activity were to:

1. identify green and brown water resources in watersheds and their role in the soil and crop water content status in water balance for wheat, corn and apple crops
2. formulate concrete signalling and intervention levels of drought by which the spatial and temporal extent of risk to the actual drought situation in the crops and apple can be quantified
3. define the integration of RS and GIS tools and intervention levels for the drought monitoring system to facilitate decision makers

The objectives were achieved for wheat and corn, but not for apples where yield loss prediction failed and was not possible because of other meteorological circumstances that affect apple yields.

Outputs/Results

This case study had three important steps, or milestones, which relate hierarchically to each other.

Green and brown water resources on watersheds (report)

Based on the amount of green and brown water, a water balance analysis of a watershed was conducted concerning different land uses and agricultural practices for each crop (wheat, corn and apple) from an agricultural drought severity point of view. Green and brown water content was analysed according to different soil terrain and climatic (non-irrigated and rain-fed) conditions.

Signalling and intervention levels of drought based on remote sensing datasets (report)

A specific data integration process was developed with which other conventional drought indices can be specified and refined, taking into account actual yield loss data, and calibrated to define remote sensing-based drought index maps. A toolbox was elaborated for the concrete identification of remote sensing and GIS data, which can also support agricultural drought monitoring and yield loss forecasting. Five drought risk levels were developed to identify the negative effects of agricultural drought on crop yields: watch, early warning, warning, alert and catastrophe.

Integration of RS and GIS tools and intervention levels into drought monitoring system

The report is composed of both above mentioned reports.

A user-friendly drought monitoring and yield loss mapping process script was generated to make yield forecasting possible for other users in an ArcGIS environment. The remote sensing-based agricultural drought monitoring and yield loss forecasting method can effectively indicate an anomaly of droughts and yield losses as well as possible interventions. The methodology is also appropriate for the early warning of agricultural droughts, since yield loss can be predicted two months before irreversible yield loss or quality degradation occurs. Through plant-specific calibrated yield loss maps, the new spatial decision support system gives precise information to farmers on agricultural drought risk in different regions. Decision makers can thus easily use these results to estimate yield loss in specific fields. The developed models and scripts can also be applicable for drought risk-affected areas other than the region which was subject of the study. This digital IDMP geoprocessing framework process makes it possible for users and stakeholders to access and share this knowledge tool for drought monitoring and yield loss forecasting.

Short **Briefing Note** presenting the achievements of this demonstration project

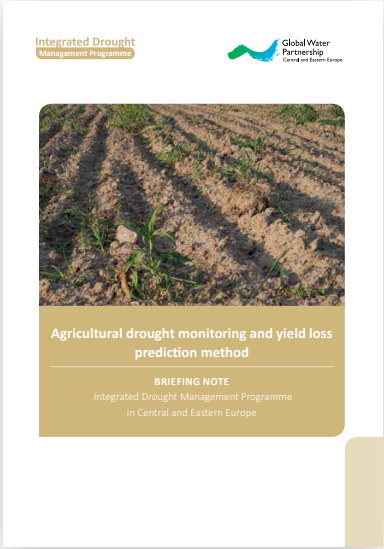
Added value

The added value is the elaborated agricultural drought monitoring and yield loss forecasting method, which can predict the yield loss of maize and wheat 4-6 weeks before harvest, and drought-affected sites can be delineated more accurately. The impact of drought on agriculture can be diagnosed far in advance of a harvest, as the knowledge of the potential impact of forecasted drought on yields is the most important information for farmers and stakeholders concerning food security and trade. This information can facilitate drought intervention activities, reduce the impacts of drought on stock uncertainty, and facilitate decision makers in developing more accurate mitigation measures and preparedness plans for specific regions.

A new drought-related soil moisture regime GIS database was also established, in which the data, based on water management parameters of high resolution soil data by using different GIS SQLs, clearly showed that the impact of drought was more severe in soils having extreme water management character. The newly developed agricultural drought monitoring and yield loss forecasting method can also be used by other IDMP CEE countries, as it is based on the utilization of NDVI (normalized data) and its calibration is also based on normalized yield data sources. NDVI data and yield loss data from different CEE countries can be easily compared. Since NDVI strongly correlates to biomass, and biomass with yield, low NDVI therefore means low biomass and low yield in CEE countries. Furthermore, the magnitude of potential yield losses is connected to the newly developed five drought risk levels, which are also applicable to IDMP CEE countries other than the study region.

The results are also appropriate for establishing further complex studies on water use, water management and scarcity:

- The extent of drought can be transformed into the determination of an exact amount of water that is missing for an average yield (t/ha) of a specific farm or a watershed because wheat and maize have their characteristic water demand for producing one ton of yield.
- Using the time series analysis of the results of this model, sites where irrigation is often required can be identified. Combining these results and soil maps, the drought-related soil moisture regime map of these sites can be identified.



Basic info

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5. Measures to reduce drought impacts, vulnerabilities and risk

Droughts differ from one another in three essential ways: intensity, duration and spatial coverage. Intensity refers to the degree of precipitation shortfall and/or the severity of impacts associated with the shortfall. It is generally measured by the departure of some climatic index from normal and is closely linked to duration, another distinguishing feature of drought, in the determination of impact.

Droughts also differ in terms of their spatial characteristics. Drought impacts are closely related not only to the magnitude of the event, but also to the timing of the onset, duration and spatial extent. As vulnerability to drought has increased globally, greater attention has been directed to reducing risks associated with its occurrence through the introduction of planning to improve operational capabilities (i.e. climate and water supply monitoring, building institutional capacity) and mitigation measures that are aimed at reducing drought impacts. Also, soil characteristics and water management practices in the catchment areas indicate drought impacts.

Collecting and analysing data through demonstration projects is the most effective approach and contributes to the enhancement of knowledge and capacity development. The IDMP CEE elaborated several demonstration projects, focusing on different aspects of drought management and covering different sectors (i.e. water, agriculture, forestry, meteorology). Three demonstration projects are presented below.

5.1. Increasing soil-water holding capacity in agriculture *(demonstration project)*

This activity was focused on delivering experimental results for strategic policy decisions and planning in order to increase water savings in soil, through the use of agricultural practices, such as mitigation measures against droughts and floods. The results are available for implementation into legal and policy documents and for practical use at the national and EU levels.

Main objective

Demonstrate concrete measures to increase soil-water holding capacity.

Background

The results of the activity describe concrete methods and procedures for increasing soil-water holding capacity. The proposed methods are: subsoiling; organic matter application into soil; conservation tillage up to 10 cm in depth; ecological farming, preferably using organic fertilizers; composting tillage; no-till farming and other measures which increase water infiltration into the soil profile and improve soil water regimes.

All of the proposed methods are immediately applicable but several activities need to be performed before large-scale implementation, such as: implementing soil-water saving methods into Drought Management Plans as limiting measures against drought; creating a practical handbook for how to use soil-water saving methods at the CEE and national levels; integrating soil-water saving methods into EU water and agricultural policies; and creating incentives and procedures for implementing such policies into practice (e.g. technical support, subsidies, extension services, control, evaluation of implementation, and feedback).

Implementation process and methodologies applied

All four countries (Czech Republic, Poland, Slovakia and Slovenia) carried out theoretical and practical field studies.

In eight different soil ecological conditions in the participating countries, five main methods and several technological modifications, focused on increasing soil-water holding capacity, were set up and observed. The five methods were: subsoiling; conservation, or ecological, farming; organic fertilizer use; no-tillage farming; and composting farming. All of the different field experiments for increasing soil-water holding capacity were set up and studied by relevant approaches and methods in the field and laboratory. The results can be implemented into large farming systems where needed.

Outputs/Results

Final report on Drought management by agricultural practices and measures increasing soil water holding capacity

The main output of this activity was an “analysis and proposals of preventive measures as a tool for drought management in agriculture practices and technologies” (report). Several practical proposals for increasing soil-water holding capacity are summarized below:

Subsoiling of soil profile: This method is recommended for farmers as a new principle for soil cultivation, using subsoiler machines, available in the market, instead of traditional soil ploughing. Subsoiling is appropriate for deep soil cultivation, down to at least 60 cm, while traditional soil ploughing is limited to a depth of 20-25 cm. Reaching greater depth enables better conditions for water infiltration into the soil profile and for higher water retention of rainfall water in fields. Simultaneously, it also reduces the threat of floods, decreases agricultural drought and increases agricultural plant yields. Field experiment results included: soil profile resistance against water infiltration (penetrometer study to a depth of 100 cm) was significantly decreased, up to a depth of 60 cm, in subsoiled soil and especially in cross-subsoiled conditions (although this effect decreased in the year following the subsoiling application); significantly higher water infiltration in subsoiled soils and especially cross-subsoiled soils were determined through methods based on soil saturated hydraulic conductivity; and increased yields of cultivated plants, of at least 10 %, achieved after subsoiling (especially in cross-subsoiled plots).

More positive effects from subsoiling can be expected in compacted soils. Several European countries, such as Serbia and Czech Republic, have detailed geographical information systems about compacted soils which can help to implement subsoiling technology.

Conservation tillage, up to a depth of 10 cm, increases water retention capacity, water infiltration into the soil profile, and aggregate stability. It also creates more space for roots and earthworms in soil bio-pores, especially in heavy clay soils. All of these results help to improve conditions for water infiltration and soil-water retention capacity.

Composting tillage (using a Vario-disk machine that incorporates plant residues into the well-ventilated layer of soil) results in general soil improvement, including improved infiltration and water retention capacity in light and heavy soils. In addition, plant residues increase the resistance of soils against water evaporating from the soil cover.

Organic matter application, through both animal manure and green (crop parts) manure application by ploughing, supports higher water infiltration and retention in soils, by improving the quality of the soil structure and soil profile.

No-till farming increases the density of macro-fauna in the upper soil layer. This provides a key argument for improving soil properties such as water infiltration and water retention capacity.

Generally, water infiltration and water retention capacity in soils increase from most to least as follows: conventional farming, no-till farming, conservation and composting farming, and subsoiling. Conditions where the methods are used, such as related to the soil, climate, degree of cultivation, and socio-economic factors, are also important and may limit increases.

It is also necessary to consider several positive effects of these methods other than water regime improvements in the soil. Examples include improved yields, protection against soil erosion, soil protection, reduced water evaporation from soil, and improvements in soil profile/architecture parameters. These will also motivate farmers to implement the methods. It is important that all methods for saving water and protecting against drought should be integrated into comprehensive water management plans and strategies.

Added value

This project focused on the under-use of farming methods, such as subsoiling, mulching, and no-tillage farming, because of traditional practices and a lack of motivation by farmers. It also focused on the specific effects of these methods, especially on increasing soil water retention capacity, water savings in soil, and national prevention against drought and floods. The results of this project justify using these farming methods in favour of better water regimes in the soil profile and across the CEE region. For example, subsoiling, composting tillage, conservation and no-tillage farming significantly improved the conditions for higher water penetration into the soil profile and for higher water content in the soil. It also led to improving water regimes country-wide and decreasing the negative threats from drought and floods.

The results and recommendations from this project can be used as motivation for the entire European continent. The recommended methods are effective for numerous types of conditions such as: compacted soils, heavy soils, sandy soils and other light soils, soils deeper than 30 cm, drained soils, soils in rainfed areas, soils in areas suffering from drought, and soils in areas with regular heavy rain and floods. A good starting point for implementation is to use available soil survey data and relevant soil information systems which include information on different soils together with country parameters. In addition, effective agricultural and water management policies must be adopted which include the subsidies for the recommended farming methods. Better implementation can be achieved when the proposed measures are incorporated into Water and Drought Management Plans. The final report of this project can be used as theoretical and practical background for implementing the proposed procedures.

Basic info

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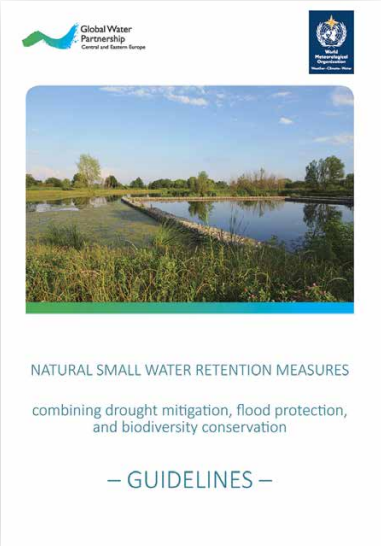
5.2. Natural small water retention measures (NSWRM) *(demonstration project)*



Small retention is an adaptive measure that serves to adjust to extreme climate variability. Specifically, it slows down flood waves during flood periods and helps retain water in the land during wet periods. This activity focuses on increasing the buffering capacity of the landscape in order to mitigate extreme events. This activity describes technical and non-technical measures as well as state-of-the-art planning of natural small retention measures in participating countries as a part of strategic actions for climate change mitigation or adaptation.

Main objective

The aim of this activity was to:

- collect technical and non-technical measures to increase water retention
- develop a methodology for choosing the catchment for the retention measures
- develop an approach to evaluate NSWRM in terms of flood protection, drought mitigation and biodiversity increase
- prepare guidelines for incorporating NSWRM into RBMP

Background

As understood in the EU, natural water retention measures (NWRM) stress the importance of green infrastructure as a means of achieving good ecological status in European water bodies as well as in reducing the risk of floods. We enriched this approach by adding small hydraulic infrastructure as an effective measure in achieving these goals and for increasing landscape water retention. We also stressed the added ecological value when applying small NWRM. This activity contributes to building capacity to meet the challenges of implementing N(S)WRM as a part of IWRM at the country, CEE and European scales. It is targeted at managers who are considering different types of measures as well as stakeholders involved in the RBM planning process.

By using examples, we show that NSWRM activities can be viewed as a single project, regional activity or national program. The evaluation of the measures should be made according to the spatial scale of the measures.

The large variety of small measures available for implementation by a number of different responsible ministries makes NSWRM implementation very difficult. This activity includes examples of small retention plans that were not implemented, where the aim of implementation was different from improving the water balance. Small retention development programs must be included in the sectoral strategies, or plans, for developing particular areas of the national economy, such as:

- Spatial development plans, both local and general
- River Basin Management Plans (RBMP), as required for the implementation of the EU Water Framework Directive; Flood Protection Management Plans (FPMP); and Drought Management Plans (DMP)
- Plans for the Common Agricultural Policy (CAP), particularly for agro-environmental programs
- Strategies for environmental protection (e.g. Natura 2000), with particular emphasis on wetlands
- Plans for the modernization of irrigation-drainage systems, if such are developed

We recommend developing a Master Plan that shows the main lines of action. This plan should include:

- Proposals for legislative changes to facilitate small retention field works, such as the simplification of procedures for obtaining permits for the construction of small water reservoirs that capture drainage water
- A suitable range of state support, both technical and organizational, for small investor-farmers, such as for the development of projects

- Proposals for legislation requiring the inclusion of certain small retention issues in investment projects
- The size and scope of financial assistance and the conditions for granting, depending on the type of measure
- Identification of the institutions responsible for conducting training and providing information on small retention issues; this refers mainly to ensuring that water issues are included in the mandates of the institutions responsible for agricultural advisory or for water management for agriculture use

Implementation process and methodologies applied

This activity was governed by the detailed plan of actions described in the project proposal and marked by the following milestones:

- Preparation of the template for gathering experiences from countries
- Practical and legal experiences from Poland, Slovakia, Slovenia and Hungary
- Workshop to summarize the experiences from countries and to plan next steps
- GIS-based methodology for the catchment comparison developed in Poland
- Literature search of effectiveness indices for flood protection, drought and biodiversity
- Fitting the natural retention measures to IRBMP, FPMP and DMP
- Workshop to select indices which can be used in different landscape settings and climatic conditions under constrained data access
- Development of template for collecting case studies and collection of the best examples from Poland, Slovakia, Slovenia and Hungary (for the GWP CEE NSWRM Case Studies report)
- Workshop for choice of the best case studies from above
- Finalization of an extended draft of the GWP CEE NSWRM Guidelines
- Workshop for finalization of the Guidelines

Outputs/Results

The final output of this activity is the **Guidelines on Natural Small Water Retention Measures**, which combines drought mitigation, flood protection and biodiversity conservation. It is meant to be a practical tool for individuals, NGOs and administrations for planning and implementing natural landscape retention measures. An annex provides **case studies** collected from four CEE countries.

Fact Sheet on NSWRM in CEE
Video
GWP Toolbox case study

Added value

The main output of this demonstration project (Guidelines) provides information about different small retention measures (both technical and non-technical); how to evaluate the results of NSWRM in terms of flood protection, drought mitigation, and biodiversity increase; and how to incorporate natural water retention measures into RBMPs. This activity included the development of GIS-based analysis for identifying areas most suitable for NSWRMs. This activity also collected case studies from all four countries involved to provide interesting examples and an overview on how to mitigate the effects of droughts through small retention measures.

An additional main added value was demonstrating that small retention is not only a flood protection measure but that storing floodwater by small retention dikes and polders is also an important source of water for ecosystems, agriculture and forestry during drought periods in river basins.

Basic info

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5.3. Assessment of drought impact on forests *(demonstration project)*

Forests are significantly dependent on the water regime and, in turn, have a significant impact on the water regime. The water regime is extremely important for forest management and climate change. Through this demonstration project, a programme of measures for climate change adaptation in forests was developed, aimed at climate change mitigation. The project was derived through: an analysis of forest ecosystems in Bulgaria, Lithuania, Slovenia and a pilot area in Ukraine regarding the status of current climate change; and outlooks for forest ecosystem vulnerability differentiated by zones.

Main objective

Establish adaptation measures to mitigate the impacts of drought on forests over the next 50 years, using experiences from four GWP CEE countries, and based on the projected distribution of forest areas and tree species in seven forest vulnerability zones.

Background

The role of forest protection in drinking water provision is a very important issue in RBMPs. This demonstration project aims to develop integrated forest adaptation measures in vulnerability zones at the local and CEE levels which will help to achieve the following:

- Sustainably manage the forestry sector to help mitigate the impact of droughts on forests
- Increase the environmental, economic and social impacts of forests
- Protect water resource quantity and quality

The following activity objectives were achieved:

- The establishment of a methodology to assess drought impacts on forests, based on IPCC (2014), a WorldClim data set and the De Martonne aridity index, was implemented in four GWP CEE countries
- Determination of annual mean temperature, annual precipitation and forest vulnerability zones using the De Martonne aridity index under current, 2050 and 2070 climate conditions (108 maps)
- Forest area distribution in seven forest vulnerability zones under current, 2050 and 2070 climate conditions (four tables)
- Forest tree species distribution in seven forest vulnerability zones under current and 2050 climate conditions (four tables)
- Identification of the main climate change adaptation measures to mitigate the negative effects of drought in forests from Bulgaria, Ukraine, Lithuania and Slovenia
- Raising the awareness of policy makers and the general public in four GWP CEE countries through publications, presentations, and including such measures into national plans and strategies (e.g. RBMP, national forest strategy)

Implementation process and methodologies applied

The implementation process of the forest demonstration project was as follows:

- Presentation of the current forest situation in four GWP CEE countries and the development of the methodology for assessing the drought impacts on forests
- Elaboration of maps about annual mean temperature and annual precipitation under current, 2050 and 2070 climate conditions

- Determination of forest vulnerability zones by using the De Martonne aridity index
- Determination of forest areas and tree species distribution in forest vulnerability zones
- Elaboration of programmes of adaptation measures to mitigate drought impact on forests
- Dissemination of the results from the forest demonstration project

A WorldClim data set and the climate projections from Global Climate Models for four Representative Concentration Pathways (RCPs) of IPCC AR5 (2014) were used. RCPs are IPCC climate scenarios. For the purpose of map intersection and statistics, local experts re-projected all maps into the national coordinate system. The raster resolution of all maps is 1 km2. The types of measures are normative, organizational and investment. Lead and support institutions responsible for implementation are listed.

Outputs/Results

- **Determination of forest vulnerability zones in current, 2050 and 2070 climatic conditions**, according to IPCC AR5 (2014), and distribution of forest areas and tree species in vulnerability zones. This output is a basis for the further determination of adaptation measures.
- The **adaptation measures for forests to mitigate the negative effects of drought** will be used in forestry chapters included in the new National strategies on adaptation to climate change, as well as in the RMBPs for 2016, 2021 and 2027. In addition, other noted measures are applicable in the future management plans of the forestry sector in four GWP CEE countries as well as in other CEE countries.

Added value

This demonstration project contributed to the better understanding of drought, its impacts on forests, and the establishment of adaptation/mitigation measures.

New projections confirmed the temperature increase and precipitation decrease in forest areas in all four involved countries observed in past investigations.

Forest areas and tree species distribution were determined in forest vulnerability zones under current and future climate conditions, according to optimistic and pessimistic scenarios developed under IPCC AR5. Adaptation measures were then prepared for each vulnerability zone and forest area and tree species. A list of measures can be used by other countries which have a similar climate.

Basic info

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5.4 Upgrading agricultural drought monitoring and forecasting: the case of Ukraine and Moldova *(demonstration project)*

Main objective

Review agro-climatic zoning and develop maps of drought-prone areas for the agricultural sector of Ukraine and the Dniester River Basin. This will be done in order to improve drought monitoring systems, update methods of data assessment and develop forecast models for key crop harvest losses caused by drought.

This demonstration project aimed mainly at raising awareness among farmers about the practical aspects of drought management.

Background

Upgraded models for crop yield loss forecasting take into account the main agro-climatic trends. EU indexes contribute to improving the monitoring of droughts and the forecasting of drought impacts in Ukraine's agro-sector, and the assessment of vulnerability and development measures and risk management for the entire territory of Ukraine and part of Moldova`s territory (a special focus was on the Dniester River Basin in both countries).

Several challenges related to drought management were addressed within this activity:

1) Regional level: improvement of knowledge about droughts; analysis of the last 30 years of the main climatic (i.e. temperature and precipitation) and agro-climatic (i.e. water retention capacities of different soil layers) trends based on the observation data of 186 meteorological stations for the period of 1961-2014 for the territory of Ukraine (603 km2) and the Dniester River Basin.
2) CEE-SEE level: drought data analysis and information exchange for Activity 1.3 (Drought Data Exchange Platform – EDO), and development of Dniester River Basin agro-climatic zoning as part of transboundary river basin management planning that addresses climate change.
3) National level: in Ukraine, agro-climatic zoning that was developed in 1986 required revision, taking into account the actual climate change trends for the last 30 years. Forecasting models used in Ukraine since the 1990s required adaptation to climate change and the application of EU drought indexes (SPI). The development of recommendations/measures for farmers and authorities was prepared to support proactive drought management approach.

The objectives of this activity were achieved as follows:

- Agro-climatic zoning of Ukraine's territory and the joint Moldova-Ukraine Dniester River Basin was updated, based on climatic trends defined over the last 30 years
- Drought-prone areas were identified by developing drought risk maps for Ukraine's agro-sector and the Dniester River Basin
- Drought-related yield loss forecasting models were upgraded for winter wheat and spring barley, taking into account climatic trends and introducing EU indexes in Ukraine
- Recommendations and good practices related to moisture conservation in agricultural lands in Moldova, and for crop-drought management in Ukraine, were provided: these contributed to the development and exchange of agricultural and drought management practices in the GWP CEE region
- Awareness about agro-drought management was raised among approximately 30 farmers in Moldova, and 10 farmers and 50 decision makers in Ukraine

Implementation process and methodologies applied

1. Observation data from 186 stations for the 1961-2014 period were collected and analysed, and the main climatic trends for the territory of Ukraine were defined. Climatic observation data from 12 Moldovan and 8 Ukrainian hydrometeo-stations were collected and analysed for the Dniester River Basin.
2. Agro-climatic trends for 140 stations for the 1961-2014 period covering all of Ukraine, and data from 20 stations for the Dniester River Basin, were analysed. Agro-climatic trends for the Moldovan area of the Dniester basin were identified.
3. Maps on new agro-climatic zones for all of Ukraine and the Dniester basin (including the Moldavian part) were developed.
4. A comparison of EU indexes with national climate indexes, based on WMO guidelines (using a Standardised Precipitation Index), was applied in Ukraine and partly in Moldova (Dniester River Basin), and the results were uploaded to the **European Drought Observatory**.
5. Forecasting models for the identification of crop yield losses, caused by drought for winter wheat end spring barley, were upgraded. Droughts impacts, calculated for seven meteo-agro parameters, on crop yield were assessed through the application of "Automatic Drought Assessment in Ukraine". Updated models for 25 administrative units for the entire vegetation period were tested.

6. New agro-climatic zoning and recommendations were published and used for awareness raising at a workshop and at NPDs (national policy dialogues performed during consultation meetings with rural, sectoral authorities) in various locations throughout Moldova and Ukraine.

The main administrative challenge was insufficient coordination between Ukraine and Moldova in joint reporting and in organizing joint workshops, while cooperation in data collection for the maps was successful.

In addition, the allocation of finances and time was not always sufficient to achieve this activity's ambitious objectives, and this resulted in overloading the experts – for example, Ukrainian experts had to work with a huge amount of long-term uninterrupted observation data for the entire territory of Ukraine covering 603 km2. To increase the effectiveness of such projects, Ukrainian partners (e.g. UkrHydroMetCentre) need to improve their hardware and software, or pilot project tasks and areas should be limited in accordance with available resources.

Output/Results

- Climate-zoning of the territory of Ukraine and the Dniester River Basin, shared between Moldova and Ukraine, was upgraded in the context of increased drought risk caused by climate change. This was based on an analysis of climate change trends related to agricultural droughts and soil-water retention capacities.
- Drought risk maps for the agricultural sector of Ukraine and the Dniester River Basin, including the identification of drought-prone areas, were produced. New agro-climatic zoning maps, for the vegetation period from May to September (Hydrothermal Coefficient HTC 5-9) and from May to June (HTC 5-6), were developed for Ukraine. A comparative analysis of HTC 5-9 for the periods of 1961-1990 and 1991-2013 showed that, during the active vegetation period in Ukraine, an amplification of climate aridity was observed in areas that previously had sufficient moisture. A comparative analysis in Moldova showed that the main problem with crop cultivation was associated with increasing temperatures in the summer, while precipitation had become more torrential. For these conditions, proposals for erosion reduction and moisture conservation were discussed and summarised and a related guide was prepared.
- Forecasting models were upgraded for the identification of yield losses, for two crops, caused by droughts in Ukraine. The models were adapted to climate change by using Outputs 1 and 2 (above) and a recalculation of the temperature, precipitation, air saturation deficit, and productive water supply norms for different soil layers for winter wheat end spring barley. Updated models were tested based on actual data (% reduction of yield) at the level of the administrative regions.
- Proposals for precipitation harvesting and practices for moisture conservation on agricultural lands were developed: Moldavian partners conducted research on the lands of the Institute of Soil Conservation and used statistical data accumulated in the country.
    - **Guide on best practices on soil conservation in Moldova** (in **Romanian** and **Russian** language)
- Remedial measures for the agricultural sector to mitigate the negative effects of drought were developed and disseminated. Agro-climatic zoning of Ukraine in the context of climate change, and recommendations for farmers, were published in Ukrainian and disseminated at a workshop and national dialogues on drought management in Ukraine. A guide on moisture conservation in soils was developed and published in Russian and Romanian languages. A poster with the mapping of agro-climatic zones in the Dniester River Basin was also prepared for publishing.
- Awareness was raised, among policy makers and stakeholders, about drought management and planning through dissemination activities. Results were presented at workshops and a national stakeholder dialogue in Ukraine, and at consultation meetings and workshops in Moldova.
    - **Publication for farmers on agroclimatic zoning in Ukraine**
    - **Seminar** "Drought Management — Practical Aspects for Farm Enterprisers" in Poltava

Added value

The updated instruments for drought monitoring and management were developed and are now in use for operational work and forecasting by UkrHydroMetCentre.

- Local rural authorities and farmers need concrete projects for the mitigation of droughts. Relevant proposals should be presented in the programme of measures developed on the basis of WMO recommendations and the SPI.
- Drought management activities should be part of rural development plans.

Regarding transferability, the results will be presented in the Atlas for SPI, which will be used for the development of the programme of measures in Moldova to support implementation of the climate change adaptation strategy approved by the government in 2014.

Basic info

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Moldova	Dr. Ecaterina Kuharuk, Dumitru Drumea

6. EU drought projects – examples and good practices

Very dry areas across the globe have doubled in extent since the 1970s. For example, long-term drying trends persist in Africa, East and South Asia, eastern Australia, southern Europe and Brazil. More climate change will make conditions even worse. Today in Europe, general water research questions related to drought are:

- Maintaining ecosystem (including agro-ecosystem) sustainability
- Developing safe water systems for citizens
- Promoting competitiveness in the water industry
- Implementing a water-wise, bio-based economy

The EU research programs dealing in water are HORIZON 2020 and the Work Programme 2014-2015. Some projects are described below.

Water scarcity and droughts; coordinated actions in European regions (Water CoRe)

The INTERREG IVC project, WATER CoRe (Water scarcity and droughts; coordinated actions in European regions), provides an exchange platform on water scarcity and drought issues. Due to climate change effects, water scarcity is foreseen to affect EU citizens ecologically, economically and socially at the local and regional levels. New and coordinated strategies and policies are required to mitigate climate change impacts. Thus, the main objectives of this project are to exchange experiences and transfer good practices between regional partners in the project, and to improve topic-related management standards across Europe. WATER CoRe involves 14 partners from 7 EU Member States.

The best practices are collected in a Handbook, the knowledge core of the project. Experiences are organised in five thematic sections covering all of the main WATER CoRe topics. Project partners were involved in identifying and collecting regional experiences through the establishment of five working groups. Specific selection criteria were identified: consistency, exchangeability, repeatability, effectiveness, involvement, measurability, sustainability, completeness, clearness and conclusions. The process led to a selection of 103 good practices divided into five areas: technological measures (37), economic and financial instruments (11), drought management (13), climate change (26), and communication and participation (16).

Duration: 2007- 2013

Link: **www.watercore.eu**

Main outputs: **Survey on Water scarcity and droughts in Europe; Best practices Handbook; Good practices guide**

Funding Programme: INTERREG IVC

Partners: **http://www.watercore.eu/partners.asp**

Fostering European Drought Research and Science-Policy Interfacing (DROUGHT-R&SPI)

The DROUGHT-R&SPI project is enhancing the understanding of:

- Drought as a natural hazard, including climate drivers and drought-generating processes and occurrences
- Environmental and socio-economic impacts
- Vulnerabilities, risks and policy responses, including the further development of drought management plans in support of EU and other international policies (e.g. UN/ISDR-HFA)

This project addresses the past and future climate and links science and science policy dialogue across a range of levels and affected sectors.

The interactive transfer of knowledge and information across different levels-- local, river basin, national and pan-European-- is a key issue in DROUGHT-R&SPI. Drought risk reduction strategies require context-specific analyses of options, in accordance with a variety of potential constraints and opportunities, including time, cost, technical feasibility, equity, effectiveness, acceptable levels of risk, as well as the overall institutional, legal, environmental and socio-cultural context. Long-term risk reduction requires that measures for improving preparedness are complemented with long-term strategies, designed to reduce underlying vulnerabilities. These need to be integrated into local development plans. DROUGHT-R&SPI will achieve this through methodology development in selected case studies in water-stressed regions across Europe. DROUGHT-R&SPI will also, for the first time, link pan-European drought research with detailed case study vulnerability assessments.

The case studies include:

- The Po River Basin in Italy, where past drought episodes have resulted in extreme pressures on the river basin system. These affected downstream demands, energy production and agriculture and incurred economic damages exceeding 1.3 billion €.
- The Jucar River Basin in Spain is one of the most vulnerable areas in the western Mediterranean due to the high water exploitation index and environmental and water quality issues. Due to the prioritization of water uses, past drought episodes have primarily affected agriculture and hydroelectricity, and have also had significant economic impacts across all water use sectors.
- On Syros Island, in the Cyclades complex in Greece, drought impacts primarily concern local ecosystems, environmental quality and agriculture. The latter is an important part of the local economy and a pillar in enhancing balanced, sustainable economic development.
- In Portugal, the 2004-2005 drought episode had a pronounced impact on all economic sectors and the environment and resulted in the second worst wave of wildfires in the country's history, destroying more than 325,000 hectares.
- In Switzerland, the impacts of the 2003 drought affected agriculture, navigation, energy production, and ecosystems, and motivated authorities to seriously consider the country's vulnerability to drought events, which are expected to become more severe as a result of climate change.

Duration: 2011 – 2015

Link: **http://www.eu-drought.org/**

Main Outputs: **Technical reports**; **Case studies**; **Science-policy briefs**

Funding Programme: Seventh Framework Programme

Partners: **http://www.eu-drought.org/projectpartners**

Drought Management Centre for Southeast Europe (DMCSEE)

DMCSEE coordinated the development and application of drought risk management tools and policies with

the goal of improving preparedness and reducing drought impacts. It provided real-time regional information on drought situations. Using a common methodology for drought analysis and impact assessment, the project obtained regionally comparable results that enabled a better overview of the drought situation for sectors that are economically dependent on water availability, such as agriculture, energy and tourism.

Duration: 2009- 2012

Link: **http://www.dmcsee.eu/**

Main Outputs: **GIS application showing climatological and vulnerability maps as input for drought risk assessment; Drought risk assessment; Report on adapting Palfai Drought Index for applicability in whole SEE area; Study on developing irrigation scheduling system and tools for case study areas**

Funding Programme: South-East Europe Transnational Programme

Countries: Slovenia, Hungary, Bulgaria, Greece, Croatia, Serbia, Montenegro, FYROM, Albania

An exercise to assess research needs and policy choices in areas of drought (XEROCHORE)

XEROCHORE SA aims to mitigate and adapt to droughts, and to reduce their risks in Europe. It compiles a roadmap that includes: 1) a state-of-the-art review and identification of the research gaps related to the natural system, impact assessment, policy-making and integrated water resources management, and; 2) an assessment of the possible impacts of droughts and guidance on appropriate responses for stakeholders.

Link: **http://www.feem-project.net/xerochore/**

Main outputs: **Result in Brief**; **Final report summary**

Funding programme: Seventh Framework Programme

Partners: **http://www.feem-project.net/xerochore/partners-1-0.php**

Water Management Strategies against Water Scarcity in the Alps (ALP-WATER-SCARCE)

The main challenges of ALP-WATER-SCARCE are to create local Early Warning Systems against Water Scarcity in the Alps. This system is based on sound and long-term monitoring and modelling and anchored strongly and actively within a Stakeholder Forum linked across comparative and contrasting regions across the Alps.

Duration: 2008- 2011

Link: **www.alpwaterscarce.eu**

Main Outputs: **Final achievements summary**

Funding Programme: Alpine Space Programme

Countries: Slovenia, Italy, France, Switzerland

Mediterranean Drought Preparedness and Mitigation Planning (MEDROPLAN)

This project's main objective is to create Guidelines for Drought Preparedness Plans. It is expected that the Guidelines will provide partner countries with an integrated approach for minimising the impacts of drought on people and resources, and for changing the approach to managing drought from the current "crisis management" attitude to more proactive "risk management". The Guidelines will be adapted to the physical and socio-economic environment of the Mediterranean countries and their elaboration will follow a common methodology. Another important objective of the project is to provide the framework for setting up a Drought Preparedness Network for the Mediterranean countries.

Link: **http://projects.iamz.ciheam.org/medroplan/index.htm**

Main outputs: **Drought Management Guidelines**; **Tutorial of the Drought Management Guidelines;**

Funding Programme: EuropeAid Co-operation Office-European Commission under the MEDAWATER PROGRAMME initiative

Countries: Spain, Cyprus, Greece, Italy, Morocco, Tunisia

Climate of the Carpathian region (CARPATCLIME)

The main aim of the project is to improve the basis of climate data in the Carpathian Region for applied regional climatological studies such as a Climate Atlas and/or drought monitoring, to investigate the fine temporal and spatial structure of the climate in the Carpathian Mountains and the Carpathian basin with unified methods. Therefore, a freely available, high resolution gridded database has been produced for the Larger Carpathian Region (LCR).

Link: http://www.carpatclim-eu.org/pages/home/
Main outputs: Climate Atlas of the Carpathian Region
Partners: http://www.carpatclim-eu.org/pages/partners/

MIDMURES

MIDMURES is a pilot project on development of prevention activities to halt desertification in Europe. This topic will be achieved by incorporating interdisciplinary team of researchers from four Romanian partner organizations – the National Meteorological Administration, the National Research and Development Institute for Soil Science, Agricultural Chemistry and Environment, the National Institute of Hydrology and Water Management and the National Institute for Aerospace Research "Elie Carafoli". This approach makes use of the advantages of the international cooperation, joined efforts and complementary expertise of the partners.

The main objective of the MIDMURES Project is to test specially designed technologies, techniques or practices in order to decrease the drought effect in the Mures River Basin.

Link: http://midmures.meteoromania.ro/index.php
Countries: Romania

7. CONCLUSIONS

7.1. Main achievements of the IDMP CEE from 2013 to 2015

GWP CEE started implementation of the IDMP CEE in February 2013. During the first phase of the programme (2013 – 2015), GWP CEE experts and partners prepared several guidance documents and publications. Within the programme, some new concrete approaches, which focused especially on the agricultural sector as one of the most vulnerable to drought, were tested and described in five demonstration projects.

Through different dissemination activities (e.g. videos, photo competitions, articles, specialized thematic publications), the Programme aimed to increase awareness of drought issues in Central and Eastern Europe, by communicating the knowledge gathered and supporting the Programme in reaching politicians, governmental authorities and the general public.

An essential part of the Programme was the involvement of the key policy makers in more than twenty National Consultation Dialogues in ten countries. The main purpose of the dialogues was to discuss the current status of drought management in each country, identify strong and weak areas, and examine how IDMP CEE results could be used at the national level to help improve all aspects of drought management, such as monitoring, risk assessment, and response. Other stakeholders, such as farmers, were also involved in the Programme through several workshops, during which experts presented practical applications of their work.

Some of the main achievements of the IDMP CEE in the 1st phase of the implementation are:

- Concise overview of the situation regarding drought management in CEE
- Guidance document for preparation of the Drought Management Plan in connection with the EU Water Framework Directive and global directions
- Communication links between the experts and policy makers active in drought management at the country level
- Increased capacity of the key actors to implement the entire process of preparing a Drought Management Plan in their own countries
- Collection of existing drought monitoring indices, methods, and approaches from the CEE region, and the establishment of a link and integration of data into the European database and monitoring service (European Drought Observatory)
- Demonstration of new, innovative approaches in drought management linked to:
  - how to increase soil water holding capacity;
  - how droughts impact forests and types of measures to avoid such impacts;
  - how Natural Small Water Retention Measures can be used for flood prevention, and also to help retain water in the land during wet periods to make water available for ecosystems, agriculture, and forests during drought periods in river basins;
  - an example of a framework for an integrated drought risk management system that can be applied to different drought contexts;
  - how remote sensing data can be used as a drought monitoring method; and
  - upgraded drought monitoring and forecasting in Ukraine and Moldova.
- Connections, and exchanges of information and results, with organizations in the region that deal with similar issues.

7.2 IDMP CEE in the next phase (2016 – 2019)

GWP CEE partners developed a new three-year work plan through which IDMP CEE will continue to build the capacity of the CEE region to change ad-hoc drought responses into pro-active drought management. This will be achieved by introducing recently developed monitoring and risk assessment tools and integrating drought resilience into regional/national development plans.

Drought monitoring will be improved with the integration of all available data, including a large volume of the most recent remote sensing data. Apart from a more timely warning of impending drought, a risk analysis is required to effectively reduce its effects. IDMP CEE will harmonize the heterogeneous methodologies for risk and impact assessments, based on existing applications in participating countries and on EU guidelines within the framework of the EU Civil Protection Mechanism. User capacities at different levels (policy, professional, stakeholders) in the management cycle will be strengthened through knowledge sharing and capacity building activities.

The main expected results of the next phase are:

- establishment of efficient and operational drought management procedures in the CEE region leading to the improvement of drought monitoring and a unified analysis of drought impacts and risk assessments for the whole region;

- overcoming gaps in decision-making processes in drought management, improving dialogue between the scientific and policy-making communities, and increasing knowledge about EU policy instruments and their relevance to the implementation of drought policy in CEE;
- increased knowledge and capacities regarding operational and strategic capacity to monitor, forecast, evaluate and respond during the onset of droughts, and improved capacity to analyse data faster and with more accuracy; and
- better access to information and products, and enhanced accessibility of IDMP CEE knowledge and outputs to all stakeholders across sectors.

8. References

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- UNCCD, 1994. URL: http://www.unccd.int/Lists/SiteDocumentLibrary/conventionText/conv-eng.pdf
- European Commission, 2007: Drought Management Plan Report Including Agricultural, Drought Indicators and Climate Change Aspects (Water Scarcity and Droughts Expert Network), Technical report 2008-023, November 2007. URL: http://ec.europa.eu/environment/water/quantity/pdf/dmp_report.pdf

Annex 1

Desertification is defined as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, such as climatic variations and human activities. Drought is defined as the naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems (UNCCD, 1994).

Desertification and drought are closely related phenomena and have similar consequences for the environment: as such, they are often used interchangeably. Persisting over months or years, drought can affect large areas and may have serious environmental, social and economic impacts. While drought is a natural phenomenon, land degradation is the process of turning fertile land into less or non-productive land. In extreme cases in drylands, this is called desertification. Land degradation and desertification are complex phenomena driven by human activity in combination with land and climatic constraints. Inappropriate land use and unsustainable land management practices, such as deforestation, unsuitable agricultural practices and overexploitation of water resources, can cause land degradation that can be further aggravated by drought. This is why drought management plans are so important in practice.

A Drought Management Plan (DMP) is a planning document that supplements a River Basin Management Plan developed as a part of planning cycles in accordance with the WFD.

In addition, most EU countries, including CEE countries, are also parties to the United Nations Convention to Combat Desertification (UNCCD) and are therefore responsible for preparing **National Action Programmes (NAPs)** to combat desertification. These two documents are therefore connected with each other while some relevant chapters of a DMP are actually included in the NAP.

Some countries within and outside the CEE region have already prepared DMPs or NAPs. In some countries, these “drought plans” have been accepted at the policy level and are being used to proactively manage drought. Several such plans are presented below as examples of good practice for countries still in the preparation phase – for comparison and eventually deciding on whether a chosen DMP model is applicable to their national situation.

The review below provides important data and information about each chosen plan, as well as links and additional information.

Greece – National Action Plan for Combating Desertification

Main sections

- Desertification factors in Greece (climate, physiography, geology, soil, hydrology)
- Desertification processes in Greece (reduction of rootable depth, reduction of available water, soil chemical degradation)
- General measures to prevent and mitigate desertification (determination of threatened areas, information and awareness, agencies for the implementation and monitoring of measures, land use planning, financial sources, international cooperation, selection of pilot areas, restoration of desertified areas, research, legal and institutional measures)
- Measures concerning the agricultural sector (current situation, soil erosion control, measures for drought conservation of soil water, measures for secondary salinization of irrigated soils, implementation of proposed measures, research)
- Measures concerning fauna (current situation, protection from over-grazing)
- Measures concerning the stock-raising sector (current situation, protection from over-grazing)
- Measures concerning the water resources sector (current situation, institutional measures, measures for irrigation, measures for urban and industrial water use, measures for increasing available water, research)
- Measures concerning the socio-economic sector (socio-economic measures against desertification)
- General instructions for the implementation of the action plan (integrated approach, temporal and spatial programming of measures and actions, synergies with UN Conventions on climate and biodiversity)
- Main issues

Specifics

- In the Greek Government's strategy for the primary sector of the economy and rural development, infrastructure and water resources play an important role. The Government takes all necessary measures to combat desertification at the national and local levels, being aware of the seriousness of this phenomenon, and always seeks the consent and cooperation of involved agencies.
- Table of preventive measures to combat desertification
- Table of corrective measures to combat desertification (desertified and/or severely degraded areas)

Link (UNCCD Web page)

http://www.unccd.int/ActionProgrammes/greece-eng2001.pdf

Date of ratifying the UN Convention for Combating Desertification: 5.5.1997

Number of pages: 34 (extended summary)

Italy – National Action Programme to Combat Drought and Desertification

Main sections

- National Action Programme
- Regional programs and those of Mediterranean Basin authorities
- National activities
- Regional Action Programme of the European Mediterranean Countries (Annex IV of the UNCCD)

Specifics

- The priority sectors of the regional programs are: soil protection, sustainable management of water resources, reduction of environmental impact from productive activities, and land restoration.
- The Guidelines of National Action Programme to Combat Drought and Desertification identify the following possible measures for information, training and research:
  - development of public information programs by government offices
  - promotion of information campaigns by public and private enterprises and associations through accords with government offices

- survey of research activity in Italy on drought and desertification
- analysis and evaluation of strategies to prevent and combat drought and desertification
- study of the causes and processes of desertification and the evolution of the phenomenon in Italy
- evaluation of the environmental, social and economic implications and consequences of drought and desertification
- development of research programs in association with the international scientific community and international programs
- dissemination of know-how and new acquisitions in scientific research
- scientific and technical support for government offices
- extensions of information to other countries in the Mediterranean Basin
- support for strengthening the clearing-house mechanism
- an inventory of traditional know-how and technologies aimed at their reproduction with modern techniques

- Strategies which have been identified by the Italian Development Cooperation to combat drought and desertification in developing countries.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/italy-eng2000.pdf
Date of ratifying the UN Convention for Combating Desertification: 23.6.1997
Number of pages: 9

Portugal – National Action Programme to Combat Desertification

Main sections

- Introduction
- Desertification in Portugal – diagnosis of the current situation
- Strategic objectives of the National Action Programme to Combat Desertification
- Strategic objectives
- Specific objectives
- Axes of intervention and operational guidelines (soil and water conservation, keeping the working population in rural areas, recovery of areas most threatened by desertification, research, experimentation and diffusion, ensuring that desertification is included in development policy)
- Implementation, monitoring and assessment
- Areas sensitive to desertification

Specifics

- The National Action Programme to Combat Desertification envisages the following five strategic objectives: soil and water conservation; fixing the working-age population in rural areas; recovery of affected areas; campaigns to raise public awareness of the issue of desertification; and making the fight against desertification an integral part of general and sectorial policy.
- The guidelines for the implementation of the National Action Programme to Combat Desertification derive from the strategic objectives adopted, and also from their being part of a framework which is being applied world-wide by the United Nations Convention to Combat Desertification and Drought.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/portugal-eng1999.pdf
Date of ratifying the UN Convention for Combating Desertification: 1.4.1996
Number of pages: 10

Turkey - National Action Program on Combating Desertification

Main sections

- Introduction
- Definitions, principles, approaches and objective
- Desertification risks in Turkey (topography and erosion)
- Desertification in Turkey
- Approaches and principles towards establishing the framework of sustainable land management
- Measures to solve problems on natural resources management
- Methods, tools and criteria to prevent desertification and reduce its effects

Specifics

The main principles taken into consideration for developing the Turkish National Action Programme are:

- Stating the spatial distribution of desertification and its level.
- Identifying ecosystems which need primary protection and placing related reclamation initiatives in the agenda.
- Analysing current environmental protection and sustainable use policies and identifying gaps and deficiencies.
- Identifying scientific, economic, social and technical criteria in new and/or additional policies.
- Informing the public through various types of publications and broadcasting for creating or increasing public awareness on desertification.
- Providing for the effective participation of all related public institutions, local administrations, civil society organisations, local communities and other groups at the local, regional and national levels to combat desertification.
- Establishing national strategies to mitigate the impacts of desertification and land degradation.
- Developing sustainable land and water use, protecting biodiversity areas and preventing social conflicts.
- Establishing early warning systems through centralized information networks.
- Networking with other countries to improve information flows.

Link (UNCCD Web page)

http://www.unccd.int/ActionProgrammes/turkey-eng2006.pdf

Date of ratifying the UN Convention for Combating Desertification: 31.3.1998

Number of pages: 20

Slovenia – National Action Plan (Draft)

Main sections

- Review of existing National Action Plans – Mediterranean countries, Central and Eastern European countries, United States, United Kingdom
- Responsibility for drought management in Slovenia
- Drought status in South-East Europe
- Monitoring and early drought management (drought observatories, current status in Slovenia)
- Processes in drought management (past national revisions, drought in Slovenia, drought prevention, elimination of drought consequences, combination of drought actions, summary, recommendations, reduction of the sensitivity of agricultural production to drought; report on the corrective actions of the Ministry of Agriculture, Forestry and Food)
- Proposal of a drought management plan
- Legislative framework (review of Slovenian drought and water laws, good practices)

- Suggestions and ideas

Specifics

- The draft National Action Plan of Slovenia, written in Slovenian language, is now being implemented. It includes a well-written review of some other countries and an effective proposal, through (figures), of responsibilities and proposal how drought management in Slovenia should be organized. (see below figure: Current status of drought management in Slovenia).

Link

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Date of ratifying the UN Convention for Combating Desertification: 28.6.2001

Number of pages: 140

Armenia - National Action Programme to combat Desertification in Armenia

Main sections

- Natural and climatic conditions in Armenia (geographic description relief, vertical zoning, climate, geological structure, soils, hydrology, flora, fauna)
- Socio-economic conditions and natural resources in Armenia (legislation in the Republic of Armenia, the population and settling characteristics, territorial division, settlements, general trends of economic development, social security issues, industry, agriculture, energy sector, land resources, water resources, biological resources, mineral resources, specially protected natural areas, recreation, economic mechanisms of nature use)
- Desertification in the Republic of Armenia (desertification criteria and factors, peculiarities of landscape desertification)
- Socio-economic consequences of desertification (correlation of desertification and economy, economic and environmental predictions for desertification)
- Strategy trends of actions to combat desertification in Armenia (enhancement of legislation and management system, economic development, improvement of economic mechanisms for natural resources management, conventions related joint actions, international cooperation)
- The role of education and science in combating desertification (environmental education issues, scientific research)
- Public participation in combating desertification (provision of public awareness, provision of public participation in decision-making and implementation of actions, public stakeholders)
- Priority projects of local importance (recovery of lands subject to desertification in the Garni community in the Province of Kotayk of the Republic of Armenia, Goris River non-structural mudflow mitigation in the Province of Syunik of the Republic of Armenia, project for engineering and geological survey of the site of Makaravank memorial complex in the Tavush Province of the Republic of Armenia, mitigation and neutralization of harmful impact of the Shamlugh tail storages in the Syunik and Lori provinces of the Republic of Armenia)
- Mapping of areas subject to desertification (methods of computer-based mapping of areas subject to desertification, land cover, seismic situation in Armenia, natural fodder holdings, forests, landslide dangerous areas, mudflow riskiness in river basins, Lake Sevan problem, desertification on the Territory of Ra, computer-making maps)

Specifics

Strategy Trends of Actions to Combat Desertification in Armenia

- This scientific analysis identified the problems of desertification in Armenia and their causes. Comprehensive measures aimed at improving the existing socio-economic situation in the country could essentially contribute to the liquidation or mitigation of desertification through the following: enhancement of the legislative and management system, improvement of the economy, and enhancement of mechanisms for nature use.
- The system of comprehensive measures completely reflects the nature of international commitments undertaken by the Republic of Armenia in different sectors, especially environmental conventions, such

as the UN Convention on Biological Diversity, UN Convention on Climate Change, and UN Convention to Combat Desertification. The following measures are therefore essential for the termination or reduction of desertification processes in Armenia: development and implementation of joint projects within the framework of the conventions, and regional and sub-regional cooperation.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/armenia-eng2002.pdf
Date of ratifying the UN Convention for Combating Desertification: 2.7.1997
Number of pages: 196

Georgia - National Action Programme to Combat Desertification

Main sections

- Introduction
- Strategic principles
- Main objectives
- Georgia: brief information on physical and geographic features
- Georgia's arid and semi-arid regions – areas that are the most vulnerable to desertification
- Characterisation of arid and semi-arid territories
- Factors contributing to desertification in arid and semi-arid areas
- Condition of arid and semi-arid ecosystems
- Analysis of anthropogenic factors occurring in arid and semi-arid areas
- Analysis of economic sectors
- National plan of action to combat desertification
- Economic mechanisms to combat desertification
- Preserving biological diversity against the background of desertification processes
- Raising public environmental awareness
- Monitoring desertification
- Desertification and agriculture

Specifics

Georgia's strategy to combat desertification shall be based on the following principles:

- It is necessary to identify the basic regional causes of desertification in Georgia, as well as their contributing factors, and to design practical measures and inputs that are essential for combating desertification and mitigating the effects of droughts.
- Decisions shall be taken on the strength of firm scientific evidence (principle of reasoned and informed decisions).
- In order for the action to combat desertification to be effective, it is necessary to carry out systematic research and monitoring.
- Preventive measures shall be taken without delay when there are reasonable grounds for concern that there is a risk of desertification, even when there is no conclusive evidence of causal relationships (precautionary principle).
- Action to combat desertification shall be based on the conservation of biological diversity and landscape protection.
- Projects that may have a potential negative environmental impact shall necessarily envisage environmental impact assessment (principle of avoidance).
- Activities that cannot be avoided, and that are particularly damaging for biological diversity and landscape, shall be carried out in less risky areas (principle of translocation).

- If it is impossible to avoid detrimental effects of physical changes in areas of special value in terms of their biological diversity and landscape, then they shall be balanced by compensatory conservation measures (principle of ecological compensation).
- Action to combat desertification shall make use of the best available technologies and methods of environmental protection; the provision of access to technologies and to the transfer of technologies is an important element of action to combat desertification.
- In respect of any action that triggers desertification processes, control costs and damages shall be paid by the responsible party (polluter pays principle).
- Action to combat desertification shall involve the local public, land owners, academic community, other stakeholders and civil society groups (principle of transparency and public participation).
- A special role in the action to combat desertification shall be assigned to the Government of Georgia, so that it is aware of its ultimate responsibility for the protection of the country's biological health for present and future generations.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/georgia-eng2003.pdf
Date of ratifying the UN Convention for Combating Desertification Ratification: 23.7.1999
Number of pages: 34

The Republic of Moldova - National Action Plan to Combat Desertification

Main sections

- Introduction
- Programme background (climatological factors as desertification intensifiers)
- Strategy to combat desertification (promotion of sustainable policies in the use of natural resources; social, economic, political and demographic background to preserve natural resources and to combat desertification; legal and institutional framework; scientific and information support in desertification control; scientific support for evaluation, prevention and combat of desertification; desertification monitoring)
- Strategic Action Plan to combat desertification and financial costs
- References

Specifics

- The National Action Programme to Combat Desertification must:
  - incorporate a long-term strategy to combat desertification and mitigate the effects of drought.
  - emphasize implementation and be integrated with the national policy for sustainable development.
  - allow for modifications to be made in response to changing circumstances and be sufficiently flexible at the local level to cope with different socio-economic, biological and geo-physical conditions.
  - give particular attention to the implementation of preventive measures for lands that are not yet degraded or which are only slightly degraded.
  - enhance national climatological, meteorological and hydrological capabilities and means to provide for drought early warning.
  - promote policies and strengthen the institutional framework which develops cooperation and coordination, in a spirit of partnership, between donor community groups; and facilitate access by the local population to appropriate information and technology.
  - provide for effective participation, at the local, national and regional levels, of non-governmental organisations and the local population, particularly resource users, including farmers and pastoralists and their representative organisations, in planning, decision-making, implementation and analysis of the National Action Programme; and require regular related reviews and progress reports.
- The main measures in the environmental protection area.

- Information on budget estimation and/or total cost of expected actions.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/republic_of_moldova-eng2000.pdf
Date of ratifying the UN Convention for Combating Desertification: 10.3.1999
Number of pages: 26

Romania – National Strategy and Action Programme Concerning Desertification, Land Degradation and Drought Prevention and Control

Main sections

- General physico-geographical characteristics of Romania and peculiarities of regions with desertification, land degradation and drought
- Factors which generate desertification, land degradation and drought
- Effects of the factors responsible for desertification, land degradation and drought
- Identification and delimitation of the areas affected by desertification, land degradation and drought
- The strategy of desertification, land degradation and drought prevention and control
- Action Programme concerning desertification, land degradation and drought prevention and control

Specifics

None

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/romania-eng2000.pdf
Date of ratifying the UN Convention for Combating Desertification: 19.8.1998
Number of pages: 117

Spain – Programa de Accion Nacional Contra la Desertification

Main sections

- Objectives for the fight against desertification (objectives for the programme, definitions)
- Diagnostics for Spain's situation (desertification factors in Spain, actions for the fight against desertification in Spain, agriculture sector, forestry sector, rural sector)
- Proposal for actions (elements of the national policy for the fight against desertification)

Specifics

This well-prepared programme, based on desertification and not drought, includes many good proposals and ideas which can be used by other countries. Its three-part structure is also a good model. However, translation of the programme into other languages is needed.

Link (UNCCD Web page)
http://www.unccd.int/ActionProgrammes/spain-spa2008.pdf
Date of ratifying the UN Convention for Combating Desertification: 30.1.1996
Number of pages: 190

United Kingdom - Drought Plan

Main sections

- Drought Plan Framework
- Regional Overview

- Drought Management Strategy
- Drought Triggers and Scenarios
- Drought Forecasting
- Drought Measures to Manage Supply and Demand
- Minimising the Impact of Drought on the Environment
- Drought Management and Communications Plan
- Post Drought Actions

Specifics

- The Anglian Water Drought Plan 2013 was produced to comply with the statutory requirements introduced in the Water Act 2003, the Drought Plan Direction 2011 and Environment Agency guidelines. The purpose of the drought plan is to demonstrate how public water supplies will be protected during a drought, while minimising any potential environmental impacts that may arise as a result of response activities. This draft Drought Plan 2013 was prepared in response to comments received following consultation on the draft Drought Plan 2012.
- The Anglian region is the driest region of England and the drought plan draws on extensive experience in managing four drought periods since privatisation in 1989.
- The Drought Plan is not strategic but outlines a framework for managing a drought if it occurs under current circumstances with existing infrastructure. The drought management process is laid out in the Drought Plan flow chart which also sign-posts the relevant sections of the plan.
- The Drought Plan was developed in accordance with the requirements of the Water Industry Act 1991 to describe how a 'water undertaker will continue, during a period of drought, to discharge our duties to supply adequate quantities of wholesome water, with as little recourse as reasonably possible to drought orders or drought permits'. Drought Management Strategy: Part Three of the Drought Plan presents the strategy and technical detail around how public water supplies will be managed during the onset and prevailing conditions of a drought.

Link (UNCCD Web page)

http://www.anglianwater.co.uk/_assets/media/Draft_Drought_Plan_2013_FINAL.pdf

Date of ratifying the UN Convention for Combating Desertification: 18.10.1996

Number of pages: 122

Integrated Drought Management Programme in Central and Eastern Europe