

Water Scarcity and Drought:

towards a European Water Scarcity and Drought Network (WSDN)

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July 2009

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HISTORY

Origin/Name of document (if different)	Version	Date	Prepared/UpdComments ated by
RpD_GapAnalysis_080728.doc	Draft	28/07/08	Jaume Fons, Agreed structure with NTUA. Alejandro Iglesias ETC/LUSI
GapAnalysis_outline_28.07.08.doc	Draft	28/07/08	Maggie Kossida, Update of the structure ETC/Water
GapAnalysis_outline_28.07.08_bw e.doc			Beate Werner, BWE EEA comments on the structure
GapAnalysis_outline_30.07.2008	Draft	30/07/08	Maggie Kossida Incorporated comment from BWE, ETC/Water Formulated Chapter 1 to be edited by ETC/LUSI
GapAnalysis_outline_30.12.2008	Draft	30/12/08	Maggie Kossida ETC/Water
GapAnalysis_WSD_072009	Final	07/2009	Ifigenia Koutiva Maggie Kossida ETC/Water

LIST OF ACRONYMS

ETC LUSI	European Topic Centre Land Use and Spatial Information
ETC Water	European Topic Centre Water
NTUA	National Technical University of Athens
UAB	Autonomous University of Barcelona
UNCCD	UN Convention to Combat Desertification

LIST OF ABBREVIATIONS

EDO	European Drought Observatory
DMP	Drought Management Plan
DPSIR	Drivers – Pressures – State – Impact – Response
SPI	Science Policy Interface
WS	Water Scarcity
WS&D	Water Scarcity and Drought
WSDN	Water Scarcity and Drought Network
WSDIS	Water Scarcity and Drought indicators System

GLOSSARY

Water Scarcity: The (long-term) imbalance between availability and demand for water. WS should not be viewed exclusively as a quantity problem: the degradation of groundwater and surface water quality, intersectoral competition, interregional and international conflicts, all contributes to water scarcity (FAO¹). Water Scarcity often has its roots in water shortage (drought), combined with population growth and economic development.

Drought: The term drought is used to define a temporary decrease in water availability due for instance to rainfall deficiency. Drought is an indistinct event, of water deficiency, that results from the combination of many complex factors and neither the beginning nor the end can be precisely defined, [COM (2007) 414]².

Indicators: Indicators are variables that describe the magnitude, duration, severity, and spatial extent of WS&D (typical indicators are based on meteorological and hydrological variables, such as precipitation, stream flows, soil moisture, reservoir storage, and groundwater levels). A more precise description and typology of indicators can be found in EEA (1999).

Indices: Several indicators can be synthesized into a single metric which will be called an *index*. An example of a simple index is the WEI index, which is formed on the basis of two indicators: water abstraction and water availability. An example of more complex indices are the US Experimental Blends.

¹ <http://www.fao.org/nr/water/issues/scarcity.html>

² COM (2007) 414, "Addressing the challenge of water scarcity and droughts in the European Union", COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL, COM(2007) 414 final, Brussels, 18.7.2007.



1 INTRODUCTION

With the **overall vision** to develop a coherent concept for water scarcity and drought observation and information in Europe this report aims to provide a first argumentation for the further needs to develop a European Water Scarcity and Drought Network (WSDN), taking into account existing activities of different actors (national and European authorities, networks, institutions and research community) and setting up the basis for joint actions and cooperation towards the common goal to prepare Europe for the increasing risk of water scarcity and droughts.

In June 2007, the Commission published its communication "Addressing the challenge of water scarcity and droughts in the European Union", [COM (2007) 414]². It stresses the importance of improving drought risk management through exchange of information and best practices, drought monitoring, efficient alert system, knowledge of the extent and impacts of water scarcity and drought. For that purpose, and to better serve the European community, reliable data and information collected and disseminated through a Water Scarcity and Drought Network also linked to a European Drought Observatory are suggested as key components of the way forward.

Furthermore, in the conclusions of the Informal Council Environment Ministers held in Lisbon September 2007 [Council of the European Union 13888/07]³ the need for increase of knowledge and wide exchange of experience to improve preparedness was underlined. Towards this direction arrangements for establishing a platform for data-collection and research activities, which is based on and closely interlinked with the existing structures and activities of the EEA, ESA, JRC⁵ and the Commission, are to be considered and this process may lead to the set up of a European Drought Observatory (EDO).

Several approaches and activities are currently ongoing in Europe to monitor and manage drought, water scarcity and desertification risk, both at national and European level. Several countries are monitoring drought or developing regional or national Drought Management Plans (DMP) (e.g. Spain, Portugal, UK, etc.), and at EU level various initiatives are implemented by different agents, centres and networks (e.g. Joint Research Centre – Institute for Environment and Sustainability (JRC-IES)⁴, Drought Management Centre for South-Eastern Europe (DMCSEE)⁵, European Drought Centre (EDC)⁶, Euro-Mediterranean Information System on know-how in the Water sector (SEMIDE/EMWIS)⁷, European Environment Agency (EEA)⁸, etc.). The supported activities deal with different aspects like drought observation and forecasting, indicator based information collection and dissemination, impact and risk assessments, development of mitigation measures like DMPs, development of policy framework etc., nevertheless the inter-linkages are significant; hence a good framework for cooperation, clear definition of roles and efficient joint use of information is vital.

The scope of the present report is to:

a) perform a Gap Analysis at National and European level in order to identify the different links and overlaps in terms of objectives, priorities, methodological approaches (e.g. mapping activities are relevant for forecasting as well as for the indicator development and DMP development), risk assessment and management, but also the gaps and missing corner stones towards the development of a coherent water scarcity, drought and desertification information system for Europe desertification.

³ 13389/07 ENV 486 DEVGEN 170 AGRI 307. Council of the European Union. Water Scarcity and Drought - draft Council conclusions. (<http://register.consilium.europa.eu/pdf/en/07/st13/st13888.en07.pdf>)

⁴ JRC-IES Action 22008 - DESERT: Desertification, Land Degradation, and Drought (Monitoring, Mitigation and Early Warning). (<http://desert.jrc.ec.europa.eu/action/php/index.php?action=view&id=-1>)

⁵ DMCSEE (<http://www.dmcsee.org/en/home/>)

⁶ EDC (<http://www.geo.uio.no/edc/>)

⁷ SEMIDE/EMWIS (www.emwis.net)

⁸ EEA (www.eea.europa.eu)

b) propose a structure for a European Water Scarcity and Drought Network (WSDN) that will bridge and coordinate the existing initiatives providing a better information, fostering synergies, promoting capacity building between scientists and the user community, and thereby increasing preparedness and resilience of the European society to drought, water scarcity and desertification

c) propose a DPSIR framework for drought and water scarcity to be populated with indicators (Water Scarcity and Drought indicators' System WSDiS) as dynamic part of the WSDN serving the purposes of observation and data harmonisation.

The specific objective of this report is to propose an articulated structure for a European Water Scarcity and Drought Network (WSDN) based on formulated conclusions drawn from the analysis on the main institutional, organisational and knowledge related problems in tackling water scarcity and drought problems in Europe in a coherent systematic European approach. The specific objectives are:

- Identify main stakeholders, authorities, agents etc. who manage and/or deal with water scarcity and drought issues
- Overview of ongoing activities on water scarcity and drought at national level (objectives, priorities, monitoring, management, mitigation)
- Overview of ongoing activities on water scarcity and drought at transnational and European level (vision, priorities, methodological approach, synergies, networking, etc.)
- Identify how water scarcity and drought are linked in different institutions, countries, transnational and EU level
- Identify information gaps on water scarcity and drought in Europe. Identify main institutional, organisational and knowledge related problems in tackling drought and water scarcity problems in Europe in a coherent systematic pan European approach
- Contribute to the reflection on the problem and to regional sharing of experience about drought management in relation to the territorial specificities (grouping and comparison by 4 geographical zones)
- Provide a first argumentation for the further needs towards the development of a European Water Scarcity and Drought Network that will help improve drought risk management next to national management plans
- Underline the importance of drought and water scarcity observation as dynamic component of the WSDN and propose a Water Scarcity and Drought indicators system (WSDiS) based on a DPSIR framework to be fully developed for this purpose.
- Underline the importance of setting a framework for cooperation, clear definition of roles and efficient joint use of information in order to increase preparedness and resilience of the European community in terms of efficiency

The current report is organised in 8 chapters. Detailed information is included in the Annex. Chapter 2 summarises the basic background information on water scarcity and drought and the EU roadmap. In Chapter 3 the methodology adopted in this report is presented. Chapter 4 summarises the current national, EU and international initiatives related to WS&D. The detailed overview of the identified initiatives is included in the Annex. In Chapter 5 of this report a gap analysis is carried at national, European and international level by classifying and grouping the countries according to their common characteristics in terms of climate and geographic aspect (Mediterranean, Central West, Central East, Northern countries). Relative tables summarising the findings are included in this section. In Chapter 6 the development of a European Water Scarcity and Drought Network (WSDN) is proposed and recommendations for its structure and the role of the identified European and International actors are proposed. The final Chapter 7 touches on the value of the development of a European Water Scarcity and Drought indicators System (WSDiS) as a dynamic component integrated into the WSDN to enhance data harmonisation and water scarcity and drought observation.

2 BACKGROUND

2.1 DEFINITION OF WATER SCARCITY, DROUGHT, AND DESERTIFICATION

2.1.1 Water scarcity

Water scarcity is a long term condition identified by the occurrence of differences between demanded and offered water resources. "At least 11% of the European population and 17% of its territory have been affected by water scarcity to date. Recent trends show a significant extension of water scarcity across Europe." [COM(2007)414]⁹. In order to classify a water shortage situation, spatial and temporal parameters are needed to define reference points for the comparison of water resources supply and demand, either for the present or for projections based on anticipated supply and demand. [MedWSD, 2007]¹⁰.

The **driving forces** of Water Scarcity are, as stated in the 2nd Interim Report¹¹ on water scarcity and droughts (WS&D), "imbalance(s) between water supply and water demand". Therefore increasing problems of water scarcity can result either from the increase of abstracted volumes or the decrease of water resources availability. Many interrelating factors are responsible for these imbalances and can be divided in the following three categories: human activities, environmental pressures and climate change.

Human activities, such as urbanization, tourism, industry and agriculture, apply pressures on the environment and threaten the quantity as well as the quality of water resources (Table 1). [MedWSD, 2007]¹¹

Table 1. Driving forces and impacts [MedWSD, 2007]¹¹

Driving Forces	Impact
Urbanization	Increasing urban population applies substantial pressures on surface water resources and groundwater. More than two-thirds of Europe's population lives in urban areas and the rate of urbanization in particular, is still increasing in Central and Eastern Europe, while in Western Europe has stabilized.
Industry	Industrial pressures involve: high water demand for cooling and cleaning purposes; pollution with potentially toxic inorganic and organic substances (e.g. organic matter, metals, chlorinated hydrocarbons, nutrients etc); disposal or dumping of sludge and waste, and inadequate containment of old industrial sites; accidents during production and transport. Further pollution arises from emissions to air, mainly from the combustion of fossil fuels, which initiate acidification. Energy sector uses water for energy production which is considered as non-consumptive and accounts for about 30 % of all reported uses in Europe. (WS Drafting Group, 2006)
Tourism	Tourism causes very high pressures especially on groundwater, because of the additional water demand during seasons when the groundwater situation may already be rather critical. Waste and sewage from this sector represent another potential source of water pollution.

⁹ COM(2007)414, "Addressing the challenge of water scarcity and droughts in the European Union", COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL, COM(2007) 414 final, Brussels, 18.7.2007.

¹⁰ MedWSD, 2007, "Mediterranean Water Scarcity and Drought Report", Technical Report - 009 – 2007, produced by the MEDITERRANEAN WATER SCARCITY & DROUGHT WORKING GROUP (MED WS&D WG), April 2007.

¹¹ 2nd Interim Report, 2007, "Water Scarcity and Droughts 2nd Interim Report", produced by the DG Environment, European Commission, June 2007.

Agriculture	Agriculture causes high pressure which can lead to its depletion due to over-abstraction. The legacy of the agricultural intensification of the post-war years is still present, and it is widely predicted that groundwater will continue to be contaminated with nitrate for several decades.
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Human activities pose threat as well to the quality and the quantity of groundwater resources through excessive pumping, return flow from irrigation water with high concentration in agrochemicals, storm water runoff from urban areas, leakages from wastewater networks, land fills, septic tanks, sewers, mine tailings etc. [Iglesias et al, 2007]¹². Based on a review conducted by the Académie des Sciences, (2006) Marsily pointed out in 2007 that "the effects of climate changes for the next century are fairly well predicted as far as the temperature is concerned..., but that their hydrologic effects are really much more uncertain". The Portuguese Presidency of the European Union Council, in 2007, placed "Water Scarcity and Drought" as one of its main priorities. In a report drafted for the purposes of the Portuguese Presidency, Marsily concluded, that the consequence, of climate change in terms of water scarcity in the EU, under normal conditions, is expected to be a strong decrease of water resources in Southern Europe, affecting mostly agricultural production.

The **impacts** of water scarcity may be summarised as follows [2nd Interim Report, 2007]¹²:

1. Economic impacts

- Deficiency in public water supply with implications in related sectors like tourism.
- Decrease of energy since river water's temperature is large and cannot be utilised as cooling water and water reservoirs' levels have dropped below the efficient level for hydropower facilities.
- Uncertainty on crops yield and deeper abstractions for use in agriculture.

2. Social impacts

- Increase of water prices due to compensating measures.
- Migration of water-intensive industry.

3. Environmental impacts

- Seawater intrusion due to over-pumping of groundwater aquifers
- Jeopardised minimum water flows in rivers.
- Less dilution increases the concentration of pollutants.
- Deterioration of wetlands.
- Land erosion and threats of desertification

The economic impact of water scarcity is difficult to estimate since water scarcity affects a variety of economic sectors in various ways and in addition to the implications that water scarcity has to the natural environment.

To **evaluate** water scarcity indicators and indices can be used. A water scarcity indicator is a variable to identify and assess water scarcity or water stress conditions. Common indicators on water availability are usually compared with water abstraction/water use, and impacts related to water scarcity. They usually account for cause-effect relationships and often follow a pressure-state-response approach. A widely accepted index for water scarcity is the Water Exploitation Index (WEI) with its application to the river basin level being the River Basin Water Exploitation Index (RBWEI). This index illustrates the extent to which the total water demand puts pressure on the water resource. In a regional level, a river basin is considered as water scarce whenever RBWEI is above 10% or if identified as such by expert judgement. [2nd Interim Report, 2007]¹², [CSI018 fact sheet EEA]¹³

2.1.2 Drought

The term drought is used to define a temporary decrease in water availability due for instance to rainfall deficiency. Drought is an indistinct event, of water deficiency, that

¹² Iglesias et al, 2007, "Challenges to Manage the Risk of Water Scarcity and Climate Change in the Mediterranean", Ana Iglesias, Luis Garrote, Francisco Flores, Marta Moneo, Water Resources Management (2007) 21:775–788, Springer.

¹³ CSI018 fact sheet accessible at http://themes.eea.europa.eu/IMS/IMS/ISpecs/ISpecification20041007131848/full_spec

results from the combination of many complex factors and neither the beginning nor the end can be precisely defined. [COM(2007)414]¹⁰

Over the past thirty years, drought events and the number of areas and people affected have dramatically increased both in number and intensity within the EU. [MedWSD, 2007]¹¹

The impacts of drought vary in relation to the affected sector. Therefore drought definitions differentiate based on the analysed effects, meteorological, agricultural, hydrological and socioeconomic, as follows [CEDEX, 2004]¹⁴:

Meteorological drought: deficit in precipitation (duration and/or intensity) in comparison with long-term average.

Description: an interval of time (months or years) during which the actual moisture supply at a given place consistently falls below the climatically appropriate moisture supply.

Hydrological drought: refers to deficiencies in surface and subsurface water supplies.

Description: stream flow, snow peak, and lake, reservoir and groundwater levels.

Agricultural drought: inadequate soil moisture to meet the needs of a particular crop at a particular time.

Description: crop yield reduction due to lack of water for average plant water supply.

Socioeconomic drought: physical water shortages affect the health, well-being, and quality of life of the people, or when the drought starts to affect the supply and demand of an economic product

Description: measurable impacts of reduced water supply on society, e.g. production losses, restrictions in waterway transport or private water supply.

The difficulty to establish a definition suitable to adequately describe drought as well as an index in order to measure it, is mainly because drought affects a wide variety of disciplines and operates in a diverse geographical and temporal multiscale distribution. One common thing to all types of drought, though, is the deficiency of precipitation [MedWSD, 2007]¹¹. The term drought is used to define a temporary decrease in water availability due for instance to rainfall deficiency. The onset of a drought event is difficult to identify both in time and place, mainly because drought events do not begin with an extreme meteorological event, such as floods. In addition, drought slowly affects regions usually with different severity and impact levels. Drought end is also difficult to identify due to the fact that the resulting effects may be evident even after the event's "end" for a long period of time.

The following Table 2 summarises drought events in Europe for the past forty (40) years.

Table 2. Drought events in Europe [CEDEX, 2004]¹⁵

Date of event	Location	Impact
1968	Hungary	Rainfall (Feb-July) 10 % of normal
1969	Sweden, UK, Denmark	Very dry summer; water rationing
1971	Most of Europe	Exceptionally dry year Lowest winter rainfall in Spain for 30 years Intensive summer drought in Poland Lowest levels on Rhine since 1818
1972	USSR	Lowest river levels for 50-80 years
1973	North and East Europe	Very dry spring in eastern UK Low winter rain/snowfall in Austria, Germany, Czechoslovakia

¹⁴ CEDEX, 2004, "Task Plan 2004. Task 11 (Activity 4.3.1) Development of background information sheets on potential issues/extreme events of public interest for inland waters. Event: Droughts", ETC/WTR Authors: Manuel Menéndez, Concepción Lallana (CEDEX), July 2004

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1974	Scandinavia, France, Holland, Austria	Dry spring in Norway (rainless April in some areas), Denmark, the Netherlands, Austria 9 week spring drought in Sweden Low rainfall April-August in France
1975	North and East Europe	Dry winter in Eastern Europe, low river levels February-August rainfall in Ireland, UK lowest this century Summer rainfall in Sweden lowest on record October rainfall in Belgium lowest on record
1976	Northern Europe (Scandinavia to France) Effects also spread to Eastern Europe	Severe drought, especially in SE England and N. France. Hot dry summer following a dry winter. Record rainfall deficits. Surface water and groundwater deficits UK: 16 month duration, unprecedented intensity. Very dry summer in Scotland, impact worst in SE England with supply restrictions March-September rainfall in the Netherlands, Denmark, Norway, Sweden, Scotland and N. France lowest on record. Very low soil moisture deficits in Ireland
1977	UK	Dry summer from May-August Scotland(mid)- driest summer since 1868 N. Ireland – seventh successive summer with below average rainfall
1978	South-east UK	SE England – driest autumn since 1752 W. France – driest Oct/Nov since records began
1984	North and west UK	Very dry spring and summer. Affected surface water sources only
1988-1992	Most of Europe (Southern England to Mediterranean and to Hungary)	Prolonged abnormal circulation pattern causing rainfall deficiency over wide geographic area interspersed with short wet periods. High summer temperatures and above average winter temperatures with reduced snowfall. Timing and severity of maximum run-off deficit varied widely. Water resource problems across Europe exacerbated by increased demand e.g. 3 000 rivers dried up in France in late 1990, irrigation restrictions. Severe summer drought in NE Germany in 1992, with crop production reduced by 22 %.
1990-1995	Spain, Portugal	Prolonged drought across all of Spain except North coast. Most intense between September 1994 and August 1995 Hydroelectric stations forced to shut down
1992-1993	Bulgaria, Hungary	Very hot dry summer 1992. Continued with below average rainfall to October 1993. Very low soil moisture in Bulgaria causing severe loss of agricultural production. Worst drought in USSR for 100 years
1995	Ireland and UK Norway, Sweden	Hot dry summer and autumn. Dry soil. Impact on surface water sources, not ground water Low temperatures and little winter snow in Nordic countries.
1996	Bulgaria	Hot dry summer across whole country
1997	France, UK, Ireland, Portugal, Germany	Very low rainfall
Summer 2003	Most of Europe	Heat wave affecting specially Mediterranean countries. Many economic sectors affected, including agriculture, navigation and nuclear and hydropower production.

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Drought events are a result of natural factors and are enhanced by anthropogenic influences. The difference of drought from other natural disasters is that it has a slow onset and a usually lengthy duration. [WS Drafting group, 2006]¹⁵. Drought's primary cause is the deficiency in rainfall. Low rainfall occurrences combined with high air temperatures, evapotranspiration rates during summer and precipitation storage in ice during winter, may increase the severity and duration of drought events. [WS Drafting group, 2006]¹⁶.

Droughts are enhanced by **human activities** that put pressure in water resources. Drought impacts are the result of interaction between a natural event (precipitation deficiencies because of natural climatic variability) and the demand placed on water and other natural resources [Wilhite et al., 2007]¹⁶. Some of the most important human activities that enhance the severity of drought events are [WS Drafting group, 2006]¹⁶:

1. Population growth increases water demand not only due to water supply needs but also due to increased water demand for agricultural purposes.
2. Climatic change and variability.

Climate change under normal conditions may trigger a strong decrease of water resources, especially in the Southern European Countries. In extreme conditions, in the same report, Marsily¹⁷ concluded, that "drought frequencies are very uncertain, though are expected to occur, with or without climate change".

3. Land use

- a. Degradation of watersheds and catchments may reduce the amount of usable water available downstream.
- b. Reduction of vegetation cover may result in higher runoff that in turn reduces groundwater infiltration and the storage capacity of dams and lakes through sedimentation.
- c. Draining of large scale wetlands or large scale deforestation.
- d. Development of "thirsty" crops.
- e. Urbanisation leads to increased surface run-off, reduced infiltration and reduced base flows locally.

4. Water pollution, the concentration of pollutants in water resources increases as the quantity of water decreases thus making water sources difficult or even impossible to use. On the other hand, reducing water pollution can increase the usable water supply.
5. Poor or inadequate legislation can exacerbate the effects of water scarcity resulting in conditions of drought.
6. The use of water in international rivers of cross-boundary catchment areas by upstream countries may lead to conditions of drought in downstream countries.
7. Political realities, the temporal perspective of many politicians does not coincide with the temporal dimension of a prudent water resources management, resulting in decisions being made on the basis of short term political benefits only.

Impacts from drought can be classified as direct or indirect. Reduced crop, agricultural land, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. [Wilhite et al., 2007]¹⁷.

Drought is usually defined, as stated previously based on its impacts, meteorological, agricultural and hydrological. When a drought event begins, soil water is rapidly depleted thus affecting the agricultural sector because of its heavy dependence on stored soil water. The other sectors that are dependent on water will feel the effects of drought if precipitation deficiencies continue. The last to be affected are usually those sectors relying

¹⁵ WS Drafting Group, 2006, "WATER SCARCITY MANAGEMENT IN THE CONTEXT OF WFD", Water Scarcity Drafting Group, MED Joint Process WFD /EUWI, June 2006.

¹⁶ Wilhite et al., 2007, "Understanding the complex impacts of drought: A key to enhancing drought mitigation and preparedness", Donald A. Wilhite, Mark D. Svoboda, Michael J. Hayes, Water Resources Management (2007) 21:763–774, Springer.

¹⁷ Marsily, 2007, "Climate Change and its Links to the Water Scarcity and Drought Problems in Europe", Ghislain de Marsily, included in the publication of the Portuguese Presidency "WATER SCARCITY AND DROUGHT, A Priority of the Portuguese Presidency", Edition: Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, 2007.



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on surface water and groundwater. When the drought event has ended soil water reserves are the first to be replenished, followed by surface water and groundwater. Therefore, the agricultural sector is the first to come off the crisis followed by the other sectors that may take even months or years to recover depending on stored surface or subsurface supplies. [WS Drafting group, 2006]¹⁶

Drought impacts may also be divided into economic, environmental and social [WS Drafting group, 2006]¹⁶ as follows:

1. Economic
 - a. Mainly agriculture and other related sectors, such as forestry and fisheries. Losses in crop and livestock production, increases of insect's infestation, plant diseases and soil erosion. Increase of fire incidents.
 - b. Recreation and tourism industries are also affected.
 - c. Prices of food, energy and other products increase as supplies are reduced. Even the need to import goods may arise or to change the transportation method due to low water levels in rivers.
 - d. Hydropower production may also decrease.
2. Environmental
 - a. Damages to plant and animal species and wildlife habitat.
 - b. Decrease of air and water quality
 - c. Forest and range fires
 - d. Degradation of landscape quality
 - e. Loss of biodiversity
 - f. Soil erosion.
3. Social
 - a. Public safety
 - b. Health
 - c. Conflicts between water users
 - d. Reduced quality of life
 - e. Inequities in the distribution of impacts.
 - f. Economic and environmental impacts have also social components

To evaluate drought events, drought indicators are used allowing the identification of the onset, the severity, and the end of a drought. These indicators need to be objective measures of the system status. [WS Drafting group, 2006]¹⁶ Common indicators are based on meteorological and hydrological variables such as rainfall, stream flow, soil moisture, reservoir storage, and ground water levels.

2.2 EU ROADMAP FOR WS&D

Based on the input of several Member States, severe drought events on an annual basis have affected more than 800.000 km² of the European Union's territory (37%) and at least 100 million inhabitants (20%) with different degrees of intensity. Moreover, water scarcity's impacts have affected at least 19% of the European Union's inhabitants and 33 river basins (12%) within the European Union's territory. [Afonso, 2007]¹⁸

In November 2003, the informal meeting of the EU Water Directors reached the agreement to develop an initiative on WS&D issues. This decision came after one of the most widespread droughts, in 2003, when over 100 million people and a third of the EU territory were affected.

The full implementation of the Water Framework Directive (WFD) is a major priority for the Member States (MS). The Directive 2000/60 expands water protection to all waters, groundwater and surface waters. It aims within a set deadline to achieve and keep "good" the ecological and chemical status, to promote "no-deterioration" state after the implementation and to develop a single management system for all European waters, the river basin. It supports the establishment of appropriate water pricing policies and it aims to introduce public participation within water management.

¹⁸ Afonso, 2007, "Water Scarcity and Droughts: Main issues at European level and the Portuguese Experience", José Rocha Afonso, included in the publication of the Portuguese Presidency "WATER SCARCITY AND DROUGHT, A Priority of the Portuguese Presidency", Edition: Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, 2007.

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Some concerns and gaps of the WFD relating to quantitative issues, which influence the achievement of the environmental objectives, were identified, particularly in regard to floods, water scarcity and droughts. The need for further developments was envisaged by the Member States, both at a political level and at technical level, aiming at acknowledging the relevance of WS&D and at fostering the analysis of measures to deal with WS&D within the implementation of the WFD. [Afonso, 2007]¹⁹

The above referred concerns were reflected within the Common Implementation Strategy (CIS) of the WFD, from the first stages to present developments. The following table summarises all the recent developments from 2003 up to now relevant to WS&D.

Table 4. E.U. addresses WS&D.

Date	Action
11/2003	The informal meeting of the EU Water Directors agreed to develop an initiative on water scarcity issues. A Drafting Group for Water Scarcity, led by France, Italy and Spain within the Common Implementation Strategy (CIS) of the Water Framework Directive (WFD), was set up by the Water Directors to produce a Technical Document on drought events and water scarcity issues
2004	The MED-EU Water Initiative/WFD joint process participated in the production of the Technical Document by the Drafting Group for Water Scarcity.
03/2006	EU Council: MS called for E.U. action on drought events and water scarcity situations
11/2006	In-depth analysis and collection of complimentary data from the MS and stakeholders to produce the 1st Interim Report
2006-2007	In-depth Assessment
29/01/2007	Stakeholder Forums were set-up and all interested parties submitted contributions to the 1 st Interim Report
26/03/2007	
24/05/2007	
06/2007	2 nd Interim Report
18/07/2007	Commissions communication to the EU Parliament and Council
31/10/2007	Meeting between EEA and DG Based on the Communication, EEA and DG start discussions on building Indicators. The objective of the meeting was to clarify the organisation of forthcoming work at European level on indicators for water scarcity and droughts (WS&D), in particular the distribution of tasks between DG ENV, EEA and Member States as well as the timetable
12/2007	Questionnaire on WS&D indicators and other related products prepared by EEA-ETC/W sent out to MS
19/03/2008	Assessment of the questionnaire results on the most commonly used WS&D indicators by the MS, and DPSIR Framework for WS&D indicators, presented by the EEA-ETC/W to the Expert Network on WS&D nad Core Group on WS&D Indicators
15/04/2008	Joint EEA-JRC Meeting to clarify the roles related to water scarcity and drought observatories
10/06/2008	Assessment of the questionnaire results on the most commonly used WS&D indicators by the MS, and DPSIR Framework for WS&D indicators, presented by the EEA-ETC/W to the NFPs/NRCs at the Thematic Eionet Workshop 'Water Quantity and Use' in Copenhagen
27/10/2008	A framework for Drought and Water Scarcity Indicators (incl. first draft indicators) presented by the EEA-ETC/W to the Expert Network on

WS&D and Core Group on WS&D Indicators

Addressing water scarcity and drought: The Communication of the Commission towards the European Parliament and the Council addressing the challenge of water scarcity and droughts at the European Union, issued in the 18th of July 2007, identified a first set of policy options with a view to opening up a wide-ranging debate on how to adapt to WS&D. The proposed policy options are the following [COM(2007)414]¹⁰:

1. Putting the right price tag on water
2. Allocating water and water-related funding more efficiently
 - a. Improving land-use planning
 - b. Financing water efficiency
3. Improving drought risk management
 - a. Developing drought risk management plans
 - b. Developing an observatory and an early warning system on droughts
 - c. Further optimising the use of the EU Solidarity Fund and European Mechanism for Civil Protection
4. Considering additional water supply infrastructures
5. Fostering water efficient technologies and practices
6. Fostering the emergence of a water-saving culture in Europe
7. Improve knowledge and data collection
 - a. A water scarcity and drought information system throughout Europe
 - b. Research and technological development opportunities

In general the Commission's Communication focuses on the full implementation of the Water Framework Directive and identifies additional policy options that could be implemented within the WFD¹⁹ which address WS&D in specific.

The Commission's Communication also sets deadlines for certain actions towards the implementation of the proposed policy options. For example, by 2009, policy research results must have been disseminated, facilitated and integrated to policy research results on WS&D. Specific drought management plans should be set up at national level by 2009, in order to supplement WFD river basin management plans, where needed, in accordance with WFD provisions (WFD Article 13(5))²⁰. In addition, at national level, by 2010, water tariffs should be set according to a consistent economic assessment of water uses and value and compulsory metering programmes must be introduced in all water using sectors. Finally, at European and national levels, by 2012, prototypes must be developed and implementing procedures must be set up for operational European Drought Observatory and early warning system. [COM(2007)414]¹⁰.

¹⁹ WFD 2000/60/EC <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32000L0060:EN:NOT>



3 METHODOLOGY

In the current report the first step included the identification of the main stakeholders, authorities, agents etc. who manage and/or deal with drought, water scarcity and desertification issues at National level and European level, and the collection of relative data on their objectives, priorities, activities (monitoring, management, mitigation etc.). Based on this the main information gaps on water scarcity and drought in Europe were identified, as well as the main institutional, organisational and knowledge related problems in tackling the problem in Europe in a coherent systematic pan European approach (Gap Analysis). These conclusions led to the argumentation and identification of the further need of developing a European Water Scarcity and Drought Network (WSDN) that will help improve risk management next to national management plans. Following this, a conceptual definition of the structure of such a WSDN and of the various components it should include is provided. As the importance of WS&D observation has a key role in mitigating the impacts, it is recognised that an observation system should be dynamically linked to the WSDN as integrated component of the latest, and thus it is suggested that a Water Scarcity and Drought indicators System (WSDiS) is developed in this respect following a concrete methodological approach as described in this report.

The methodology followed in each distinct part of this report (namely the Gap Analysis, the WSDN structure, and the WSDiS development approach) are presented in the sections bellow.

3.1 GAP ANALYSIS

The purpose of gap analysis is to compare the current activities for water scarcity and drought observation and information of different actors in Europe and propose the vision for a coherent concept for water scarcity and drought network. The application of gap analysis for the purposes of this report was twofold.

Firstly, the current activities for water scarcity and drought of the different actors in the Member States were compared with criteria, relevant to: the vision; the planning stage at the organisational/institutional national level (national objectives and priorities); the implementation stage (monitoring, indices, etc.); and the management and mitigation stage (DMP, forecasting, etc.).

Secondly, the current activities for water scarcity and drought observation and information of different actors at European level were compared to selected pillars based on the necessity to address water scarcity and drought in a coherent systematic pan European approach. The gap analysis identified the different links and overlaps in terms of objectives, priorities, methodological approaches, risk assessment and management, but also the gaps and missing corner stones towards the development of a European Water Scarcity and Drought Network (WSDN). It also identified appropriate WSDN components and the way these components may be coordinated by using the existing initiatives providing better information, fostering synergies, promoting capacity building between scientists and the user community, and thereby increasing preparedness and resilience of the European society to water scarcity and drought.

In order to collect and process the information needed for the gap analysis, the following steps have been taken:

1. Collection of information relevant to the current activities for water scarcity and drought of the different actors in the Member States.

A **predefined template** was compiled to collect web information for all institutional and organisational structures and for the current situation on water scarcity and drought related activities in each country.

- Compilation of a **questionnaire by the ETC/Water** to collect information from all the 27 EU countries; the questionnaire was distributed in December 2007 by DG Environment to the Expert Network on WS&D to collect relative information on WS&D national authorities, products, indicators (see annex I) but was focused on

the indicators used by the MS to identify, assess and monitor water scarcity and drought. Even though this questionnaire did not have an observatory question specifically in its objectives, nevertheless the information was used of cause.

- The collection of this information was presented for each country separately. Then a classification of the countries in four categories was conducted in terms of the geographical location e.g. Mediterranean countries, Central European countries - West, Central European countries – East and North European countries.
- Synthesised tables for all countries were compiled and presented with the purpose to identify and present the possible gaps at organisational/institutional national level in the planning stage (national objectives and priorities), the implementation stage (monitoring, indices, etc.), and the management and mitigation stage (DMP, forecasting, etc.)
- Finally the main findings of the gap analysis were discussed.

The first step was to identify the problem of water scarcity, drought and desertification where the researcher evaluated whether the country has detected a drought problem. Then the national objectives-priorities of each country referring to water resources were collected. These objectives were classified based on the importance of each element as following: Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, and fisheries), Secure Vital flow – Ecological Status, Social Activities Status. Next all the interested parties and structures, providing their name and link were reported.

The current status of each country regarding drought and water scarcity activities and observation was identified and reported in this template. The classification in this case had several steps as follows: First, an examination of whether monitoring systems were established in this country and collecting any kind of relevant data. Second, a research on the indices/indicators that each country has developed or used was carried out. The next step referred to the identification of any Drought Management Plans that the countries may have compiled at a national level. As a final step, the mitigation measures that were taken or the policy instruments that were practiced in the countries to combat drought situations were detected.

As a final step of this procedure, an evaluation of the institutional and organisation structure was carried out with individual comments and specific remarks on the gaps for each country according to their priorities and objectives for drought. This evaluation was based on different parameters such as the importance of drought in the country, the gaps of the relevant objectives and the problems in the organisations and responsible bodies (e.g. capacity, effectiveness).

2. Collection of information relevant to the current activities for water scarcity and drought at European level.

Again a predefined template was compiled to collect web information for selected European institutions and organisational structures, EU Initiatives, Information Centres, Action Programmes, Financial Instruments etc, relevant to the current activities for water scarcity, drought and desertification at the European level.

The first step was to present a short description coupled with the objectives and the vision of each actor. In addition, the relevance of the actor to water scarcity, drought and desertification was identified. The actors were classified based on the relevance of their activities, objectives and vision to the following: research, observation, monitoring (drivers, pressures, state of the environment, impacts and responses), knowledge (dissemination, awareness) and economic. Synthesised tables for all actors were compiled and presented containing all relevant information.

As a final step of this procedure, the actors at the European level were compared to the proposed structure of a European Water Scarcity and Drought Network (WSDN). The gap analysis identified the different links and overlaps as well as the gaps in terms of the relevance of their activities to the above mentioned criteria (research, observation, monitoring (drivers, pressures, state of the environment, impacts and responses), knowledge (dissemination, awareness) and economic). It also identified which WSDN

components may be coordinated by using the existing initiatives as well as which components are not currently included at the European level and therefore need further development.



4 OVERVIEW OF INITIATIVES

4.1 RESULTS AT NATIONAL LEVEL

Short summary on the main findings reported in the Annex. The summary will touch on the following:

Box 1. Abstract of the national overview: terms of reference

1. Problem identification of WS&D
2. National objectives and priorities in relation to WS&D awareness and management [*Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status*]
3. Presentation of the country's main bodies and structures responsible for WS&D management [*Ministries, organisations, authorities, etc*]
4. Current status for WS&D management

Austria

1. Austria is classified according to the EEA assessment as a non – stressed country in terms of having the WEI₉₀²⁰ index below 20% (WEI_Austria = 4%) (EEA, Use of freshwater resources - Assessment published Jan 2009). The period between 1999 and 2003 has been characterised as a dry period in Austria and caused damage to agriculture and cattle farming. In addition, it also affected the national electricity supply since 75% of electricity generation in Austria is covered by hydropower, which amounts to about 12% share in the total energy input (Austrian Energy Agency). However, despite this long sequence of dry spells after 1999 and up to 2003 drought does not seem to be a major problem in Austria.

2. The main concerns of Austria, water – wise, are to secure energy production and potable water, especially after the dry period of 1999-2003. Since 2000 a high priority relates to the cattle farmers also due to lack of feeding resources. Climate change scenarios seem to affect Austria and therefore main concerns are expressed on that issue.

3. The Federal Republic of Austria is made up of nine states. Each one of these states has a *Hydrographical Department* and all of them compile the *Central Hydrographic Office* ("Hydrographisches Zentralbuero"). The Departments are administrated by the *Federal Ministry for Agriculture, Forestry, Environment and Water Management* ("Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft") and among others they provide ample information regarding Austria's environmental status.

4. Numerous hydrometeorological parameters are monitored in Austria from several bodies, the most important of which are actual precipitation and percentage of normal rainfall, river discharges and water levels, water balance, snow observations and ground- and spring water level.

There are no drought management plans identified in Austria, however a couple of mitigation measures and policies were identified that concern exclusively the dry period 1999-2003. During that period the citizens were called to water saving, springs unused so far were exploited and provisional associations were established.

Belgium

²⁰ Water-scarcity can be defined by the **water exploitation index (WEI)**. WEI divides the total water abstraction by the long term annual average (LTA) resource. The warning threshold, which distinguishes a non-stressed from a water scarce region, is around 20 %, with severe scarcity occurring where the WEI exceeds 40 %.

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1. Belgium is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Belgium≈30%) (EEA, *Use of freshwater resources - Assessment published Jan 2009*).

3. The *Direktorat General for International Cooperation – DGIC* of the *Ministry of Foreign Affairs* has a long-standing record of action in the field of combating desertification and drought. It organizes periodic meetings with the scientific and academic society, as well as with all interested NGOs of Belgium in order to prepare upcoming international meetings or to discuss the outcome of past ones. In this way professional colleagues are kept informed while having the opportunity to provide their input to the negotiating process (*CP2002-Belgium*). Water distribution companies, municipalities, provincial authorities, and civil protection agencies are responsible for drought prevention (*CP2002-Belgium*). Coordination between the regions has been institutionalized by the creation of a Coordination Committee on International Environment Policy.

4. Numerous parameters are monitored in Belgium, the most important of which relate to water quality and groundwater and in particular the purification infrastructure to reach the desired environmental objectives for water. Data on monitoring of water table and surface water flow are also available on the Flemish Environment Agency (VMM), while surveillance of surface water in terms of quantity has not been identified in Belgium. No WS & D indices or drought management plans were identified in Belgium.

Belgium has educational measures to mitigate water scarcity and drought e.g. brochures on sustainable water use and sanitation are made for architects (2000), cattle breeders (2001) and municipalities (2002). The launch of these brochures is organized on provincial level by means of seminars or workshops. A thematic centre provides tailor made information on sustainable water use on request of any individual or organization (*CP2002-BELGIUM*). Annual reports on water quality and discharges are made public by organizing press conferences. Further more, awareness raising campaigns are organized through printed (newspapers and magazines) and audio-visual media (TV and radio).

Bulgaria

1. Bulgaria is classified according to the EEA assessment as a severely water-stressed country in terms of having the WEI_90 index above 40% (WEI_Bulgaria≈60%) (EEA, *Use of freshwater resources - Assessment published Jan 2009*).

Freshwater resources and water sanitation in Bulgaria are of concern because of severe deficits in some regions. The main WS & D problems are situated on the western slopes of Rila Mountain, where a water crisis on supply exists. During the droughty years not only the irrigated fields, situated at river basin, but also the public water supply systems are the victim of chronic water shortage (towns of Dupniza, Blagoewgrad, Pernik, Kiustendil). Insufficient groundwater resources are mainly located in the region of Ludogorie, Fore-Balkan, Eastern Balkan, Kraishte, Eastern Rhodope Mountain, Strandja and Sakar. There is also considerable water loss through leakage, lack of accumulated water volume and illegal water abstraction and use (*Ministry of Environment and Water of Bulgaria - MOEW*). Availability and distribution of water present serious difficulties. While current water shortages are related mainly to a prolonged drought, major problems exist with old and leaky distribution systems and with wasteful agricultural and industrial use. Many municipal wastewater treatment plants are incomplete and funding for them is slow. In addition, because of the severe drought experienced over the years 1998-2002, the share of hydro-energy in total production has fallen from between 6-8% to 1-2% (*CP2002-BULGARIA*).

2. Bulgaria's priorities on WS & D include securing public water supply, securing water uses for agricultural purposes (irrigation, animal drinking pools) and industrial uses as well as recreational activities (*National Operative Programme "Environment" 2007 – 2013*).

3. The Ministry of Agriculture and Food Industry, the Committee of Forests at the Council of Ministers, and the Ministry of Environment are responsible for drought and related issues. The International Convention to Combat Desertification in Countries

Experiencing Drought and/or Desertification particularly in Africa has not been signed by Bulgaria (*CP2002-BULGARIA*).

4. Surveillance systems originate from ground stations and satellite images and include both surface and groundwater monitoring. No WS & D indices were identified for Bulgaria. The National Statistical Institute distributes information on water specifically on water usage by agriculture, household and industrial. A bulletin of the Ministry of Environment and Water is published annually (*CP2002-BULGARIA*).

The drought management plans for Bulgaria include a program concerning the necessary measures in the circumstances of trend to drought. Bulgaria also participates in Subregional Project "*Drought Management Centre for South-Eastern Europe in the Context of the UNCCD*", which is an Operative Centre for drought monitoring and management (*MOEW, July 2007*).

The mitigation measures and policies for WS & D management in Bulgaria include measures for control, monitoring and assessment of drought, insurance of minimum permissible rivers run off, measures to prevent from groundwater overexploitation, prohibition on the clear felling with artificial renovation in water supply zones, selection of vegetative species, accumulating water stocks in vegetative mass and drought resistant species (*MOEW, July 2007*). Bulgaria generally attempts to improve institutional structure for water management; however national policy for combat to drought as whole is not clearly cut and accordingly reflected in currently existing strategies, policies and plans (*Ministry of Environment and Water, July 2007*).

Cyprus

1. Cyprus is listed among 9 countries, which will face "water scarcity" by year 2025 (*Young Reporters, January 2008*). Cyprus is classified according to the EEA assessment as a severely water-stressed country in terms of having the WEI_LastYear2005 index above 40% (WEI_Cyprus≈45%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

Cyprus has been experiencing problems concerning its water supply, which has been rapidly decreasing over the past several years. The prolonged drought of the last years drastically reduced the water reserves of the surface and underground reservoirs (*CP2002-CYPRUS*). Cyprus depends heavily on water storage in dams to satisfy its water needs and has a high risk of having its reservoirs becoming virtually empty if the drought conditions persist, as the island suffers from low rainfall and ever-increasing demand for water (*International Herald Tribune, August 2007*). Average rainfall has dropped 15-20% over the past three decades and ground water has been exploited for many years. Meanwhile, continuous development and tourist arrivals, which more than triple the island's population to nearly 3 million, create ever-increasing demand. In 2007, the reservoirs held around 17% of capacity, at 45Mm³, about half the level of the same time in 2006 (*IHT, August 2007*). The annual demand is about 266Mm³, with day reservoirs being able to carry 327Mm³ (*UN Division for Sustainable Development, June 2008*). The authorities notify that reserves could drop to below 1% of capacity by 2008, if the drought conditions persist. Large areas of cracked and dried mud stretch across the once-brimming artificial lake at Kouris, the Mediterranean island's largest reservoir (*IHT, August 2007*). In the island's breakaway Turkish Cypriot north, most residential areas get water only once every three days, especially in the summer.

2. In drought seasons, priority is given to the supply of drinking water, with restrictions in the supply of water for irrigation purposes. The principal government policy is to secure ample water supply for irrigation and development in the agriculture, tourism, housing, industry and other sectors, so as to bring about equilibrium between supply and demand.

3. Bodies responsible for WS & D are the *Cyprus Meteorological Service* and the *Water Development Department* under the *Ministry of Agriculture, Natural Resources and Environment*. The Meteorological Service with a permanent staff of about 60 people has all the normal responsibilities of a national Meteorological Service operating a network of meteorological stations for the collection of data, weather forecasts, process and publication of meteorological data, reports on weather and climate etc. The Water

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Development Department is responsible for implementing the water policy in Cyprus. The main responsibilities of the department cover the collection, processing and classification of hydrological, hydrogeological, geotechnical and other data necessary for the study, maintenance and safety of the water development works, the surveillance of dams, ponds, irrigation, domestic water supply and sewerage schemes and desalination plants as well as the protection of the water resources from pollution (*Water Development Department*).

4. Numerous hydrometeorological parameters are monitored in Cyprus, most important of which are precipitation, rain-days, dry spells, potential evapotranspiration, dam information, reservoir storage etc. Although drought indicators are estimated, they are not currently available online. No drought management plans were identified in Cyprus.

Mitigation measures and policies are taken in Cyprus to confront the problem of a continuous drought, the government switched to a multiple water development strategy of collecting, producing, recycling and conserving water. First, the government sped up the construction of additional dams on the stream-like rivers of Dhiarizos, Akaki, Peristerona, Karyotis and Tylliria. Then, it completed the Nicosia and Limassol sewage systems which recycle sewage water for irrigation, gave licenses for the construction of desalinization plants, and initiated a water conservation campaign (*Young Reporters, January 2008*).

The government has introduced conservation measures, including increased fines for water wasting. Fines for wasting tap water by hosing sidewalks and washing cars are also set to rise from 30 to 50 Cyprus pounds (€51-€85). The government is offering cash incentives for recycling household water and subsidizing new boreholes to tap water supplies under the cities. However not much has been done to fix leaking pipes. Officials are considering bringing in water from Turkey in undersea pipes and distilling sea water. In the south, authorities say there are no immediate plans to restrict household supply but irrigation water for farmers - who use 69% of the island's water - has been cut back (*IHT, August 2007*).

In order to eliminate dependency on rainfall and satisfy the increasing water demand, the Government has decided to precede with the construction of seawater desalination plants (*CP2002-CYPRUS*). Authorities plan to build a mobile desalination unit and expand existing water plants as well as build two new fixed units. In particular a new desalination plant is planned for Paphos to alleviate the problem. The risk that desalination will increase greenhouse gas emissions, and that salt released back into the sea will upset natural levels and harm marine life is stated by environmentalists. The Green party noted that desalination should be used as a last resort and favours improved recycling of water and investment in fixing the network which could be leaking as much as 40% of water into the ground (*IHT, August 2007*).

Czech Republic

1. Czech Republic is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Czech≈22%) (EEA, *Use of freshwater resources - Assessment published Jan 2009*).

In the last fifteen years, drought was not an essential issue for the Czech Republic although there were dry periods 1993 - 1995 and 2003 - 2004. On the contrary extreme floods have significantly affected large parts of the country. While addressing the flood issues in national strategic documents, the opposite hydrological event - drought - is also taken into account (*National SD Reports - Droughts, June 2008*). According to many studies, negative impacts of climate change include extreme hydrological events such as droughts with negative impacts on water quantity and quality. Concerning the forestry in the Czech Republic, drought has not been a limiting factor so far. The dry periods caused an increased defoliation of tree species, and especially dieback of unoriginal spruce forests

and *Pinus nigra*. Forests weakened by drought were consequently attacked by *Armillaria ostoyae* and bark-beetles (*National SD Reports – Droughts, June 2008*).

There are only a small number of minor water courses entering the Czech Republic, and therefore the water balance of Czech Republic is affected primarily by precipitation. With the expected increase in evaporation and without a significant increase in atmospheric precipitation, a substantial part of central and southern Moravia, central and north-western Bohemia, and the regions around lower and central parts of the Labe and Vltava are in danger of drought, which could have a detrimental effect on harvest yields in the most productive agricultural areas (*National Program to Abate the Climate Change Impacts in the Czech Republic*). Under the warmest conditions and on extremely damp soils, it can be expected that locations will appear that are not suitable for economic production. Higher areas, where agricultural production is currently limited by low temperatures, should gain in productivity under the expected changes in climatic conditions, as they are probably not affected by the lack of precipitation (*National Program to Abate the Climate Change Impacts in the Czech Republic*). In the Czech Republic to date, the effect of climate change on water reserves and compensation options of climate change impacts by means of water reservoirs have been assessed.

2. The main goal of the national policy is to create the conditions for sustainable management of the limited water resources of the Czech Republic (*National SD Reports – Droughts, June 2008*). Securing public water supply is important as well as the use of water for industries and fisheries. Securing vital flow status in river basins is a national objective for Czech Republic. Framework goal of water protection from detrimental effects of drought in the River Basin Management Plan of the Czech Republic is to integrate other resource management sectors and regions into long-term prognoses of demands for water resources with adaptations to presumed climate change (*National SD Reports – Droughts, June 2008*). Czech Republic main objective in protection of waters is the improvement of the condition of water resources and water ecosystems, support for sustainable water use and alleviation of the adverse effects of droughts by improving the retention ability of the landscape.

3. Responsible bodies in Czech Republic for WS & D are the *Ministry of Agriculture* that operates the water management information portal, the *Ministry of the Environment* that is conducting geological research and is responsible for the natural hazards and the country water resources. The Czech Hydrometeorological Institute is also working on the fields of hydrology, water quality, climatology and meteorology.

4. Protection of the water resources is achieved through the rational management of waters and the ongoing creation of conditions for increasing the accumulation ability of the landscape (*National SD Reports – Droughts, June 2008*). Large losses in water supply systems and leaks in sewerage systems also occur in Czech Republic (State Environmental Policy, January 2001)

Czech Republic has put a lot of energy into developing new policies and indicators for assessing drought. The different bodies and authorities report every year and the information through the websites and the portal has been improved in terms of language, availability of data etc. However there are still data in the portal on environment not available online.

The National Programme for the Reduction of Climate Change Impacts in the Czech Republic was approved in 2004, which, among others, emphasizes the need to develop and implement appropriate adaptation measures in the relevant sectors including the water resource management sector. Measures that have been taken in Czech Republic gradually improve and revitalize the natural water cycle in nature, ensure consistent protection of groundwater and surface water not only as resources, but particularly as aquatic ecosystems, increase the retention ability of the landscape and ensure the renewable nature of water resources.

Denmark

1. Denmark is classified according to the EEA assessment into a non water stressed country in terms of having the WEI_90 index below 20% (WEI_Denmark≈7%) (*EEA, Use of freshwater resources, Jan 2009*). However, dry winters were reported in 1995-1997

and extreme temperatures were recorded in July 2005. Due to those records, the country declared being almost entirely affected by water scarcity (*DG Environment, Water Scarcity and Droughts, Second Interim Report, June 2007*). Water abstraction exceeds sustainable recharge by up to 300% around Copenhagen and other large towns and irrigation, which is dominant in Western Jutland and exceeds sustainable recharge by up to 70% (*DG Environment, Water Scarcity and Droughts, Second Interim Report, June 2007*). Abstractions for public water supply and for manufacturing industry an energy cooling are also widely practiced in Denmark.

A large proportion of the sandy soils in Denmark are irrigated. This requires permission for groundwater retrieval. Higher summer temperatures and longer periods of drought may increase the need for irrigation of agricultural crops, with negative consequences in streams and/or rivers flows, and therefore there may be a need to revise existing permissions for groundwater retrieval (*UN Commission on Sustainable Development, Danish National Report*). Furthermore, higher temperatures reduce the generation time for both pests and diseases, and milder winters also improve winter survival of both pests and their natural enemies. It is likely that higher temperatures increase the crop protection problems in agriculture and thus the need for pesticide use (*UN Commission on Sustainable Development, Danish National Report*).

2. Securing public water supply and vital flow in rivers are national objectives for Denmark. The Danish government is also very concerned about the damage that droughts cause to agriculture.

3. The main bodies and structures responsible for WS &Din Denmark are the Danish Meteorological Institute (DMI), which is under the Ministry of Transport, the Danish Water Forum (DWF) and the Danish Environmental Protection Agency, which is under the Danish Ministry of the Environment.

4. The above mentioned bodies operate measurement stations for weather and climate monitoring at several hundred locations that cover the entire country. The data collected are exploited for the estimation of several indices that assess WS & D. Therefore, apart from daily climate information that mainly includes precipitation, barometric pressure and temperature, monthly and annual reports are provided as well. The groundwater status (quality and quantity), including groundwater levels and abstractions is also provided in annual reports. As drought index, the annual maximum number of consecutive dry days (days when < 1mm of precipitation is recorded) is estimated.

In order to mitigate drought local community-based programmes to sustainable enhance the productivity of land and the efficient use of water resources are promoted. Moreover, a water pricing policy has been developed. Water pricing always had a positive effect on both water use and loss in distribution systems (EC). The Danish Government has initiated a series of projects aimed at giving more solid knowledge on how the agricultural sector is affected by a changing climate and how to adapt in the most effective way (*UN Commission on Sustainable Development, Danish National Report*). However no agro-environmental measures address directly quantitative issues (EC).

Estonia

1. Estonia is classified according to the EEA assessment into a non water stressed country in terms of having the WEI_90 index not exceeding the 20% (WEI_Estonia≈15%) (*EEA, Use of freshwater resources, Jan 2009*). The severest drought in Estonia with the mean number of 13 dry days was observed in August–September 2002. The mean number of dry days in that year was more than double than that in 2006, which was the second driest year over a 50year period. The period without precipitation lasted in Valga for 41 and in Mauri for 49 days in August–September 2002 (the number of dry days was respectively 21 and 29). In 2006, in many districts there were two dry spells – the first one in May and the second one in July. The current warming trend in Estonia, about 1–1.7 °C for the recent 50 years, is expected to lead to increased frequency, intensity, duration and severity of extreme weather events. Therefore, the annual number of extreme (wet and dry) days together has been presented as the average of 56 stations. It confirms the statistically significant rising

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trend of extreme precipitation events in Estonia in the period 1957–2006. Inter-annual variability of the average number of wet and dry days in Estonia has remarkably grown in 1957–2006. In the last years, extreme dry as well as extreme wet periods have occurred in Estonia. In July 2006, the precipitation was only about 22% of the average level, which caused great damages to agriculture (*Distribution of extreme wet and dry days in Estonia in last 50 years, 2007*).

2. In Estonia securing public water supply is a national objective, while securing water for agricultural purposes, fisheries and vital flow status are also priorities for the Estonian government. Several relevant plans and programmes have been elaborated during recent years in Estonia to implement the Declaration on the Protection of the Marine Environment of the Baltic Sea in 1988, to meet Helsinki Commission recommendations, to improve water quality of the Baltic Sea and inland water bodies, and to supply the population with high drinking water quality.

3. The *Estonian Ministry of Environment - MoE* is the higher executive body for issues related to freshwater resources. The *Estonian Meteorological and Hydrological Institute - EMHI* is responsible for all activities carried out by a national meteorological and hydrological service e.g. collection, analysis and storage of the results of meteorological and hydrological measurements, issuing of weather forecasts etc. By approving the Estonian Environmental Strategy 2030 the Government has determined the long term development plans in order to maintain the status of the natural environment. The government in order to implement this strategy has approved the Estonian Environmental Activity Plan 2007-2013. The priorities of the Activity Plan include the improvement of the state of surface and groundwater and the protection of landscapes and biological diversity (*The Implementation of the EU Sustainable Development Strategy in Estonia, Tallinn 2007*). The *Estonia Water Management Development Plan* is a document in which general principles and goals of water protection and water supply are formulated. No Drought management plans have been identified for Estonia.

4. The main Estonian water legislation is the Water Act, which entered into force in 1994. According to the Water Act "River basins and sub-river basins to be covered by a water management plan shall be designated and their water management plans shall be approved by the Government of the Republic" (*Water Act, 1994*). Additionally the Act states that the county governments, local governments and residents of and other interested parties from the territory of the relevant river basin or sub-river basin shall be involved in the preparation of a water management plan. In order to publicise the initial outline and draft of a water management plan, the Ministry of the Environment shall organise public meetings. "The guidelines for establishment of river basin management plans" was elaborated in 2001.

Several indexes have been used in Estonia including the WEI, the use of freshwater resources, the water abstraction index, the mean precipitation etc. Numerous hydrometeorological parameters are monitored in Estonia, the most important of which are water level, water level change, water temperature, ice thickness, precipitation 24h, precipitation duration etc.

Finland

1. Finland is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Finland≈2%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Finland in general cannot be characterized as a country that suffers from drought. However, several dry periods have been recorded so far. An unusual drought that began during the summer of 2002 has left Scandinavians with soaring electricity prices and possible power outages. In Finland, reservoir levels which dropped to 10-year record lows resulted in a 10% increase in energy costs (Reuters).

The low precipitation on the south coast, in south-western Finland and in parts of Western Finland, combined with the high evaporation rates for July and August, resulted in severe drought on nearing the end of 2002. The drought was at its severest along the coastline. At its lowest, the annual precipitation on the mainland dropped to about 400mm, which is

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only slightly over half of the long term average, especially along southern and south-western coastline (*Finnish Meteorological Institute, 2003*).

2. Water abstraction is practiced in Finland for public water supply, for manufacturing industry and for energy cooling. Hydroelectrical power is a national priority. The Finnish government is also particularly concerned about securing public water supply, vital flow for the ecological status and recreational water uses.

3. The main bodies and structures responsible for WS & D activities in Finland are the Finnish Environment Institute (SYKE) and the Finnish Meteorological Institute (FMI). SYKE coordinates environmental monitoring and FMI provides regular meteorological observations from about 500 locations that cover the entire country. Apart from current hydrological information, monthly hydrological reports and monthly hydrological and climatological reviews are also produced. Hydrological simulations and forecasting models are implemented, as well in the framework of several projects. Forecasts are made on a daily basis for 650 discharge and water level observation points.

4. Several hydrometeorological parameters which can be primarily used as drought indices are estimated on a regular basis. These parameters include the actual precipitation (daily and 30 days precipitation), the soil moisture and its deficit, the groundwater levels (which incorporate both simulations and forecasts), the total water power reservoir storage and its fluctuation and the snowpack accumulation.

As far as water scarcity is concerned, the hydrological water balance and water budget for all Finnish catchments, the water abstraction by source (surface water and groundwater) and by sectors and the per capita water use (in litres/capita/day) variation are estimated. The impacts of water scarcity on economic sectors (hydropower production) and its impacts on society (length of period when water level/discharge is inadequate for recreational use) are assessed.

No mitigation measures and policies to combat water scarcity or drought have been identified for Finland. Also, the pricing policy for irrigation is not common and the systems are operated by individual farmers (ec.europa.eu).

France

1. France is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_France≈20%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Despite the fact that water is abundantly available in France, there are chronic imbalances between withdrawals and resources available in a number of basins. Large stretches of river regularly dry up in the summer and the water table in some areas can drop substantially. These chronic situations are different from the difficulties experienced in exceptionally dry years. However, the regular occurrence of dry years increases the vulnerability of those sectors that are subject to excessive withdrawals (*National SD Reports – Droughts*).

Drinking water impact has been limited thanks to the work done on water availability and mainly thanks to the water supply network interconnections built since the drought of 1976 (*National SD Reports – Droughts*). Only a few isolated municipalities which did not carry out this work may today have supply problems. The only recent example: in 2005, 3,000 people were drawing their water supplies from cisterns, out of a population of 60 million.

2. The law on water and aquatic environments in December 2006 included legal provisions on: priority for drinking water over other uses; collective organization of irrigating farmers; quantitative safeguard zones; mandatory water meters in new apartment buildings; coverage of domestic wells; water savings as part of the Water Agencies mandate, etc. Other work is under way in the framework of the management plan and should make real progress possible.

3. In France the organization of potable water supply services, waste and storm water collection and treatment is under the responsibility of municipalities or groups of communities (*National SD Reports – Droughts*). INRA (Institut National de la Recherche Agronomique) carried out a "drought and agriculture" review in 2006 that provided data available to public authorities and stakeholders to support decision-making, particularly:

establishing the physical basis for balanced water resource management; exploring the possibilities for setting up cultivation and production systems better adapted to the new circumstances; analyzing the available avenues for economic and policy action (*National SD Reports – Droughts*).

4. Drought monitoring (DM) in France includes remote sensing technologies, hydrological bulletins, water resources situation reports, hydrological yearbooks, national or regional drought Information portals, water information systems, water portal etc. The website of the ministry in charge of ecology provides every month (every two weeks in the summer) data on weather, hydrology, piezometric pressure, and fill level of the major retention dams. This data is compared to the average of the last fifty years or calculated in terms of frequency. Announcements made by the ministries at the beginning of years identified as dry have enabled farmers to adjust their choice of crops. This information on climate and weather conditions, forecasts and monitoring and rapid warning data is used to mitigate the effects of drought (*National SD Reports – Droughts*).

Supplementing the implementation of all available regulatory instruments aimed at securing water supplies, a water scarcity management plan has been formulated. The water scarcity management plan in France, adopted by the Council of Ministers in October 2005, is structured in three parts: reinforce the legal priority given to drinking water, improve water management by users, farmers and industries; seek better sustainable use of water. The purpose of this plan is to sustainably reduce France's exposure to drought, by providing additional safety margins (particularly with respect to the drinking water supply) and by reconciling the various uses while preserving the quality of aquatic environments (*National SD Reports – Droughts*).

In France drought emergency plans consist in restricting withdrawals by the main consumer (irrigation in the agricultural sector) and the other sectors (manufacturing industry and energy) for the benefit of drinking water supplies. Drought emergency plans are structured by department, with four staged levels, defined in terms of piezometric level or flow rate: vigilance; alert: slight limitation of withdrawals; crisis: partial ban on withdrawals; reinforced crisis: total ban on withdrawals (according to use). A Drought Early Warning System (DEWS) is implemented in France as well as a Drought Mitigation and Response Plan. Also policies in mitigating drought impacts are practiced.

Germany

1. Germany is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Germany≈24%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Germany has experienced dry seasons (mainly dry summers) in the past, the majority of which was of short duration. Concerning the southern Germany, Demuth S. and Heinrich B. (1997) investigated the temporal and spatial variability of drought behaviour, including drought duration and deficit volume (severity). The research concluded that according to an estimated dryness index the years 1962-1964, 1971-1973, 1976 and 1991 can be characterised as dry years. Based on the study, the Alpine region seems to suffer regularly from pronounced winter droughts (October-March), while the Pre-Alps and the River Rhine regions suffer mainly from summer droughts. However, the Pre-Alps and River Rhine regions present high variation coefficient regarding drought occurrence, since the temporal variation on these regions is also increased. In July 2006 an extreme heat wave was reported (Emergency Events Database) and as a consequence 20 people were killed.

Two nuclear plants in Germany recently had to reduce output due to the lack of sufficient water for cooling in rivers. According to WWF, if the droughts occur frequently many nuclear plants that rely on rivers for cooling water will have to reduce output or shut down (WWF_04/08/2006).

2. Securing public water supply is a high priority for the German government. Securing water for energy production, industry and agriculture are also national objectives for Germany.

3. The main bodies and structures responsible for WS & D management in Germany are the German Weather Service (DWD) which is under the Federal Ministry of Transport,

Building and Urban Affairs, the Federal Environment Agency, the Federal Institute of Hydrology, the German Federal Ministry of Education and Research and the Electronical Waterway Information System (ELWIS). The DWD operates several international data centres, which are collecting data over different time scales. Depending on the objectives of each centre, data may be collected only from certain regions. KLIWA, a Research Program under DWD focuses on the impacts of climate change on waterways. The Federal Institute of Hydrology provides most of the relevant products (data/reports/bulletins/yearbooks). GLOWA is embedded in the Ministry research programs for sustainability. It focuses on the problem of water availability and addresses also climate change, precipitation variability etc. Within GLOWA 2 cluster projects concern Germany (Danube, Elbe)

4. Numerous stations assess the current conditions & provide all necessary data for the production of hydrometeorological forecasts. The following parameters are regularly estimated: precipitation (actual rainfall, percentage of normal rainfall, SPI), soil moisture, flows (mean lowest values and statistical analysis), reservoir storage and its fluctuation (for the larger German reservoirs), snowpack accumulation, evaporation, potential water availability, water abstractions (total, by source and by sector) and ecological discharges. Hydrologic Atlas of Germany and the Water and Ground Atlas for Baden Wurttemberg are available. Forecasts, which are constantly produced, activate early warning systems.

Regarding mitigations measures and policies, water saving measures for very dry summers have been identified (e.g. water consumption control in Hamburg). Price policies, which are federal dependant, are also applied as water efficiency measures (EC).

Greece

1. Greece is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Greece≈10%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Greece is presenting a reduction of precipitation during the last 20 years of the period 1951-1990, but there appears a trend of recovery the following decade. In North Greece in the period after 1967 there is a tendency for reduction of precipitation, due to the reduction of the precipitation in winter months. In the Athens area during the period 1976-1990 there was a gradual reduction of precipitation, which led to the great drought period in 1989/90. This was followed by a significant increase in precipitation during the decade 1990/2000. The decade 1984-1994 is the most drought decade in both Athens and Thessalonica areas (*Tsiourtis X. Nicos, 2002*). The frequency of mild and moderate drought conditions is approximately of the same order of magnitude over the whole Greek territory as was shown in a study on *Spatial and temporal analysis of drought in Greece using the Standardized Precipitation Index (SPI)* (*I. Livada and V. D. Assimakopoulos, 2007*). Also development of tourism has led to a water demand in summer from 5 to 10 times higher than in winter in some Greek islands (Cyclades), (Plan Bleu 2004).

2. Securing public water supply is a high priority for the Greek government. Securing water for agriculture and energy production are also national objectives for Greece.

3. The bodies responsible for WS & D activities are the Ministry for the Environment, Physical Planning and Public Works - Directorate General for Environment; the Ministry of Agriculture - Forest Service, the Land Reclamation Service, Department of Environment; the Ministry of Development - Directorate of Water resources. Also the Public Power Corporation S.A. (DEH A.E.), the Greek Institute of Geology & Mineral Exploration and the National Technical University of Athens have records of hydrometeorological data. However these bodies are not well coordinated which creates overlap and gaps in the monitoring stations both spatially and temporally. Since the United Nations Conference on Environment and Development (UNCED), the issues of early warning information to decision makers, and drought preparedness and relief schemes have been addressed in part. Meteorological and hydrological monitoring is moderate.

4. No drought management plan has been identified for Greece. However, mitigation measures have been practiced in cases of drought events and water scarcity periods. In particular measures related to the construction of water reservoirs and distribution systems with priority given to insular areas, groundwater recharge and broad range of



water infrastructure projects; measures for the protection and recharge of water tables although these measures did not attract many beneficiaries; measures to reduce irrigation even though evaluation of these measures is not available.

In the 2007-2013 programmes, Greece has planned to improve the efficiency of irrigation systems but not providing any funding figures makes the statement not easily credible. Also plans foresee the maintenance of highly water consuming crops, like beetroots, converted to energy crops. However the sustainability of such plans is questionable. It is characteristic that reduction of irrigation water consumption up to 30% through set aside and/or creation of standard fallow fringe and/or application of crop rotation were applied on 2.037 ha, corresponding to 0,024% of the regional area and 2% of the problem zone area (Agro-Environmental Measures - AEM).

Training on the sustainable water use of resources is provided by the related university departments. The National Committee is conducting a large scale awareness programme. Major groups (NGOs, women groups, and youth organizations) are ad hoc participants at all planning levels.

Hungary

1. Hungary is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Hungary≈6%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Hungary is located in a climate zone predisposed to drought, and dry periods have always occurred. Large parts of the country are semi-arid or dry sub-humid. According to the worldwide used aridity index, the ratio of annual precipitation to potential evapotranspiration (P/PET), Hungary can be identified as an "affected country" under the terms of the UNCCD. In fact, drought is a considerable and increasing risk factor, especially on the Great Hungarian Plain, an area which is irrigated by canals, and other parts of the country. The problem of droughts is compounded in some areas by soil erosion (*UN Department of Economic and Social Affairs, Division for Sustainable Development*).

Nearly every year Hungary suffers from severe or moderate droughts and drought frequency has increased, primarily in the last decades. Considering future tendencies that have been identified, extraordinary droughts are to be expected, particularly - in patches of variable intensity - in the Great Plain and, to a lesser degree and involving only moderate droughts, in Transdanubia. Considering the typical precipitation levels during the vegetative period, rainfall alone is insufficient to supply the water needs of crops (*UN Department of Economic and Social Affairs, Division for Sustainable Development*). According to the aforementioned future tendencies, an increase in temperature and a significant decrease in precipitation as well as in average soil moisture content is anticipated and therefore the fight against drought is a high priority in Hungary. So far, drought has affected agriculture and the extreme dry spells led to extensive forest fires.

2. The Hungarian government is concerned about securing public water supply as well as vital flow. Regarding public water supply, as part of a long term drinking water supply protection programme launched by the government in 1997, replenishment areas are supposed to be identified for vulnerable supplies that are either active or designated for long-term strategic use.

3. The main organizations that provide up-to-date information about actual environmental data, meteorological observations and forecasts are the *Ministry of Environment and Water*, the *Ministry of Agriculture and Rural Development*, the *Hungarian Meteorological Service - HMS* and the *National Directorate for Environment, Nature and Water*.

4. Several drought indices are estimated for Hungary, such as the Palmer Drought Severity Index (PDSI), the Standardised Precipitation Index (SPI) for series of 3-, 6-, 9- and 18-month time scales, the Palfai Aridity Index (PAI), mainly used by Hydrologists and Water Authorities and the Agro-Hydro Potential (AHP), which is the ratio of effective water consumption and water demand, mainly used by agronomists.

Based on PAI, a partial drought monitoring system is operating in water management and provides information to the local water authorities interested in drought mitigation. This

system will be extended, a general drought monitoring and forecasting system will be established and a special database for drought analysis will be created. The HMS provides an operational statistical (analogue) technique for long-range forecasting (for the last 20 years) / dynamical seasonal forecasts (since 1998) / precipitation, surface air temperature, mean sea level pressure forecasts.

Between 2001 and 2003 a project about National Drought Strategy was initiated and it was the starting point for the present Strategy, which was elaborated in 2006. It is a strategic planning framework for the protection and sustainable management of ecosystems in drought-prone areas and aims at prevention and control of droughts. The key elements of the strategy are promotion of water-saving farming methods e.g. tillage systems, application of organic manure, use of certain types of agricultural machines; plant protection and weed control; amelioration and irrigation; afforestation and plant breeding; and improvement of observation systems.

On 19th February 2007 the New Hungary Rural Development Programme 2007-2013 came into force in order to combat drought effects on agriculture, among others (*Ministry of Agriculture and Rural Development, Department for Agricultural Rural Development*). *Agroecology*, a national research and development programme dealing with water management and water scarcity in agriculture under the leadership of the *Research Institute of Soil Science and Agro-chemistry - RISSAC* of the *Hungarian Academy of Sciences*, and with participation of several academic and scientific institutions of Hungary is currently running (*UN Department of Economic and Social Affairs, Division for Sustainable Development*).

In terms of mitigation measures and policies Hungary implements afforestation programmes that support the planting of the drought-resistant, fast-growing species on the sites that are most vulnerable to climate change are favoured. The government also promotes drought tolerant varieties of the cultivated crop species and farmers are motivated to undertake agricultural activities less stressful on the environment. Forecasting is recognised as one of the most important preventive actions.

Regarding drought damage mitigation Hungary has implemented water retention, storage of excess surface waters, economical use of water supply, increase of the water storage capacity of the soil, alternative development of irrigation regionally, reconstruction of water-flow regulation facilities, integrated excess surface water management and regional water management. In the most endangered by drought areas beside water supplementation it is encouraged to apply environment-friendly irrigation, to spread drought tolerant cultures or to change land use.

Ireland

1. Ireland is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Ireland≈2%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Although Ireland is assumed to be wealthy in terms of water resources, there are substantial regional variations in the availability of water per head of population, with large parts of the east coast already coming under pressure to meet water demand. (<http://icarus.nuim.ie/research/water.shtml>).

Regarding climate change in Ireland the average temperature in the years 2021 to 2060 is expected to be 1 to 1.5°C higher compared to the years 1961 to 2000. For the same years, the prediction model *Community Climate Change Consortium for Ireland - C4I* is predicting wetter winters and drier summers (<http://www.c4i.ie/home.php>). Rainfall will increase in the winter and decrease in the summer. This could lead to droughts and water shortages in the south and east, especially Dublin. There will be fewer but stronger storms.

2. In Ireland, priority is given to the supply of drinking water, water availability for agricultural purposes, fisheries, energy and tourism. Securing the vital flow is also a national objective.

3. The *Department of Environmental and Local Government* and the *Environmental Protection Agency* are responsible for the development of national water resource

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management. The terms of the Environmental Protection Agency Act 1992, provide for the preparation and implementation of national water resource monitoring programmes and overseeing the performance by the 33 local authorities of their statutory environmental protection functions.

4. Numerous hydrometeorological parameters are monitored in Ireland from several bodies, the most important of which are rainfall, temperature, humidity, wind, soil moisture deficits in average and extremes.

To facilitate the implementation of the EU WFD, the *Department of the Environment, Heritage and Local Government* is promoting the establishment by Local Authorities of river basin management projects for River Basin Districts in relation to all inland and coastal waters that will facilitate participation by all stakeholders, and lead to the identification and implementation of effective measures for improved water management. The overall objective of these projects is to develop a River Basin Management System, including a programme of measures designed to maintain and/or achieve at least good water status for all waters, and to facilitate the preparations of River Basin Management Plans (<http://www.wfdireland.ie/>).

Italy

1. Italy could be classified according to the EEA assessment as a water-stressed country in terms of having the WEI_LAstYear1998 index above 20% (WEI_Italy≈24%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

2. Securing public water supply is a national objective for Italy and a detailed study on drinkable water has been carried out. The predominant water use in Italy is the agricultural use and a detailed study on agriculture, industry and hydropower has been conducted. Also hydroelectrical power is a national objective for Italy.

3. The responsible organisations for water management in Italy are the Ministro dell'Ambiente e della Tutela del Territorio e del Mare, the Ministry of Agriculture, the Italian Environment Protection and Technical Services Agency, APAT (Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici, the National Hydrographic Service, the Ufficio Centrale di Ecologia Agraria (UCEA), the Regional Basin Authorities, the Regional Agencies for Environmental Protection (ARPA) centrally co-ordinated by the National Agency for Environmental, the Water Research Institute (IRSA-CNR) and the CIMA - Centro di ricerca interuniversitario in Monitoraggio Ambientale

Drought and monitoring system (hydro-meteorological network of tele-measurement in real time; national water table measuring network;) is in place by the National Hydrographic Service, the Ufficio Centrale di Ecologia Agraria (UCEA) & Ministry of Agriculture. Co-ordination between the different sectors involved in the drought prevention and mitigation by Regional Agencies for Environmental Protection (ARPA) centrally co-ordinated by the National Agency for Environmental Protection (ANPA). The Italian Committee to Combat Drought & Desertification was constituted to coordinate national and local governments and to draw up initially the guidelines for the Italian National Action Programme (NAP) and, later, the actual National Action Programme "The analysis and evaluation of strategies to prevent and combat drought and desertification".

4. Numerous hydrometeorological parameters are monitored in Italy from several bodies, the most important of which are rainfall, streamflow etc. In addition, in Italy hydrological drought is monitored through PDSI and SWSI and a Drought Watch System (drought indicators, monitoring network, links with existing information systems, organisational structure) is in place. Furthermore, the Italian authorities use the Standardized Precipitation Index (SPI): SPI-12, the Cumulative stream flow anomaly and Reservoir storage, the Palmer Drought Severity Index (PDSI): for hydrological drought monitoring and the Surface Water Supply Index (SWSI): for hydrological drought monitoring.

In Italy, Drought Management Plans have been developed and elaboration of general management plans for drought in Italy (River basin authorities & emergency plans by Civil Protection)

Latvia

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1. Latvia is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Latvia≈1%) (EEA, Use of freshwater resources - Assessment published Jan 2009).
2. Public water supply is a national objective for Latvia. Securing water for agriculture, fisheries and vital flow status are also a priority for Latvia.
3. Since January 2004 the management of river basin districts in Latvia has been carried out mainly by 1 institution- The River Basin Authority under The State Geological Survey. The main task of the River Basin Authority under the State Geological Survey is to ensure preparation of basin plans and programmes- what are the main elements for meeting EU and national legislation requirements. Currently most of tasks are subcontracted for external experts or done ion the framework of bilateral assistance projects. Authority's task is to co-ordinate implementation process of programs of measures to meet targets.

Lithuania

1. Lithuania is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Lithuania≈17%) (EEA, Use of freshwater resources - Assessment published Jan 2009).
2. Regarding securing public water supply, there is no policy for combating drought and desertification. The priority is to ensure supply of good-quality in drinking water to the majority of the country's population.
3. The responsible agency for water resources management is the Ministry of Environment.
4. In Lithuania there are decreased groundwater resources and there is a problem in water quality as it is described in the WFD. There is no specific policy for combating drought and water scarcity. Various economic measures are implemented in Lithuania for regulating water resources.

Luxembourg

1. Luxemburg could be classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_LastYear1999 index below 20% (WEI_Luxemburg≈3%) (EEA, Use of freshwater resources - Assessment published Jan 2009).
2. For securing public water supply there is no policy for combating desertification and drought.
3. Responsible organisations for water resources management are the Ministère de l'Environnement, the Administration de l'Environnement and the Ministre de l'interieur - Administration de la Gestion de l'Eau.
4. Water quality is monitored in Luxembourg and drinking water is monthly checked by the Laboratory of Water and the Environment. To guarantee a reliable drinking water supply, an adequate monitoring system is established with regular maintenance. Risk analysis is also carried out.

No drought or water scarcity indices are used in Luxembourg. Various quality parameters (flow of the source, temperature and conductivity of collected water) belong to this program and complementary samples are taken.

No mitigation measures or policy instruments are implemented in Luxembourg.

Malta

1. Malta is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Malta≈30%) (EEA, Use of freshwater resources - Assessment published Jan 2009). In Malta surface waters cannot be exploited economically as 80% of Malta's groundwater resources are abstracted from sea-level fractured-limestone aquifers. Secure groundwater quantity and quality, reversibility of aquifer degradation are examined. Malta's freshwater needs are met with desalinated

water through desalination plants. Thus construction of sewage treatment plants is identified as an important objective.

2. For securing public water supply in Malta, the attainment of internationally acceptable standards in drinking-water quality is important through the undertaking of the necessary improvements in the water production and distribution infrastructure. National priority is also to encourage further water conservation measures with specific reference to the use of cisterns.

The predominant water use in Malta is the agricultural use (irrigation). For the irrigation use, the agricultural water users have turned to groundwater. Thus in order to protect the quality of groundwater, designation of the entire Maltese Islands as a nitrate-vulnerable zone is critical.

3. The responsible bodies and structures for water resources management are the Malta Resources Authority (MRA), the Malta Environment and Planning Authority (MEPA), the Water Services Corporation (WSC), the Health Department, which is responsible for regulating drinking-water quality and the Malta Resources Authority (MRA) which is responsible for the elaboration of studies and consultations to articulate the national water policy.

4. Pricing industrial and agricultural use, irrigation of crops with treated sewage effluent (TSE) and desalinated water is a further priority. Optimization of the use of second-class water and purification of wastewater are further objectives. IWRM coupled with further enforcement of regulatory measures in particular with regard to illegal abstraction is also assessed. The protection of high-status sites in line with the EU Water Framework Directive (WFD) is important for securing basins vital flow.

The main control on urban water demand (e.g. domestic, industrial or tourist sectors) has been the tariff charged by the Water Services Corporation (WSC). Tariffs had the desired effect of encouraging some larger hotels to install their own mini-desalination plants and some industries to recycle water.

Domestic or agriculture sectors overall demand considerably higher water resources than tourism, industry and government organizations (e.g. hospitals and schools). Illicit construction of boreholes has an important overabstraction risk. Farmers observe increasing problems of poor crop quality and yields as a result of deteriorating groundwater quality.

Water-related information exists in Malta but this information is fragmented and difficult to access. The WSC monitoring network (i) has access to safe drinking-water; and (ii) shares distributed water not conforming to quality standards.

Poland

1. Poland is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Poland≈24%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

2. Public water supply is a national objective for Poland. Securing water for agriculture, hydroelectric power and vital flow status are also a priority for Poland.

3. The bodies and structures responsible for water resources management in Poland are the Polish Ministry of the Environment, the 7 Regional Water Management Boards, the National Water Management Board and the Institute of Environmental Protection. In addition SOK holds a database with a radar map with animation from 1 -24h.

4. The National Council for Water Management pronounces opinions on the matters of water management, flood control and drought impact. The Polish bodies maintain systems for weather forecasts and actual weather data, hydrological forecasts and actual hydrological data, products of agrometeorological protection, assessments of wind energy resources and studies concerning domains such as meteorology, hydrology, water management and hydrometry.

Portugal



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1. Portugal is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Portugal≈10%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Droughts are natural phenomena that occur in Portugal regularly with more or less intensity but always with widespread impacts in such diverse fields as agriculture, irrigation, forest fires water distribution to the populations and energy generation.

The very pronounced annual precipitation cycle, with almost no rain during the summer months, especially in the south part of Portugal, leads to the necessity to store water during the winter to be used during the summer.

The longer the drought, the more important its consequences are, but if it lasts less than a year, a winter drought is more important and has severer consequences than a summer one, as it occurs during the Portuguese rainy season.

2. The predominant water use in Portugal is the agricultural use and there water abstractions are mainly used for irrigation. Main objectives of the water management sector in Portugal are to improve public water supply and water treatment systems and to improve the efficiency of these systems and to reduce water mismanagement (Portugal – Operational Programme 2007-2013). This is to be done through support for the construction of water supply and water treatment infrastructures.

In addition, another specific objective of the water management sector is to complete the basic primary water supply and to manage the distribution for irrigation and other needs. This is to be pursued through the construction of water supply and water-transport systems (OP Portugal 2007-2013).

3. The bodies and structures responsible for water resources management in Portugal are the INAG - Instituto da Água, Planning Department & Water Resources Department, the Instituto de Meteorologia, the Agência Portuguesa do Ambiente (APA) and the Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional.

4. To secure Vital flow the 'RIOS' system is implemented under which Portugal has established an integrated network to monitor river flows, rainfall, reservoir levels and water quality in all the country's river basins.

Portugal has established a National/Regional Drought Information System SNIRH: Synthesized Data - Water Resources - Drought Monitoring and uses remote sensing through the Meteorological Observatory. In addition, Portugal has established a National Inventory of Water Supply and Sewers Systems as well as the RIOS system which is a water resources alert and surveillance system.

Portugal uses indices such as Actual precipitation; % of normal Rainfall; Precipitation deciles; Standardized Precipitation Index (SPI); Palmer Severity Drought Index (PSDI) as well as drought and water scarcity indicators/indices such as Palmer Moisture Anomaly Index (Z index); Cumulative stream flow anomaly; 7-day average flow; Surface Water Supply Index (SWSI); Reservoir storage; measurements of impacts on economic sectors; Hydrological Water balance; Aquifer Depletion - changes in water table; Reservoir storage fluctuations; Fire potential (e.g. Keetch-Byram Drought Index)

The national water resource information system (SNIRH), including the main hydrometeorological data collected from the national networks, with yearly, monthly, daily and hourly data and also reports, legislation, and other data. This is a national water resource information system, including the main hydrometeorological data collected from the national networks, with yearly, monthly, daily and hourly data and also reports, legislation, and other data. This is the main data base about water resources in Portugal.

In addition, SVARH a real time water resources warning system, with hourly data. It permits to have in real time information about basins, rivers and reservoirs, with data collected from a network of stations of rainfall, flows and reservoirs. This is a complete information data base about the water users and the infrastructures of water supply and sewers, including physical and economic characterisation and water use quantification. It is a support for the socio-economic drought evaluation, mainly during a drought management

Romania

1. Romania is classified according to the EEA assessment as a severely water-stressed country in terms of having the WEI_90 index above 40% (WEI_Romania≈41%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

2. National priorities for Romania are public water supply and flooding and water pollution mitigation.

3. The bodies and structures responsible for water resources management in Romania is the Ministry of Environment & Water Management (MEWM).

4. The Ministry of Environment and Water Management has designed and is in the stage of implementation of a monitoring system for water management in case of disasters (WATMAN). This system incorporates water balance monitoring in reservoirs and in-time behaviour of dams, inter-basins derived water volumes measurement and the monitoring of the most important catchments with influence over natural runoff regime. The data collected and directly processed, stored at meteorological, hydrologic and water management databases will be the basis of a Decision Support System usage.

In Romania there are no drought and water scarcity indices used as well as no mitigation measures to combat drought and water scarcity.

Slovakia

1. Slovakia is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Slovakia≈2%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Desertification and drought is not currently urgent in Slovakia. However Slovakia has experienced severe droughts, particularly in recent years.

2. Public water supply accounts for more than a quarter of the overall water consumption in Slovakia. In eastern Slovakia, drinking water supply is being ensured with surface water reservoirs, as scarcity problems have arisen in groundwater. Distribution of sectoral water abstractions in Eastern Slovakia river basins affected by water scarcity: public water supply (51%), agriculture (4%), industry (45%).

3. The bodies and structures responsible for water resources management are the Ministry of Environment of the Slovak Republic and the Slovak Hydro-meteorological Institute.

4. There is no national policy for combating desertification and drought in Slovakia.

Slovenia

1. Slovenia is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Slovenia≈1%) (EEA, Use of freshwater resources - Assessment published Jan 2009). Slovenia has rich water resources, although they are not spatially uniformly distributed. Water covers about 272 km² of Slovenia's territory, while geologic units, which may store and transmit groundwater, contain about 50 m³/s of dynamic supply.

2. Public water supply is a national objective for Slovenia in terms of water quality.

3. The bodies and structures responsible for water resources management in Slovenia are the Ministry of the Environment and Spatial Planning, Environment Directorate, the Inspectorate of the Republic of Slovenia for the Environment and Spatial Planning and the Environmental Agency of Slovenia.

4. In Slovenia the responsible bodies monitor and measure individual elements of the water cycle at hydrologic monitoring stations for surface water (watercourses, lakes, sea) and for groundwater and springs

The Environmental Agency of the Republic of Slovenia:

- measures levels and temperature of groundwater, springs, rivers, lakes and sea, and determines changes

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- monitors river discharge regimes, and notes changes on the basis of water level and hydrometric measurements
- issues warnings of an increased risk of flooding from rivers and sea, and of declining water levels of surface and groundwater
- manages waters in a manner to protect water in all its forms, regulates waters and decides on the use of water in accordance with: long-term protection of available water resources
- keeps databases, records and registers in the area of water quality and quantity
- Hydrological data - automatic gauging stations and observations: Water table level, Discharge, Temperature
- The index that is mainly used is the Discharge Decile Class

Spain

1. Spain is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index above 20% (WEI_Spain≈31%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

3. The Spanish Ministry of Environment, the Andalusian Water Agency and the Catalan Water Agency are the three governmental bodies that are more involved in the definition and implementation of strategies, monitoring systems and data acquisition for drought management in Spain.

Regional Governments have more extended competences in their own territory than the National Government in the whole country, and some River Basins are belonging to the regions. In some cases the development of common indicators, indexes and measures are not ensured in between the regional water agencies and public bodies.

However there is a problem identified in Spain in relation to the internal organisation of the water management authorities. Spain is divided into 19 different Autonomous Communities that have fully competences on water management in their own territory without any common base, what it makes difficult the coordination and the implementation of national drought plans due the different regional interests.

An example of this problem is that the Spanish Ministry of Environment is not offering data regarding drought and water scarcity from those River Basins that have been transferred to the Regional Governments (Andalusia, Catalonia, Galicia, Basque Country, Balearic Islands and Canary Islands), the available core set of maps at the Spanish Ministry's web site is already classifying part of these Spanish regions as "no data".

4. Spain is considered a high water stressed country according to the relevant EEA reports and the national and regional governments are reacting quickly in the implementation of action plans to manage the drought periods. In this sense all the River Basin Authorities belonging to the Spanish Ministry of Environment have already put into force their own Drought Management Plan as a complement to the River Basin Management Plan establishing the different methodologies and actions that each Authority should take into account for emergency situations.

During the last years and facing the implementation and transposition of the Directive 2000/60/CE into the Spanish Legal System, the Spanish Ministry of Environment and other Public Bodies such as the Hydrological Studies Centre and the Spanish Observatory on Sustainability have created a core set of indicators on waters that facilitate a better understanding of the water resources status and identify the main pressures and uses of the water in Spain. Some indicators are directly involved with drought management and water scarcity. The underpinning data related with this core set of indicators is periodically updated at the public and integrated information systems on waters at the Ministry's web site. In addition to the National Government, the Autonomous Communities of Andalusia and Catalonia have also developed regional indicators to follow up the water scarcity within the region.

Sweden

1. Sweden is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Sweden≈1%) (EEA, Use of freshwater resources - Assessment published Jan 2009).



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Water resources in Sweden are abundant with more than 100.000 lakes and a yearly runoff estimating 175.000 million m³. Cases of water scarcity are restricted to archipelago areas and the islands Gotland and Oeland. Therefore it can be assumed that Sweden in general does not suffer from water scarcity or droughts. However, some drought incidents have been recorded, such as the severe drought of 1993 and the record-breaking European heatwave of 2003 definitely affected Sweden, as well. It was preceded by an unusually dry spring during which soils dried up across the continent. Also extreme temperatures were recorded in July 2006. Hot summers had as a result power cuts in Swedish nuclear power plants.

2. In Sweden water abstraction is implemented mainly for public water supply and for manufacturing industry. An important objective for the Swedish government is the securing of hydroelectric power.

3. The main bodies and structures responsible for WS & D activities in Sweden are the Swedish Meteorological and Hydrological Institute (SMHI), the Stockholm International Water Institute (SIWI), the Swedish International Development Cooperation Agency (SIDA) and the Swedish Water House (SWH). Since drought does not seem to be a major problem of Sweden, those bodies are activated for combating drought problems of other countries. SIWI is a policy institute whose diverse Stockholm-based, internationally-oriented programmes and activities contribute to finding sustainable solutions to the world's escalating water crisis. The United Nations Environment Programme Finance Initiative (UNEP FI) and SIWI initiated the project on water-related challenges for financial institutions, with the main aim founded on the need to learn and expand on the issues that arise from dealing with water scarcity and identify opportunities for the financial sector for contributing to sustainable development through active engagement in mitigating water related risks. SIDA is a government agency under the Ministry of Foreign Affairs and is working raising awareness and responsibility for social and environmental issues for long-term sustainability of the economic growth.

4. As far as the situation in Sweden is concerned, environmental monitoring for studying trends and effects is regular and relevant reports are also regularly produced. The main meteorological parameters daily recorded include precipitation, temperature, wind and snow depth and are available at request. Also, extreme values of the hydrometeorological characteristics of the previous day are recorded and reported. Weather, climate and runoff forecasts are produced.

In Sweden criteria for environmental quality assessment that intend to classify and/or facilitate the interpretation of environmental data have been established e.g. criteria for evaluating groundwater potability, criteria for agricultural landscape etc.

Concerning mitigation measures and policies, brochures, policy briefs with structural policy suggestions, policy reports and textbooks or even techniques to manage demand in dry periods ranging from temporary restrictions on water use to public education campaigns, have been identified.

The Netherlands

1. The Netherlands is classified according to the EEA assessment as a non water-stressed country in terms of having the WEI_90 index below 20% (WEI_Netherlands≈9%) (EEA, Use of freshwater resources - Assessment published Jan 2009).

In the Netherlands there is increased water abstraction. Water deficits (demand vs available water) occur annually. Precipitation deficits (max. cumulative difference between precipitation and evaporation over the period 01/04-01/10) are experienced every summer season. Water deficits have regional characteristics that vary according to local area features (elevation, groundwater regime, soil type, land use, water-transporting infrastructure) and the presence of water-dependent sectors. Furthermore, drinking water reservoirs are constructed in a proper way so as to overcome possible water deficits and therefore it is rather unlikely that drinking water deficits occur. However, increased local demand may lead to a significant drop in its pressure.

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Warm summers, as the one recorded in 2003 result in deficit of cooling water causing problems in power stations, affecting by that way the energy supply. Extreme dry spells led in the past to extensive forest fires, as well. As far as agriculture is concerned, it forms the larger single water consumer for the Netherlands and water deficit for irrigation can cause calamitous damages to crops.

2. The maintenance of water level in dikes is extremely important for safety reasons. The highest priority in the Netherlands is given to water-level control in low-lying areas to prevent settling and safeguard the stability of flood barriers. When the water level drops, the stability of the flood barriers deteriorates and the protection against flooding is reduced. The security of water supply for energy production, agriculture, manufacturing industry and inland fisheries is also a high priority for the Danish government. The negative impact of water deficit both on aquatic habitats and terrestrial nature has been clearly identified in the Netherlands. Moreover, the Danish government is concerned about the impacts of drought social activities and mainly on cruising, recreational angling and swimming.

3. The main Dutch bodies and structures responsible for WS & D management are the Ministry of Transport, Public Works and Water Management and the Royal Netherlands Meteorological Institute (KNMI).

4. Drought monitoring in the Netherlands includes remote sensing technologies. National Drought Information, Drought Reports, Hydrological Bulletins and Yearbooks, Climate Atlas and Water Situation Reports are produced on a regular basis. Water balance, annual precipitation deficit (and its comparison with the dry years since 1976), monthly precipitation anomaly, top soil moisture and top soil moisture anomaly maps (from observed and forecasted data) and annual seasonal variation in runoff compared with dry years are also available.

As far as Drought Management Plans are concerned, by the end of 2006 the government produced an update of the 2005 Drought Study. Then it decided whether changes are needed in the national water supply priority series. Moreover, 3-month precipitation and temperature forecasts are produced and when necessary they activate Drought Early Warning Systems.

Several mitigation measures and policies have been identified in the Netherlands. The most important are listed below.

- A time-dependent (month-dependent) lower limit is assumed for Rhine discharge levels. The LCW (National Coordination Committee for Water Distribution) assembles when the limits at Lobith are exceeded & the situation is expected to last longer than 3 successive days.
- If Meuse discharge is less than $25m^3/sec$, the Head Engineer from the Department of Public Works requests a LCW meeting with the Limburg directorate.
- A LCW meeting takes place also when water temperature at Lobith exceeds $23^\circ C$.
- Anti-drought measures, such as letting in fresh water and changing the management of sluices, can exacerbate the salinisation of surface water and groundwater in those parts of the country at or below sea level.
- During water deficit water drainage is avoided as much as possible.
- Abstractions of drinking water are avoided where and/or when possible.
- Weirs and discharge sluices are kept closed with full chambers.
- Flushing used to combat salinisation is restricted.
- Anti-drought measures, such as letting in fresh water and changing the management of sluices, can exacerbate the salinisation of surface water and groundwater in those parts of the country at or below sea level.
- In general, every user is expected to use water as efficiently as possible.

United Kingdom

1. UK is classified according to the EEA assessment as a water-stressed country in terms of having the WEI_90 index just above 20% ($WEI_{UK} \approx 20\%$) (EEA, Use of freshwater resources - Assessment published Jan 2009).

Naformátováno: není zvýrazněné

Naformátováno: není zvýrazněné



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2. In United Kingdom water abstraction is mainly implemented for public water supply. Secure public water supply is a national priority for United Kingdom. Industrial and agricultural water uses as well as securing vital flow status are also a national objective.

3. The bodies and structures responsible for water resources management in the United Kingdom are the Environment Agency, DEFRA, the Scottish Environment Protection Agency, the Centre for Ecology and Hydrology and others.

4. Monitoring of water resources is implemented through a monitoring network and yearly reports are published. In terms of indicators for drought, in the UK the following are being used: for meteorological drought cumulative rainfall anomaly; for agricultural drought soil moisture deficit; and for hydrological drought GW levels compared with long-term range for time of year. In terms of indicators for water scarcity, in the UK the following are being used: measurement of abstraction and use per sector and per type of resource (GW & SW), catchment water balances contained in around 100 Catchment Abstraction Management Strategies in England and Wales; and surface water low flow comparison with long-term average low flows.

The Environment Agency publishes an Early Drought Prospects report when drought threatens and throughout the drought. They identify the hydrological situation, the area likely to be affected by drought, and recommended actions for water companies, farmers and people.

In addition, in UK monthly water situation reports are published together with monthly hydrological summaries. Water situation reports cover rainfall totals, river flows, soil moisture deficit, groundwater levels and reservoir levels. These are produced monthly at all times, with weekly information during droughts. Furthermore, monthly hydrological summaries have an in-depth textual summary on current UK hydrological conditions and a general appraisal of water resources status. A commentary is provided on regional & national monthly rainfall (totals & accumulations), monthly river flows (accumulations & peaks), groundwater levels and reservoir levels with occasional soil moisture deficit information.

All water supply companies have drought plans by law. These can be found on each company's own web site. The Water Industry Act 1991 (as amended, WIA91) requires water supply companies (which provide public water supplies) to produce long term (25 years, revised every 5 years) plans for supply-demand balance and to produce drought plans (revised yearly) in order to allow for water supply companies to impose restrictions on garden watering and some other household water use (powers to extend, expected to be in 2010). These drought plans from water companies explain the measures that water companies will take to identify and manage the impact of drought. They include measures to reduce demand as well as improved leakage control and resource options. The plans include an assessment of the environmental impact of different drought management options. The plans are subject to public consultation and are submitted to Ministers.

Furthermore, the water supply companies of England and Wales have a statutory duty to prepare and maintain water resources management plans (s37A Water Industry Act 1991). These will explain the measures that water companies will take to maintain public supplies, setting out the measures used to promote water efficiency, reduce leakage etc. The plans are subject to public consultation and are submitted to Ministers. Draft plans are being consulted on in mid-2008 and will be finalised in 2009.

In addition, Water Resources Act 1991 allows for Ministers to make drought orders – these can allow further restrictions on water use to manage demand, and also for restrictions on abstraction to protect the environment. The drought plans set out the circumstances in which these measures are to be deployed.

Environment Agency drought plans set out the management structure and actions for drought management. They cover drought monitoring, triggers for drought status, the way that decisions will be made during a drought, any changes to management structure that are necessary, and communications work. They are at river basin and sub-river basin scale, with an overview drought plan for England and Wales.



In terms of mitigation measures in England and Wales spray irrigation can be limited by the Environment Agency as needed (s57 Water Resources Act 1991) in addition many abstraction licences have conditions that limit/stop abstraction at times of low flows or water levels. In Northern Ireland water use restrictions and interruptions are determined by assessment of the extent of water scarcity.

4.2 RESULTS AT EUROPEAN LEVEL

The European actors that are active in the field of water scarcity and drought were identified at the European level. These actors, in alphabetical order, coupled with a short description, are:

1. DG Environment – Directorate General Environment

DG Environment has initiated the debate around water scarcity and drought issues since 2003. In 2007, following two Interim Reports on WS&D a Communication was drafted for addressing WS&D. Following that DG Environment is active in the policy making for addressing WS&D through the funding of related activities (i.e. EUWI) of EU institutions and research projects and the publication of reports, studies and policy documents relevant to WS&D.

2. DG Regional Policy

The mission of the Directorate General for Regional Policy is to strengthen economic, social and territorial cohesion by reducing disparities between the levels of development of regions and countries of the European Union. In this way the policy contributes positively to the overall economic performance of the EU. DGRegio funds through instruments like INTERREG projects related to water scarcity and drought.

3. DG Research

The mission of the Directorate General for Research is to develop the European Union's policy in the field of research and technological development and thereby contribute to the international competitiveness of European industry; to co-ordinate European research activities with those carried out at the level of the Member States; to support the Union's policies in other fields such as environment, health, energy, regional development etc.; to promote a better understanding of the role of science in modern societies and stimulate a public debate about research-related issues at European level. DG Research funds through instruments such as FP6 and FP7 projects related to water scarcity and drought.

Examples of projects funded under DG Region and DG Research:

a. EC-IP WATCH: WATer and global Change: Drought in Europe (<http://eu-watch.org>)

Integrated Project Water and Global Change (WATCH), funded under the EU FP6, is a collaboration of 25 policy and research institutions.

Objectives:

1. To integrate modelling of the water cycle into global and regional climate models
2. To better quantify possible changes in the water cycle due to human influences and climate change in the period 2000-2100 - esp. floods and droughts
3. To assess impacts of the changes on agriculture, industry, energy, drinking water supplies and the environment
4. To analyse and describe the current global water cycle
5. To evaluate how the global water cycle and its extremes respond to future drivers of global change
6. To evaluate feedbacks in the coupled system as they affect the global water cycle
7. To develop a modelling and data framework to assess the future vulnerability of water as a resource

b. AQUASTRESS (<http://www.aquastress.net>)

EU funded integrated project (IP) contract n°511231-2 - 6th EU Framework Programme for RTD.

Objectives:



1. Major advances in the understanding, effectiveness and empowerment of stakeholder driven participatory decision making in water management at local and regional scales;
2. New insights into the pressures and drivers of water stress in different regions of the EU, and in the regional aggregation of stakeholder based decisions;
3. New assessments of diverse policies, institutions and cultural factors as causes and remedies to water stress, leading to new measures of the effectiveness and side effects of mitigation options;
4. New approaches to the integration of diverse multi-sectoral and multi-disciplinary expertise for participatory vulnerability assessment and adaptive planning;
5. The development of IT knowledge management tools to support this new management approach;
6. Identifying areas where new technologies would have the most impact in mitigating water stress;
7. A culture change in the European approach to water management, from centralist infrastructure dependency towards a distributed, bottom-up, adaptive integrated systems approach.

4. DMCSEE - Drought Management Centre for South-eastern Europe

(<http://www.dmcsee.org>)

DMCSEE was initiated jointly by the World Meteorological Organization and the UN Convention to Combat Desertification. The mission of DMCSEE is to coordinate and facilitate the development, assessment, and application of drought risk management tools and policies in South-Eastern Europe with the goal of improving drought preparedness and reducing drought impacts. Therefore DMCSEE focuses on monitoring and assessing drought and assessing risks and vulnerability connected to drought.

Objectives:

1. To assess the data available for effective drought monitoring and early warning system.
2. To evaluate and select the most effective and reliable indices and indicators for drought assessment.
3. To conduct a drought risk assessment.
4. To identify the specific training needs.
5. To develop and implement a data and information delivery system on drought management.
6. To develop a comprehensive network of experts and institutions to assist the DMCSEE.
7. To ensure communication and user feedback.
8. To establish the permanent DMCSEE and ensure its sustainable functioning and operations.

5. EDC - European Drought Centre (<http://www.geo.uio.no/edc/>)

EDC is a virtual centre with the aim to act as a networking platform for actors that are active in drought related activities in Europe. The main aim of EDC is to assist in the process towards mitigation of the environmental, social and economic impact of droughts. EDC promotes collaboration and capacity building between scientists and the user community and thereby increase preparedness and resilience of society to drought.

Objectives:

1. Work towards a better understanding of the drought phenomenon

2. Act as a platform to initiate and discuss scientific progress on drought research within the academic society, but as important be a meeting place between multi-disciplinary experts in drought research, policy and operational management
3. Act as a forum for discussion on policy issues related to sustainable water resources management in a pan-European context, e.g. implications of the Water Framework Directive on low flow and drought management
4. Liaise with international organisations and programs (e.g. UNESCO, WMO-HWRP, IAHS), EU framework programs, international river commissions and regional drought centers
5. Work towards establishing a European Drought Watch System, focusing on drought forecasting and monitoring at the pan-European level
6. Support the developing of national drought mitigation plans based on best practice guidelines

6. EEA – European Environment Agency (www.eea.europa.eu)

The European Environment Agency (EEA) is an agency of the European Union, established in 1990, with the mandate to help the Community and member countries make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability and to coordinate the European environment information and observation network (Eionet) and the integration of all relevant data flows into the Water Information System for Europe (WISE).

EEA received a grant from DG Environment to work towards addressing Water Scarcity and Drought. Following that EEA established a new State of the Environment reporting sheet for water quantity in order to set up a stable data flow for the availability and abstraction of water resources in the Member States and to upgrade the CSI 018 use of freshwater resources.

In addition EEA has initiated a work programme towards addressing WS&D which includes the establishment of an indicator framework for WS&D.

7. ENPI - European Neighbourhood and Partnership Instrument

(http://ec.europa.eu/europeaid/where/neighbourhood/index_en.htm)

Direct link to WS&D: **FUNDING PROJECTS RELEVANT TO WS&D**

The ENPI is the main source of funding for the 17 partner countries (ten Mediterranean and six Eastern European countries, plus Russia). The ENPI replaces the co-operation programmes TACIS (for the Eastern European countries) and MEDA (for the Mediterranean countries). In this light, the ENPI appears as the strategic continuity with enlarged objectives of the former TACIS and MEDA programmes. The overall allocation for the ENPI instrument amounts to almost €12 billion for the seven-year period 2007-2013. This represents an increase of 32%, in real terms, compared with the amount available over the period 2000-2006 for the MEDA and TACIS programmes. The main purpose is to create an area of shared values, stability and prosperity, enhanced co-operation and deeper economic and regional integration by covering a wide range of co-operation areas. ENPI priorities "will be identified in key areas such as water quality, waste management, air pollution and the fight against desertification".

ENPI's proprietor MEDA funded several projects relevant to WS&D.

MEDA Water programme: Euro-Mediterranean Regional Water Programme for Local Water Management (<http://www.medawater-rmsu.org/>)

Direct link to WS&D: **FUNDING PROJECTS RELEVANT TO WS&D**

MEDA-Water is the water sector's regional programme of the financial instrument, MEDA. A call for proposals was launched in 2002, with a total budget of 40 M€. Since early 2005, the MEDA-Water programme is managed by the EC delegation of Jordan.

Objectives:



1. The improvement of the performance of the MEDA Water projects through improvement of planning and follow up of activities and progress towards achievement of objectives;
2. The improvement of co-ordination between the MEDA Water projects through the facilitation of information exchange, the organisation of workshops and the stimulation of interaction between the projects; and
3. The promotion of the MEDA Water programme through the preparation of promotion materials, the development of a MEDA Water website, promotion of MEDA Water activities towards decision makers and support of the MEDA Water projects in their promotion activities.

Examples of projects funded under MEDA, are:

1. EMWater - Efficient management of wastewater, its treatment and reuse in the Mediterranean countries.
2. EMPOWERS Euro-Med Participatory Water Resources Scenarios
3. ISIIMM - Institutional and social innovations in irrigation Mediterranean management.
4. MEDAware - Development of tools and guidelines for the promotion of sustainable urban wastewater treatment and reuse in agricultural production in the Mediterranean countries.
5. MEDWA - Cooperation with Jordan and Palestine for the stakeholder participatory sustainable water management at farm level.
6. Zer0-M - Sustainable concepts towards a zero outflow municipality.

Even though these projects are not directly linked to WS&D their outcomes will enhance the response to WS&D.

8. EMWIS – SEMIDE - Euro-Mediterranean Information System on know-how in the Water sector (www.semide.net/initiatives)

EMWIS is an initiative of the Euro-Mediterranean Partnership. It provides a strategic tool for exchanging information and knowledge in the water sector between and within the Euro Mediterranean partnership countries. The countries involved in the Euro-Mediterranean Partnership are the 27 EU member states and the 10 Mediterranean Partner Countries (Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine, Syria, Tunisia and Turkey).

Objectives:

1. To provide easy access to information, with special emphasis on:
 - a. Institutions: types of institutions and people involved.
 - b. Documentation: Existing centres and their organisation; the means and technologies used for processing, accessing, consultation and dissemination, standardisation and quality certification.
 - c. Training: Existing organisations, programmes, localisation, trainers, methods, training materials, quality certification.
 - d. Research and development: Existing organisations, programmes, people involved, means and technologies, publications, partnerships, funding sources.
 - e. Data administration: Existing organisations and databases, methods used for data gathering and checking, publications.
2. To develop the sharing of information
3. To work together on common products and cooperation programmes.

EMWIS - SEMIDE research activities relevant to WS&D are presented below:

- 8.Towards a Mediterranean Water Information Mechanism compatible with the Water Information System for Europe (WISE) Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Tunisia, Turkey, Syria, Palestine EC-ENRTP (2008)
- 9.Water Scenarios for Europe and for Neighbouring States Finland, Spain, Poland, Netherlands, France, Turkey, United Kingdom, Estonia, Italy, Greece, Hungary, Russian Federation INCO MED (FP6) (2006)
- 10.Mediterranean Drought Preparedness and Mitigation Planning Spain, Cyprus, Morocco, Greece, Tunisia, Italy MEDA-WATER (2003)
- 11.Euro-Med Participatory Water Resources Scenarios Improving long-term access and rights to water for local populations in Egypt, Jordan and West Bank/Gaza (2003)

9. EU-INCO: International Research Cooperation with Mediterranean Partner Countries (<http://ec.europa.eu/research/iscp/index.cfm>)

EU-INCO's mandate is to jointly mobilise European and partner countries' research teams to help solve social problems of regional interest to partner countries.

Objectives: To become more competitive and play a leading role globally, the European Community needs a strong and coherent international science and technology (S&T) policy with three objectives:

- 1.support European competitiveness through strategic partnerships with non-EU countries in selected fields of science and by engaging the best scientists from such countries to work with and in Europe;
- 2.enhance the production of knowledge and scientific excellence by enabling European universities, research institutions and firms to establish contacts with their partners in such third countries, thereby facilitating access to research environments outside Europe and promoting synergies on a global scale;
- 3.address specific problems that third countries face, or that have a global character, on the basis of mutual interest and mutual benefit.

A selection of EU-INCO research activities relevant to WS&D, are shown below:

- 8.MEDROPLAN Mediterranean Drought Preparedness and Mitigation Planning
- 9.ASTHyDA Analysis, synthesis and transfer of knowledge and tools on hydrological drought assessment through a European Network
- 10.DSS-DROUGHT A decision support system for mitigation of drought impacts in the Mediterranean region
- 11.WAM-ME Water Resources Management under Drought Conditions: Criteria and Tools for Conjunctive Use of Conventional and Marginal Waters in Mediterranean Regions
- 12.WATERWEB Water resource strategies and drought alleviation in Western Balkan agriculture

10. EU LIFE, Financial Instrument for the Environment
(<http://ec.europa.eu/environment/life/index.htm>)

Introduced in 1992, is one of the spearheads of the European Union's environmental policy. It co-finances projects in the European Union and some third countries bordering the Mediterranean and the Baltic Sea, as well as in EU candidate countries that have chosen to participate. Under EU Life projects may be funded that are relevant to water saving and integrated water resources management.

11. EURAQUA (<http://www.euraqua.org>)

EURAQUA is the European Network of Freshwater Research Organisations. The aim of EurAqua is to contribute substantially to the development of European freshwater science and its dissemination on a European scale, thus having a significant input on the development of the scientific basis of European water management.



Objectives:

1. Integration of European research resources through joint actions and initiatives
2. Promoting the collaboration and efficient transfer of knowledge between scientific institutions and between researchers
3. Providing expert advice to EU institutions and other stakeholders
4. Increasing the competitiveness of the European water sector on a global scale

12. EUROSTAT (<http://epp.eurostat.ec.europa.eu>)

Eurostat's mission is to provide the European Union with a high-quality statistical information service of statistics at European level that enable comparisons between countries and regions.

In terms of water resources quantity, EUROSTAT has established a reporting request together with OECD which is requested from the Member States every two years. The results from this questionnaire were used up until 2008 from EEA to support the assessment of the CSI018 – Use of Freshwater Resources.

13. EU-SMAP - The Short and Medium-term Priority Environmental Action

Programme (<http://ec.europa.eu/environment/smap/home.htm>)

SMAP is a framework programme of action for the protection of the Mediterranean environment, within the context of the Euro-Mediterranean Partnership. It was adopted unanimously by the Euro-Mediterranean Ministerial Conference on the Environment, held in Helsinki on the 28 November 1997.

Priorities:

1. Integrated Water Management,
2. Integrated Waste Management,
3. Hot Spots (including polluted areas and threatened biodiversity zones),
4. Integrated Coastal Zone Management and
5. Combating Desertification.

14. JRC (<http://desert.jrc.ec.europa.eu>)

The DESERT action team was created in January 2008. DESERT staff has a wide range of experience related, for example, to land management, climatology, hydrology, remote sensing, GIS, or database development. The aim of the team is to support decision makers with expert knowledge and access to relevant information from the regional to the global scale.

Objectives:

1. Development of a European Drought Observatory as a contribution to a global drought monitoring system.
2. Evaluation and development of benchmarks and indicators for the assessment of drought and desertification processes and their impacts.
3. Development of a global Early Warning System (EWS) for desertification.
4. Development of the new World Atlas of Desertification

4.3 RESULTS AT THE INTERNATIONAL LEVEL

Actors from the international were identified that are active in the field of water scarcity and drought. These actors, in alphabetical order, coupled with a short description, are:

1. FRIEND - Flow Regimes from International Experimental and Network Data

The FRIEND programme is an international collaborative programme intended to develop, through the mutual exchange of data, knowledge and techniques at a regional level and a better understanding of hydrological variability and similarity across time and space. The advanced knowledge of hydrological processes and flow regimes gained through FRIEND helps to improve methods applicable in water resources planning and management. FRIEND is a cross-cutting programme that interacts with all five core IHP-VI themes.

A FRIEND project relevant to WS&D is the NE-FRIEND (Northern European FRIEND) Project 2: Low Flow and Drought (<http://ne-friend.bafg.de/servlet/is/7398/>)

2. GWP- Med - Global Water Partnership – Mediterranean (www.gwpmed.org)

GWP - Med is a Regional Water Partnership of the Global Water Partnership (GWP). GWP-Med, in its present form, was created in 2002 and it is the successor partnership to the Mediterranean Technical Advisory Committee of GWP (MEDTAC).

Objectives:

1. Promotes and sustains a strong partnership in the Mediterranean among competent organisations that have an impact on water management.
2. Makes the principles of sustainable use and integrated management of water resources (IWRM) widely known, recognised and applied by countries and all other stakeholders in the Mediterranean, through appropriate mechanisms for sharing information and experience.
3. Supports exemplary actions at local, national and regional level that demonstrate the value applicability and positive impact of the above principles.
4. Seeks and facilitates the appropriate international funding and involvement of international institutions for activities promoting IWRM.
5. Introduces, helps to implement and adapts to the specificities of the Mediterranean region, global initiatives launched or adopted by the GWP.

3. NDMC - National Drought Mitigation Center (<http://www.drought.unl.edu>)

The NDMC, established in 1995, is based in the School of Natural Resources at the University of Nebraska-Lincoln. The National Drought Mitigation Center (NDMC) helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management.

Objectives:

1. Understanding and Defining Drought: A discussion of the concept and definition of drought.
2. Drought Indices: An analysis and discussion of 8 drought indices, also available as a pdf.
3. Predicting Drought: The multiple causes of drought and their use in drought prediction.
4. Drought and Climate Change: A short history of the Greenhouse Effect and climate change.
5. Other Resources: Resources on El Nino and Climate Change



4. NIDIS - National Integrated Drought Information System (<http://www.drought.gov>)

The NIDIS Act was introduced in the U.S. Congress and signed by the President in 2006.

Objectives:

1. Develop the leadership and networks to implement an integrated drought monitoring and forecasting system at federal, state, and local levels.
2. Foster and support a research environment focusing on risk assessment, forecasting, and management.
3. Create an ""early warning system"" for drought to provide accurate, timely, and integrated information.
4. Develop interactive systems, such as the Web Portal, as part of the early warning system.
5. Provide a framework for public awareness and education about droughts

5. UNCCD - United Nations Office for Combat of Drought and Desertification (<http://www.unccd.int>)

The permanent Secretariat of the UNCCD was established during the first Conference of the Parties (COP 1) held in Rome in 1997.

Objectives:

- (a) To promote the establishment and/or strengthening of national environmental information coordination centres that will act as focal points within Governments for sectoral ministries and provide the necessary standardization and back-up services; to ensure also that national environmental information systems on desertification and drought are linked together through a network at sub-regional, regional and interregional levels;
- (b) To strengthen regional and global systematic observation networks linked to the development of national systems for the observation of land degradation and desertification caused both by climate fluctuations and by human impact, and to identify priority areas for action;
- (c) To establish a permanent system at both national and international levels for monitoring desertification and land degradation with the aim of improving living conditions in the affected areas.

6. UNEP

The Regional office in Europe collaborates with the Secretariat of the International Committee for the Protection of the Danube River (ICPDR) in promoting a river basin management approach for the Tisza River. An environmental outlook of the river basin has been prepared and submitted to ICPDR.

Transboundary water related problems, in particular pollution risks from mining and other industrial activities, have been identified as priority areas of attention in all geographical areas (Central Asia; Southern Caucasus; South eastern Europe) of the UNEP/UNDP/OSCE Environment and Security Initiative. The river basins involved include the Aral Sea river basin and the Kura-Aras and Amu-Darya river basins. Future work in these areas will include environmental assessment (through GRID Arendal or GRID Geneva), or convening meetings, subcontracting and/or backstopping specific projects, and, where appropriate moderating or servicing negotiations.

Together with ECE, the Secretariat of the ICPDR, the REC, WWF and others. ROE is assisting in exchanges and discussions to solve problems and mitigate risks of projects which impact on water bodies and their surroundings in the Danube-Carpathian region.

ROE, through its Moscow office has also promoted and supported projects of the Russian Ministry for Natural Resources and the DUMA on aspects of environmental sound management of the Volga river basin. ROE participates in and contributes to selective meetings of the MAP.



7. UNESCO – IHP (<http://typo38.unesco.org/en/about-ihp/ihp-partners/assessment.html>)

IHP is UNESCO's international scientific cooperative programme in water research, water resources management, education and capacity-building, and the only broadly-based science programme of the UN system in this area.

Objectives:

1. To act as a vehicle through which Member States, cooperating professional and scientific organizations and individual experts can upgrade their knowledge of the water cycle, thereby increasing their capacity to better manage and develop their water resources
2. To develop techniques, methodologies and approaches to better define hydrological phenomena
3. To improve water management, locally and globally
4. To act as a catalyst to stimulate cooperation and dialogue in water science and management
5. To assess the sustainable development of vulnerable water resources
6. To serve as a platform for increasing awareness of global water issues

8. WMO – World Meteorological Organisation (www.wmo.int)

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 interaction with the oceans, the climate it produces and the resulting distribution of water resources.

One of WMO's major efforts over the past few years has been the promotion of the World Hydrological Cycle Observing System (WHYCOS). WHYCOS is being supported by the World Bank and other agencies, and will involve the creation of about 1 000 benchmark hydrological observatories sited on major rivers.

Objectives:

1. Strengthen technical and institutional capabilities of Hydrological Services
2. Promote and facilitate dissemination and use of water-related information
3. Establish a network of key national stations

Up till now there are three projects implemented:

Med – HYCOS involved eighteen Mediterranean countries and thirty-one Data Collection Platforms have been installed in selected basins in the participating countries with major output of the first phase has been the establishment of the Mediterranean Hydrological Information System (MHIS)

SADC - HYCOS involved 11 countries of the South African Development Community (SADC) and a network of 43 Data Collection Platforms were installed and the development of an Internet based Information System based in the Regional Centre.

AOC - HYCOS involved 11 countries from the Western and Central Africa sub-region and the major achievement was to consolidate the development of the Regional Hydrological Observatory of Western and Central Africa (OHRAOC) by supporting data collection activities in the countries and reinforcing the regional data bank.



5 ASSESSMENT – GAP ANALYSIS

5.1 ASSESSMENT OF EUROPEAN COUNTRIES BY 4 GEOGRAPHICAL ZONES

Given the diversity of countries in terms of climate and biogeographic aspects, the assessment has been done by classifying and grouping the countries according to their common geographical characteristics into four regional groups.

During the 2nd interim report, Member States provided information that revealed that annual severe drought events had affected more than 800.000 km² of the EU territory (37%) and 100 million inhabitants (20%) in 1989, 1990, 1991 and more recently in 2003.

5.1.1 Mediterranean – Southern Europe Countries

Countries included: Spain, Italy, Greece, Portugal, Cyprus, Malta

The 2nd interim report, published in 2007, indicated that based on the Water Exploitation Index at least all Mediterranean – Southern Europe EU Member States (Cyprus, Malta, Italy, Spain, Portugal, Greece) are impacted by water scarcity, with a total population concerned of 130 million inhabitants (27% of the EU population). In addition, the most affected river basin districts from water scarcity, based on a RBD WEI, are located in Mediterranean – Southern Europe (Cyprus, Malta, Italy, Portugal, Spain, France).

In terms of drought, Italy, Portugal, Cyprus, Spain and France have registered the highest frequency of droughts from 1976 to nowadays, with 8 to 21 events per country. In Cyprus, Italy, Portugal, Spain, droughts may last one or several years. Furthermore, most of the Mediterranean – Southern countries (Cyprus, France, Italy, Malta, Portugal, Spain), drought affects a large part of their territory and not just a specific part of their territory.

Based on the Analysis in Chapter 4.1 the Table "Assessment of countries by 4 geographical zones" was derived. The main conclusions from this assessment are that most of the water stressed countries in the Mediterranean and Southern Europe are focused in observing and monitoring WS&D and mitigating their impacts. Most of the countries do have a proactive planning in the form of Drought Management Plans and have set objectives of ensuring public water supply and other uses.

5.1.2 Central European countries – West

Countries included: Austria, Belgium, Germany, Luxembourg, the Netherlands and the UK

Belgium and Germany and UK have specified, during the 2nd Interim report, specific river basins that are affected from water scarcity. In addition, in terms of drought events Austria, has been affected by droughts and Belgium, Germany, Netherlands and the UK have reported to experience severe droughts, particularly in recent years. Only a specific part of Austria and Belgium is affected from drought events with a duration of two to six months while in Germany the predominant duration of drought events is one month.

Based on the Analysis in Chapter 4.1 the Table "Assessment of countries by 4 geographical zones" was derived. The main conclusions from this assessment are that half of the countries in Central Europe are affected from water scarcity and drought. From the water stressed countries only Belgium has not yet implemented Drought Management Plans. The Netherlands even though they are not classified as water stressed, based on the WEI_90, they have included WS&D within their water management policy through the elaboration of Drought Management Plans, monitoring programmes and mitigation measures. Most of the countries do have a monitoring programme that includes water quantity issues and have set objectives of ensuring public water supply and other uses.

5.1.3 Central European countries – East

Countries included: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia

Hungary has identified river basins that are affected from WS&D, during the 2nd interim report, even though based on the WEI_90 is not classified as water stressed country. In terms of drought, Hungary and Lithuania have been affected by severe drought events in the last thirty years that lasted one month

Based on the Analysis in Chapter 4.1 the Table "Assessment of countries by 4 geographical zones" was derived. Bulgaria and Romania are severely affected from water scarcity, based on the WEI_90, but only Bulgaria has set clear objectives and implements measures for the proactive management of WS&D. Poland is also affected from water scarcity based on the WEI_90 and implements Drought Management Plans, monitoring programmes and mitigation measures.

5.1.4 North European countries

Denmark, Finland, Ireland, Sweden, United Kingdom

During the 2nd interim report, it was identified that Denmark specified river basins that were affected from water scarcity. Furthermore, in terms of drought events Norway has been affected by severe droughts in the last thirty years. In addition, a large part of Finland is affected whenever droughts occur. Furthermore, Finland was affected by a 270 day drought from August 2002 to April 2003.

Based on the Analysis in Chapter 4.1 the Table "Assessment of countries by 4 geographical zones" was derived. Bulgaria and Romania are severely affected from water scarcity, based on the WEI_90, but only Bulgaria has set clear objectives and implements measures for the proactive management of WS&D. Poland is also affected from water scarcity based on the WEI_90 and implements Drought Management Plans, monitoring programmes and mitigation measures.

Assessment of countries by 4 geographical zones

	Objectives					Current Status				Institutional & Organisational Problem		
	Secure Public water supply	Secure Other water uses (agriculture, industry, energy, fisheries)	Secure Vital flow, Ecological Impact	Impact on social activities (e.g. recreational water use)	Problem identification	Water Stressed (no, yes, severely)	Monitoring	Indices	Drought management plans	Mitigation measures, policy	Bodies (ministries, authorities etc)	Links
Mediterranean Southern Europe Countries												
Cyprus	X	X	X	X	X	Severely (2005)	X	X	X	X	X	See Annex
Greece	X	X			X	No	X				X	See Annex
France	X	X			X	Yes	X	X	X	X	X	See Annex
Italy	X	X			X	No (1998)	X	X	X	X	X	See Annex
Malta	X	X			X	Yes	X	X	X	X	X	See Annex
Portugal	X	X	X	X	X	No	X	X	X	X	X	See Annex
Spain	X	X	X	X	X	Yes	X	X	X	X	X	See Annex
Central European countries – West												
Austria	X	X	X		X	No	X			X	X	See Annex
Belgium	X	X			X	Yes	X			X	X	See Annex
Germany	X	X	X		X	Yes	X	X	X	X	X	See Annex
Luxembourg	X				X	No (1999)	X				X	See Annex
The Netherlands	X	X	X	X	X	No	X	X	X	X	X	See Annex
United Kingdom	X	X	X	X	X	Yes	X	X	X	X	X	See Annex
Central European countries - East												
Bulgaria	X	X	X	X	X	Severely	X	X	X	X	X	See Annex

Assessment of countries by 4 geographical zones												
	Objectives					Current Status				Institutional & Organisational Problem		
	Secure Public water supply	Secure Other water uses (agriculture, industry, energy, fisheries)	Secure Vital flow, Ecological Impact	Impact on social activities (e.g. recreational water use)	Problem identification	Water Stressed (no, yes, severely)	Monitoring	Indices	Drought management plans	Mitigation measures, policy	Bodies (ministries, authorities etc)	Links
Czech Republic	X	X	X		X	Yes	X	X		X	X	See Annex
Estonia	X	X	X		X	No	X	X			X	See Annex
Hungary	x	X	x		X	No		X	X	X	X	See Annex
Latvia	X	X	X		X	No	X			X	X	See Annex
Lithuania	X				X	No				X	X	See Annex
Poland	X	X	X		X	Yes	X		x	X	X	See Annex
Romania	X				x	Severely	X				X	See Annex
Slovakia	X				X	No		X			X	See Annex
Slovenia	X				X	No	X	X			X	See Annex
North European countries												
Denmark	x	X	x		X	No	X	X	X		X	See Annex
Finland	x	x	x	x	X	No	X	X	X		X	See Annex
Ireland	X	X	X		X	No	X		X	X	X	See Annex
Sweden	X	X	X		X	No	X	X	X	X	X	See Annex

5.2 ASSESSMENT OF EUROPEAN INSTITUTIONS AND NETWORKS

The identification of the main actors for drought and water scarcity issues at European level, and the collection of relative data on their objectives, priorities and activities led to an assessment of a set of pillars that are needed in tackling the problem in Europe in a coherent systematic pan European approach. Based on this, the main information gaps, on drought and water scarcity in Europe, were identified (Gap Analysis) based on the relevance of their activities, objectives and vision to the following:

1. **Research** relevant to WS&D related topics.
2. **Observation** of WS&D events through the establishment of real or semi - real time monitoring networks.
3. **Monitoring** of drivers, pressures, state of the environment, impacts and responses for WS&D through the use of appropriate indicators.
4. **Knowledge** enhancement through the dissemination of knowledge and raising stakeholder awareness
5. **Funding** of WS&D related research or consulting activities.

European actors	RESEARCH	OBSERVATION	MONITORING					KNOWLEDGE		FUNDING
			DRIVERS	PRESSURES	SoE	IMPACTS	RESPONSES	AWARENES	DISSEMINATI	
DG Environment * policy actor								Through several actions such as conferences, website etc.	Informs through conferences and online for news in the field of WS&D such as events, projects, reports etc.	EU funding schemes for relevant consulting projects.
DG Region								Through several actions such as conferences, website etc.	Informs through conferences and online for news in the field of WS&D such as events, projects, reports etc.	EU funding schemes for relevant research projects.
DG Research									Indirectly through the conferences organised by its funded research projects	EU funding schemes for relevant research projects.
DMCSEE			Monitors the state of WS&D by using GPCC data in order to create preliminary maps of the SPI, Percentiles and Precipitation for the SEE region.						Informs through the website for events, projects, reports, research activities and calls etc	
EDC								At this moment the EDC is an information website for people, events and projects in the field of WS&D		
EEA	On specific topics if required to produce enhanced assessments (e.g. indicators)		Establishment of an indicator framework for Water Scarcity and Drought. SoE#3 in water quantity. CSI018 on use of freshwater resources Water Information System for Europe -WISE					Through conferences, website, publications etc	Part of the EU team for addressing WS&D. Work with national authorities for the establishment of	For consulting activities supporting the EEA Work Programm e.

European actors	RESEARCH	OBSERVATION	MONITORING					KNOWLEDGE		FUNDING
			DRIVERS	PRESSURES	SoE	IMPACTS	RESPONSES	AWARENES	DISSEMINATION	
									stable data flows on water quantity.	To the ETCs to support the EEA activities implementation
ENPI									Indirectly through the conferences organised by its funded research projects	Funding of research projects
EMWIS – SEMIDE									Networking Platform, sharing of information - knowledge between members	
EU-INCO									Networking Platform plus organisation of conferences, papers etc	Funding of projects through EU funds
EU LIFE									Indirectly through the conferences organised by its funded research projects	Funding of research projects
EURAQUA									Networking of research institutions. Participation in calls for water research. Network of water researchers. Conferences, papers,	

European actors	RESEARCH	OBSERVATION	MONITORING					KNOWLEDGE		FUNDING
			DRIVERS	PRESSURES	SoE	IMPACTS	RESPONSES	AWARENES	DISSEMINATION	
									scientific and technical reviews etc	
EUROSTAT			Inland waters data gathering through the EUROSTAT/OECD Joint Questionnaire every 2 years. Eurostat Yearbook publication presents the data on inland waters which are also available online.					Reports	Reports, data sets	Small grants specific to projects meeting EUROSTAT needs, such as disaggregation of water resources data to RBD level.
EU-SMAP									Networking, conferences, reports, publications etc	Funding of research projects
JRC * DESERT Action	Through the Institute for Environment and Sustainability -IES	EDO development Monitoring the state of WS&D in Europe through the application of indicators such as SPI and soil moisture.							Participate in WS&D groups, part of the EU team for addressing WS&D etc	



5.3 ASSESSMENT OF INTERNATIONAL ACTORS

Following the same methodology for the assessment of the European actors, the International actors relevant to WS&D were classified based on the relevance of their activities, objectives and vision to the same pillars.

International actors	RESEARCH	OBSERVATION	MONITORING					KNOWLEDGE		FUNDING
			DRIVERS	PRESSURE S	SoE	IMPACTS	RESPONSES	AWARENES S	DISSEMINATI ON	
FRIEND	Cross cutting programme that incorporates research programmes								Provides support, networking, project proposals etc	
GWP- Med								Introduces, helps to implement and adapt to the specificities of the Mediterranean region, global initiatives launched or adopted by the GWP. Promotes and sustains a strong partnership in the Mediterranean among competent organisations that have an impact on water management.		Seeks and facilitates the appropriate international funding and involvement of international institutions for activities promoting IWRM.
UNCCD			To establish a permanent system for monitoring desertification and land degradation with the aim of improving living conditions in the affected areas.							
UNEP/MAP								Sharing of knowledge that may be used for combating WS&D		
UNESCO – IHP								Postgraduate courses on water resources Sharing of knowledge that may be used for combating WS&D		

International actors	RESEARCH	OBSERVATION	MONITORING					KNOWLEDGE		FUNDING
			DRIVERS	PRESSURE S	SoE	IMPACTS	RESPONSES	AWARENES S	DISSEMINATI ON	
WMO		Strengthen technical and institutional capabilities of Hydrological Services. Establish a network of key national stations	Development of an Hydrological Information System connected to the Web						Promote and facilitate dissemination and use of water-related information	
USA										
NDMC	Collaborative research; participates in numerous international projects.	Drought monitoring; participation in the preparation of the U.S. Drought Monitor and maintenance of the web site (drought.unl.edu/dm).					K-12 outreach; advising policy makers; providing data to and answering questions for the media and the general public.	Workshops for federal, state, and foreign governments and international organizations; organizing and conducting seminars, workshops, and conferences		
NIDIS	Integrating and fostering strategies through research, preparedness, education and public awareness	Provide early warning about emerging and anticipated droughts. Assimilate and quality control data about droughts and models.	Provide information about past droughts for comparison and to understand current conditions. Provide information about risk and impact of droughts to different agencies and stakeholders Explain how to plan for and manage the impacts of droughts				Provide a forum for different stakeholders to discuss drought-related issues			



5.3 CONCLUSIONS (WHAT IS MISSING/NEEDED)

The conclusions arising from the assessment of the European actors in Chapter 5.2 are presented in the following Table.

The conclusions arising from the assessment of the International actors in Chapter 5.3 are that out of the eight (8) institutions that were identified as directly linked to WS&D the majority is active in the field of knowledge either by raising stakeholder awareness or by disseminating knowledge and enhance networking between experts. In addition, three (3) actors are involved with research, two (2) with observation, four (4) with monitoring, and one (1) with funding.

European Actors		
Pillar	Actors involved #	Comments
Research	2 (JRC, EEA)	COM(2007)14 suggested the enhancement of research related to WS&D as one of the main targets for addressing WS&D. Even though only one European actor is active in the field of Research most of the actors participate in the funding of relevant research activities and therefore most of the institutions do support the research for WS&D (e.g. DGs)
Observation	1 (JRC)	COM(2007)14 suggested the creation of a European Drought Observatory and an early warning system as one of the main targets for addressing WS&D. JRC implements the Desert Action Programme which among other targets the creation of an EDO. Other national level observatories or cluster of observatories are relevant and could perform together under an overarching WS&D network.
Monitoring (Drivers, Pressures, SoE, Impacts, Responses)	3 (DMCSEE, EEA, EUROSTAT)	COM(2007)14 suggested the improvement of knowledge and data collection through the use of an annual European Assessment based on agreed indicators as one of the main targets for addressing WS&D. EEA is currently (beginning 2009) undertaking an indicator system development based on the D – P – S – I – R framework with the scope to monitor water scarcity and drought at EU level. DMCSEE produces regional relevant maps on precipitation indicators gathering data from regional monitoring networks.
Knowledge (Awareness and Dissemination of research results)	ALL (either directly through the publication of results and the organisation of conferences etc or indirectly through dissemination actions of the actor's funded projects.)	COM(2007)14 suggested the need to foster the emergence of a water-saving culture and foster water efficient technologies and practices in Europe, to allocate water and water-related funding more efficiently, to consider additional water supply infrastructures, to improve drought risk management, as main targets for addressing WS&D. This communication is along with other initiatives (e.g study on water saving potential, on alternative water resources etc.) trying to raise the awareness and can also help in formulating national water policies of Member States. For example, EEA and EDC through various publications (e.g. EEA Water Resources Report 2009) raise awareness to the stakeholders and general public also supporting policy making. In addition, COM(2007)14 suggested the enhancement of the dissemination of the research efforts related to WS&D as one of the main targets for addressing WS&D. Most of the European actors are involved in dissemination activities of research results either directly or indirectly through the dissemination activities of the research projects they funded or in the creation of networking platforms and events in order to bring together experts in the field of WS&D and water management in general.
Funding	9	WS&D field can be a specific subtopic for research launched in a call, or it can be not explicitly mentioned and incorporated indirectly under the topics of climate change, environment, water resources management etc. In the latest case it relies on the scientist and field experts to actually submit research proposals narrowed on thematic area of WS&D and is not guaranteed that they will be evaluated as priority for funding.



6 TOWARDS A EUROPEAN WATER SCARCITY & DROUGHT NETWORK (WSDN)

In June 2007, the Commission published its communication "Addressing the challenge of water scarcity and droughts in the European Union", [COM (2007) 414]²¹. Under Article "2.7 Improve knowledge and data collection" the need for a water scarcity and drought information system throughout Europe was identified.

This system will provide:

1. a reliable information base at the appropriate temporal and spatial resolution required for decision-making
2. shared interpretations/definitions
3. presentation of an annual EU assessment, based on agreed indicators and indices with data provided by MS and stakeholders to the COM or EEA on a yearly basis

In addition, the COM (2007) 414 identified that the proposed system should "fully exploit the Global Monitoring for Environment and Security (GMES) services for the delivery of space-based data and monitoring tools in support to water policies, land use planning and improved irrigation practices.

6.1 ROLE OF THE EU WSDN FOR BRIDGING THE GAP

The assessment of the European and international actors that are currently involved in the effort to address water scarcity and drought led to the argumentation and identification of the further need of developing a European Water Scarcity and Drought Network (WSDN).

This gap analysis will try to propose a structure for a European Water Scarcity and Drought Network (WSDN) that will bridge and coordinate the existing initiatives providing better information, fostering synergies, promoting capacity building between scientists and the user community, and thereby increasing preparedness and resilience of the European society to water scarcity and drought.

In that extent, a selection of the vision of what should be dealt within such a system is the following:

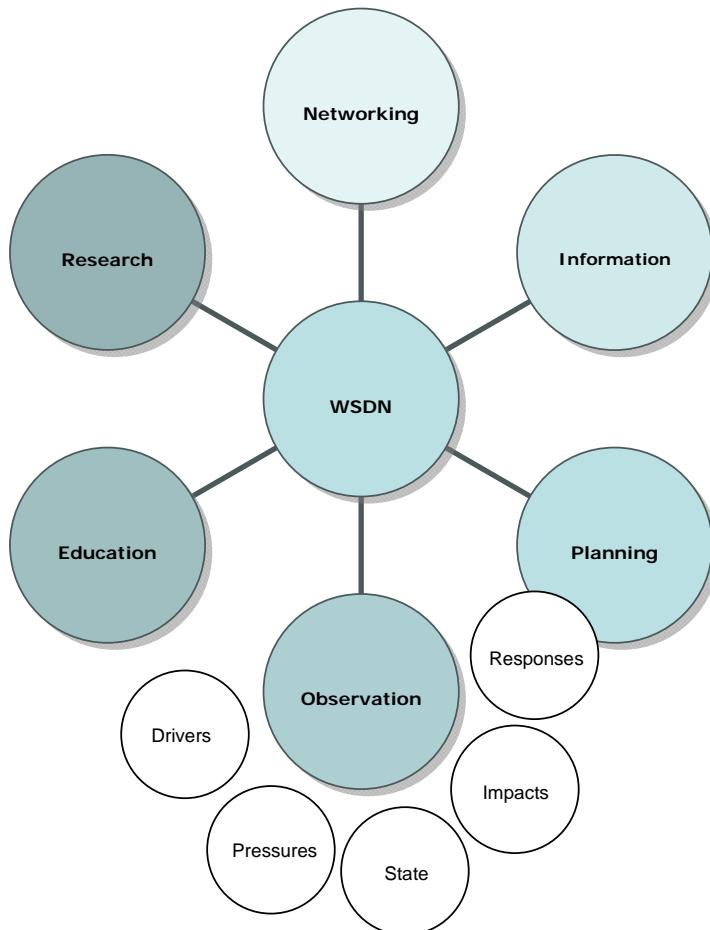
1. WS&D Information
2. WS&D Observation: European Drought Observatory, Drought Forecast and WS&D indicator system
3. WS&D Planning: MS Drought Management Plans (DMPs), Drought Policies (existing and recommendations)
4. WS&D Education: Targeted education for different stakeholders and end users, Water saving potential/ smart technologies, Outreach Activities, Specific Training, Creation of training/educational programs (such as e-learning MS program)
5. WS&D Research: Networking activities such as a portal to relevant projects and programmes (national or international), enhancement of international cooperation and funding opportunities, dissemination of research results.
6. Networking

²¹ COM (2007) 414. Communication from the Commission to the European Parliament and the Council Addressing the challenge of water scarcity and droughts in the European Union (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007DC0414:EN:NOT>)



This system could be established as a collaboration network between the different actors that are already active in the water scarcity and drought field in Europe and is conceptually given in Figure 1.

Figure 1. Pillars for assessing European and International actors for WS&D.



The EU WSDN will try to bring several aspects of the WS&D issue in common view. The main scope of the WSDN is to bridge science with policy with the aim to aid decision makers to take informed decisions and to be updated with the most important advances in the scientific field.

The WS&D Network will share information about the issue of WS&D and will also provide a range of more specific aspects of WS&D, such as links with an European Drought Observatory (EDO), with a WS&D indicators System with the aim to monitor driving forces, pressures, current state, impacts and responses for Water Scarcity and Drought, as well as Educational, Training and Dissemination links.

Even though there is a wide range of European institutions, instruments and networks that are involved with one or more of the selected pillars for addressing water scarcity and drought there is a gap on the development of an actual action list that will bring all actors together towards the common goal of understanding, addressing, and alleviating the impacts of WS&D. International actors and especially USA relevant actors seem to have a more coherent approach since most of them incorporate all pillars except funding.



Water Scarcity and Drought: Towards a European WSDNetwork

The purpose of this gap analysis is to assess whether the existing activities of selected European and International actors address the pillars of the WS&D Network. The identification of possible roles of existing structures in the WS&D Network are presented in the following Figure 2.

Figure 2. Identification of possible roles of existing institutions within the WS&DNetwork

WS & D Network	WS&D Information	WS&D Observation	WS&D Planning	WS&D Education	WS&D Research	Networking
	General Information	EDO: Drought Watch, Drought Forecast	MS Drought Management Plans (DMPs)	Targeted education for different stakeholders and end users	Portal to projects, programmes (national or international)	Institutions that either fund research projects or control EU funds and that organize and participate in dissemination activities.
	Institutions that may provide information	WS&D indicator system	Drought Policies (existing and recommendations)	Outreach Activities	Scientists exchange blog	
			Institutions that may provide help with drought risk assessment, drought	Specific Training	International cooperation and Funding Opportunities	
				Creation of training/educational programs (such as e-learning MS program)		Institutions that may educate stakeholders in
WSDN Bodies & structures	WS&D Information	WS&D Observation	WS&D Planning	WS&D Education	WS&D Research and Dissemination	Networking
DG Environment * policy actor	√		√		√	
DG Region			√		√	√
DG Research					√	√
DMCSEE	√	√		√		√
EDC	√					√
EEA	√	√		√		
					√	√
ENPI						
EMWIS – SEMIDE	√		√	√		√
EU-INCO					√	√
EU LIFE					√	√
EURAQUA					√	√
		√				
EUROSTAT						
EU-SMAP					√	√
JRC * DESERT Action	√	√		√	√	
International						
FRIEND					√	√
GWP- Med	√					√
UNCCD	√	√	√			
UNEP	√		√		√	
UNESCO - IHP	√			√	√	
WMO	√	√				
USA						
NDMC	√	√	√			√
NIDIS	√	√	√			√



7 TOWARDS A EUROPEAN WATER SCARCITY AND DROUGHT indicators SYSTEM (WSDiS)

It is suggested that work on an EU Indicator System should encompass both **Drought** (in terms of water availability), but also, importantly, **Water Scarcity** (in terms of the mismatch between availability and demand). This suggestion (i.e. the firm inclusion of Water Scarcity as a major theme in Water Resources and Environmental Management) is based on several reasons:

- a) Water Scarcity affects a larger part of the EU: At least 11% of the European population and 17% of its territory have been affected by water scarcity to date. Recent trends show a significant extension of water scarcity across Europe. [COM(2007)414]²²
- b) Water Scarcity often has its roots in water shortage (drought) which is combined with population growth and economic development.
- c) Water Scarcity is at the same time a social and environmental phenomenon and hence more manageable with policy instruments – this presupposes a firm basis of policy on a clear understanding of the situation and hence is of direct relevance to the EEA, which is tasked to provide this situation assessment to policy makers such as DG Environment).
- d) There is a gap of knowledge and tools at the EU level on the demand side of the Water Scarcity and a lack of reliable information [COM(2007)414], thus the formulation of an adequate indicators' framework could provide a powerful tool for building a common basis for policy and decision making.
- e) Work on Water Scarcity, with an emphasis on the demand side, would complement but not overlap with ongoing work at the EU level for improving Drought Management (incl. work at the JRC).
- f) Since Water Scarcity is at the crossroads between environmental phenomena (in the form of drought) and social phenomena (in the form of water demand – either directly or indirectly) is a clear example of an area that would benefit from a robust Science-Policy Interface (SPI). Such an interface requires common data as well as a common understanding of what the data show. The development and adoption of a common set of indicators, as a part of a Water Scarcity and Drought Information system directly linked to WISE is providing exactly such a SPI (which is currently missing at the EU level).
- g) Drought definitions differentiate based on the analysed effects, meteorological, agricultural and socioeconomic and therefore there is a need to combine indicators and indices used up till now to observe and monitor drought with socio economic indicators that will identify drivers, pressures and impacts of the phenomenon.

7.1 A DPSIR FRAMEWORK

The *Driver-Pressure-State-Impact-Response* methodological division has often been used to provide a thinking framework for the development and categorisation of indicators²³. It is to be noted however that although effort has been made to provide definitions of these five categories, that would assist in

²² COM(2007)414. Communication from the Commission to the European Parliament and the Council. Addressing the challenge of water scarcity and droughts in the European Union. Brussels, 18.7.2007, COM(2007) 414 final, {SEC(2007)993} {SEC(2007)996}

²³ See for example: OECD (1993). OECD core set of indicators for environmental performance reviews: a synthesis report by the group on the state of the environment. Environment Monographs 83, Organisation for Economic Co-operation and Development, Paris.



making the DPSIR framework operational (e.g. EEA, 1999²⁴), the concepts have not always been interpreted in a consistent way and the resulting definitions were not always followed rigorously in the subsequent indicators categorisation. This needs to be attributed to a large degree to the complexity of the process of developing a thinking framework, in other words the complexity of the required level of abstraction, and the subjectivity in the conceptualisation of the developer.

DPSIR frameworks can be developed for almost anything and have been increasingly applied to a range of environmental problems (Aubry and Elliott, 2006²⁵; Bidone and Lacerda, 2004²⁶; Borja A. *et al*, 2006²⁷; Hameedi, 2005²⁸; Jorge et al, 2002²⁹; Marsili-Libelli *et al.*, 2004³⁰). Clearly, there is a serious challenge in developing consistent definitions of what the main domains of the framework are (ie. Drivers, Pressures, States, Impacts and Responses), that are generic enough to become meaningful vessels for a variety of indicators measuring processes as different as floods and droughts, energy policy or agriculture.

Due to both the inconsistency of the definitions and the lack of clarity on how to use the framework to categorise indicators, researchers and policy makers have often been tempted to proceed with developing indicators, using the DPSIR framework very loosely and modifying it ad hoc. Often, the DPSIR framework has been considered something too obscure to be useful and hence remained as a formality rather than as a tool, especially in cases where the cause-effect relations are complex and ill-defined.

It should be noted however that this loose use of the DPSIR framework, is not advisable, as it may constraint the conceptualisation of the phenomenon (casting it as a set of more-or-less formal cause-effect relationships), while at the same time does not profit from the methodological support that such a restriction was developed to provide in the first place. A more rigorous application of the DPSIR framework is hence more desirable.

We are therefore suggesting, a specific interpretation and application of the DPSIR framework to underpin the development and categorising of indicators for Water Scarcity. It is not, however, necessarily suggested that the DPSIR framework has to be an explicitly visible part of the communication between policy makers (incl. the EEA) and other stakeholders. What is more important is to allow any communication to follow the logical sequence and language of the framework.

The following definitions have been used in the EEA (1999) report "Environmental Indicators: Typology and overview" and have been updated to serve as the basis for categorisation.

24 Smeets, E., Weterings, R., (2005). Environmental indicators: typology and overview. Technical report no. 25. European Environment Agency, 19 pp.

25 Aubry, A., Elliott, M., (2006). The use of environmental integrative indicators to assess seabed disturbance in estuaries and coasts: application to the Humber Estuary, UK. Mar. Pollut. Bull. 53, 175–185.

26 Bidone, E.D., Lacerda, L.D. (2004). The use of DPSIR framework to evaluate sustainability in coastal areas. Case study: Guanabara Bay basin, Rio de Janeiro, Brazil. Reg Environ Change (2004) 4, 5–16.

27 Borja A. *et al* (2006). The European Water Framework Directive and the DPSIR, a methodological approach to assess the risk of failing to achieve good ecological status. Estuarine, Coastal and Shelf Science 66, 84–96

28 Hameedi, J., (2005). Environmental indicators as performance measures for improving estuarine environmental quality. In: Bortone, S.A. (Ed.), Estuarine Indicators. CRC Press, Boca Raton, FL, pp. 451–465.

29 Jorge, M.R., Nelson Lourenço, N., Machado, C.R., Rodrigues, L. (2002). Measuring, monitoring and managing sustainability in Indian coastal areas: the socioeconomic dimension. Littoral 2002, 22–26 September. Porto, Portugal.

30 Marsili-Libelli, S., Betti, F., Cavalieri, S. (2004). Introducing River Modelling in the Implementation of the DPSIR Scheme of the Water Framework Directive. Proc. IEMSS 2004 International Congress "Complexity and Integrated Resources Management", Osnabrück, Germany, June 2004

**Table 3.** Modified DPSIR framework

EEA (1999) Definitions	Suggested Definitions	Rationale
Indicators for driving forces describe the social, demographic and economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production patterns. Primary driving forces are population growth and developments in the needs and activities of individuals. These primary driving forces provoke changes in the overall levels of production and consumption. Through these changes in production and consumption, the driving forces exert pressure on the environment.	Indicators for driving forces describe the environmental , social, demographic and economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production patterns. Primary driving forces are, climatic changes , population growth, migration and developments in the needs and activities of individuals. These primary driving forces exert pressure on the environment, either directly (through changing precipitation patterns) or indirectly through changes in production and consumption.	Suggesting that all drivers are anthropogenic is ignoring elements of the problem (particularly in the water availability part of the equation). It also leaves no room of assessing the impact of climatic changes – that may not necessarily be anthropogenic, but have potentially severe impacts on society.
Pressure indicators describe developments in release of substances (emissions), physical and biological agents, the use of resources and the use of land. The pressures exerted by society are transported and transformed in a variety of natural processes to manifest themselves in changes in environmental conditions. Examples of pressure indicators are CO2-emissions per sector, the use of rock, gravel and sand for construction and the amount of land used for roads.	Pressure indicators describe developments in release of substances (emissions), physical and biological agents, the use of resources and the use of land. They also describe pressures on infrastructure (e.g. an increased demand for infrastructure). The pressures exerted by nature (anomalies) or society are transported and transformed in a variety of natural processes to manifest themselves in changes in environmental conditions. Examples of pressure indicators are CO2-emissions per sector, the use of rock, gravel and sand for construction and the amount of land used for roads.	Natural drivers (e.g. climatic changes) exert pressures in the form of anomalies (e.g. a precipitation anomaly). Socio-economic drivers (e.g. population density) exert pressures in the form of increased demand for either a natural (water) or a technical (infrastructure) provision. Pressure indicators can include <i>efficiency</i> indicators to characterise further the (socio-economic) pressure and give handles for policy Pressure indicators (resulting from physical drivers) can include <i>performance</i> indicators (in the form of deviations/anomalies from an expected value – e.g. a LTA)
State indicators give a	State indicators give a	What is reservoir



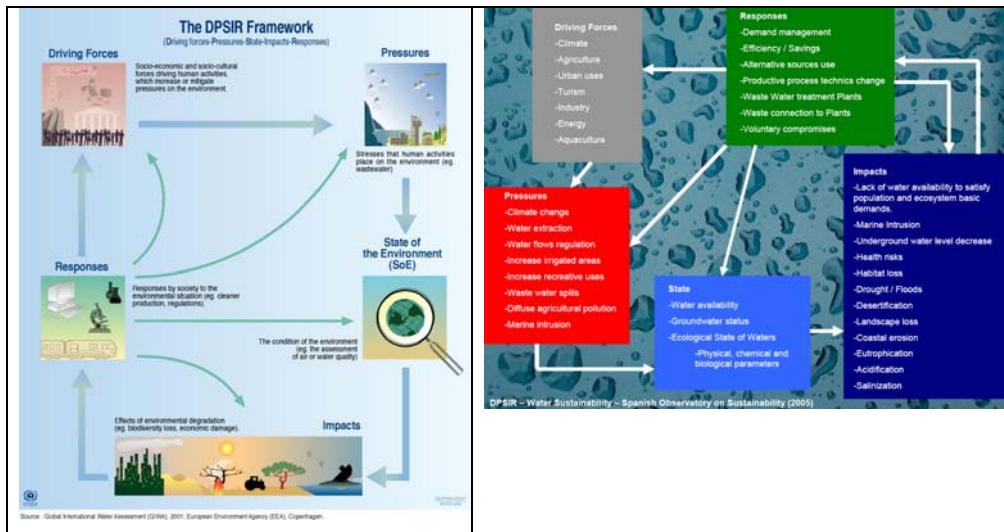
<p>description of the quantity and quality of physical phenomena (such as temperature), biological phenomena (such as fish stocks) and chemical phenomena (such as atmospheric CO₂-concentrations) in a certain area. State indicators may, for instance, describe the forest and wildlife resources present, the concentration of phosphorous and sulphur in lakes, or the level of noise in the neighbourhood of airports.</p>	<p>description of the quantity and quality of physical phenomena (such as temperature), biological phenomena (such as fish stocks) and chemical phenomena (such as atmospheric CO₂-concentrations) in a certain area at the time of inquiry. State indicators may, for instance, describe the forest and wildlife resources present, the concentration of phosphorous and sulphur in lakes, or the level of noise in the neighbourhood of airports. They can also describe the state of the socio-economic and technical system of interest. Unavailability of infrastructure can result to water scarcity (ie inability to meet demands) even with water available (elsewhere).</p>	<p>storage if not a "state"? However it is not necessarily a state of the environment but of infrastructure. The state of infrastructure (including its existence (MDGs) and quality (WSSTP) are central to the problem – and much of the available response.</p>
<p>Due to pressure on the environment, the state of the environment changes. These changes then have impacts on the social and economic functions on the environment, such as the provision of adequate conditions for health, resources availability and biodiversity. Impact indicators are used to describe these impacts. Impacts occur in a certain sequence: air pollution may cause global warming (primary effect), which may in turn cause an increase in temperature (secondary effect), which may provoke a rise of sea level (tertiary impact), which could result in the loss of biodiversity</p>	<p>Due to pressure on the environment, the state of the environment changes. These changes then have impacts on the environmental, social and economic functions, such as the provision of adequate conditions for health, resources availability and biodiversity. Impact indicators are used to describe these impacts.</p> <p>Over-abstraction of groundwater (a pressure) may result in saline intrusion (an environmental impact), which may in turn result in loss of crop production (a socio-economic impact). It should be noted that it is the <i>loss of production</i> that is the impact. The yield <i>per se</i> is a state indicator.</p>	<p>Clearly environmental impacts are very much part of the problem, not only for their deprecations on the society and economic, but for their "intrinsic value" per se. Although an anthropocentric approach to responses is certainly warranted, the inclusion of environmental impacts allows for a non-monetary valuation to be included in the decision-process.</p>
<p>Response indicators refer to responses by groups (and individuals) in society, as well as government attempts to prevent, compensate, ameliorate or adapt to changes in the state of the environment. Some societal responses may be regarded as negative driving forces, since they aim at redirecting prevailing trends in consumption and production patterns. Other responses aim at raising the efficiency of products and processes, through stimulating the</p>	<p>Response indicators refer to responses by groups (and individuals) in society, as well as government attempts to prevent, compensate, ameliorate or adapt to changes in the state of the environment. It also refers to attempts by ecosystems themselves to respond (e.g. by adaptation or migration) Some societal responses may be regarded as driving forces, since they aim at redirecting prevailing trends in consumption and production patterns. Other</p>	<p>Due to the iterative nature of the processes involved, quite often a response can be a driver for change (see also figure). Response indicators could serve indirectly to answer questions of how much more can be put in place (by subtracting what is in place from the system capacity for).</p>



<p>development and penetration of clean technologies. Examples of response indicators are the relative amount of cars with catalytic converters and recycling rates of domestic waste. An often used overall response indicator is an indicator describing environmental expenditures.</p>	<p>responses aim at raising the efficiency of products and processes, through stimulating the development and penetration of green technologies. There may also be societal responses targeted at facilitating physical responses by ecosystems: increasing the connectivity of river systems, would allow species to migrate to more appropriate habitats, to respond for example to a drought situation. An often used overall response indicator is an indicator describing environmental expenditures.</p> <p>Indicators of Responses show what is currently in place.</p>	<p>Indicators for responses are bound to change as new policy instruments and technologies become available. Combining information between response and pressure indicators would yield information on the effect of policies and measures.</p>
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It is also important to note, that although the basis of the DPSIR mode of organising thinking around environmental problems is a strict causality, it should by no mean be conceptualised as a linear process. This is highlighted in the figure below (which is in accordance with Figure 1 of the EEA (1999) Report).

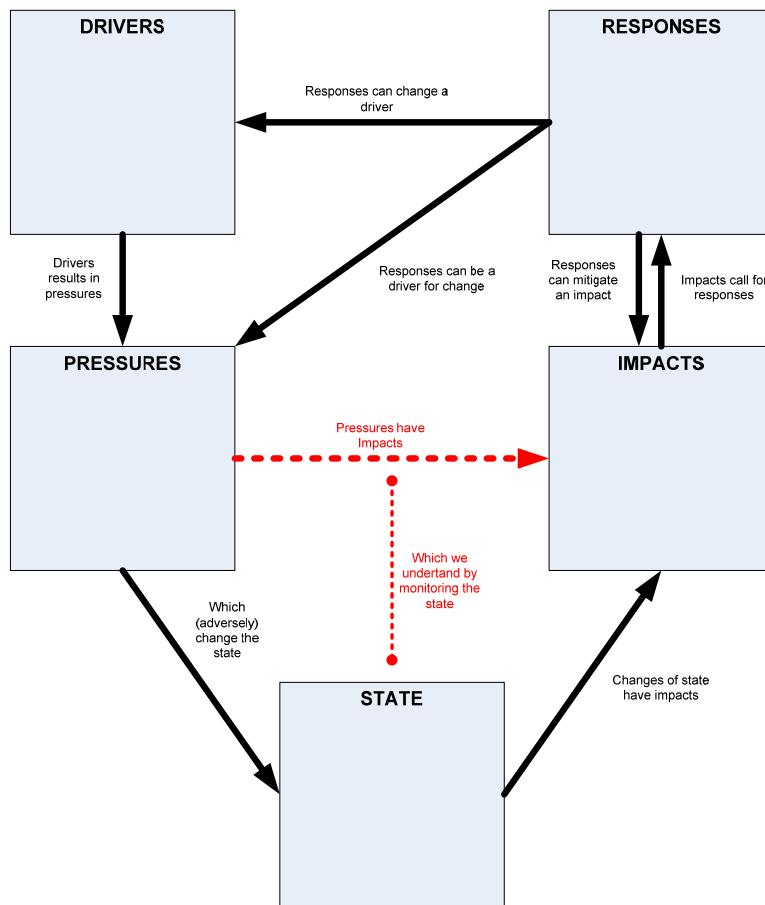
Figure 3 A 2D visualization of the DPSIR framework



We are hence suggesting a 2-dimensional visualisation of the DPSIR framework which allows for the illustration and acknowledgement of the feedback mechanisms between the elements of the framework.



Figure 4. Identifying links in the DPSIR framework



7.2 CAPTURING THE REALITY OF THE WATER SCARCITY & DROUGHT SITUATION

It is important to include the socio-economic dimension in a Water Scarcity indicator framework – particularly since Water Scarcity is a socio-environmental problem par excellence.

There are two obvious ways of accomplishing this within the proposed framework:

- Include socio-economic **indicators** to capture socio-economic processes and phenomena of interest (e.g. migration, the CAP etc). This is crucial to allow for a complete picture of the situation, in view of the fact that Water Scarcity is in part driven by demand.
- Take into account the socio-economic (and political context) in the development of **indices** (which are composite metrics which are formed using multiple indicators). In other words propose different indices for specific stakeholders and decision making scales (incl. the EEA, DG Environment; National EAs? Farmers?). This will ensure the relevance of the resulting indices to specific decision making processes.



7.3 METHODOLOGY FOR TRIALLING THE APPROACH AND LOGICAL TESTING: AN ISSUES-BASED APPROACH.

Although the development of a methodologically robust and well-defined underlying framework (in this case the proposed DPSIR framework) is sine qua non for a structured indicators selection process, it is equally important to ground the selection of specific indicators in the problem at hand, rather than proceed in selecting indicators abstractly. The latter approach could easily result in long lists of indicators, which may have been “correct” but not necessarily relevant. This is especially true in the case of Water Scarcity, which is a complex socio-environmental phenomenon, and whose description is necessarily multi-faceted. This complexity requires a step-by-step approach in developing indicators, which would allow questions of relevance and completeness to be answered throughout the indicators’ development process.

A specific step-by-step approach, which is methodologically sound and facilitates a conceptually clear deconstruction of the (complex) Water Scarcity problem is proposed below.

Water Scarcity, results from an *imbalance* between:

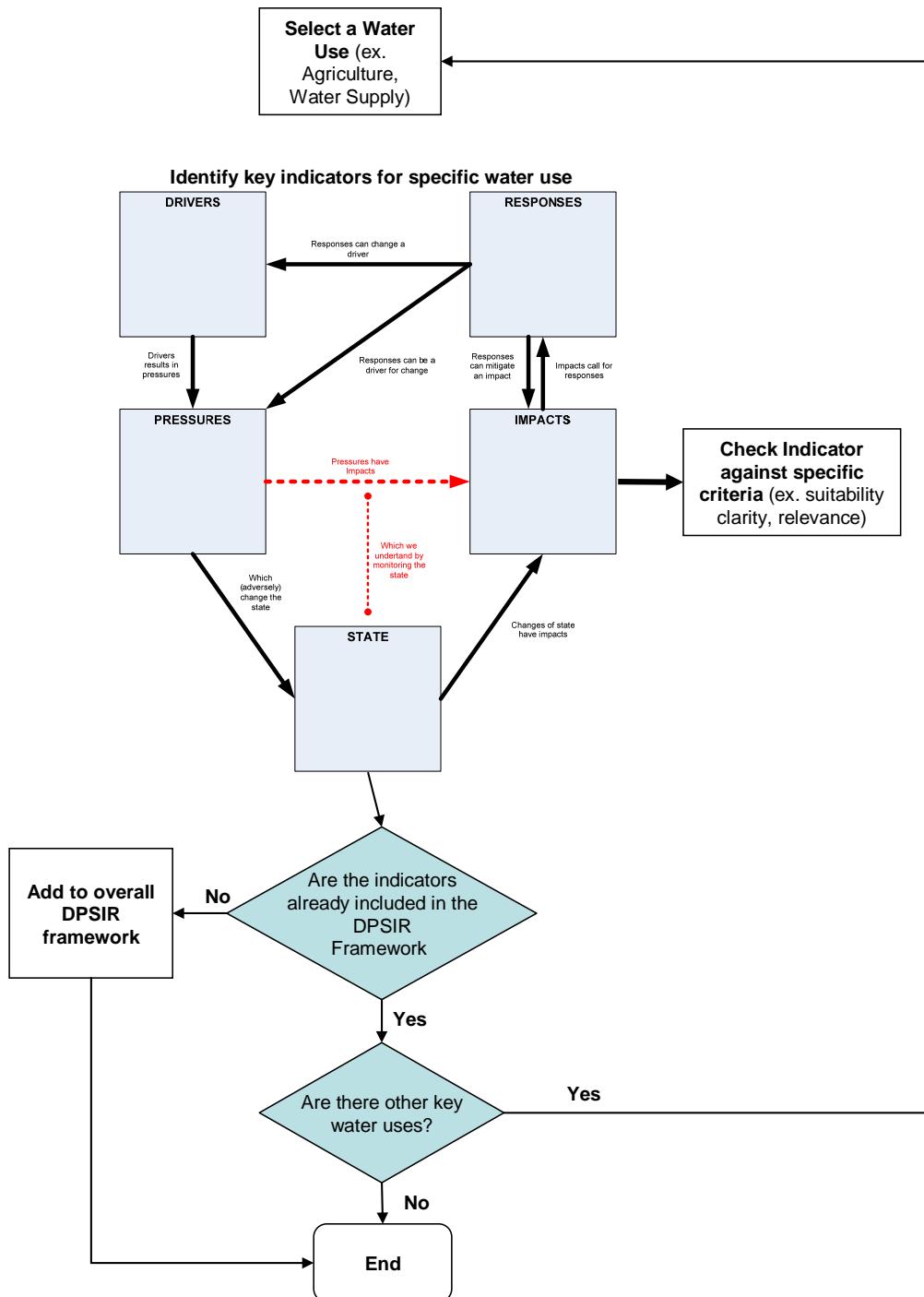
- water availability, in the broader sense - physical (related to the water cycle) and technical (related to water infrastructure) as suggested above, and
- water demand, for a series of (well-defined) activities, from consumption to industry.

Since both sides of the equation are required to define Water Scarcity, it would suffice if methodologically, we used one side as the “check-list” to make sure the indicators list is complete and relevant. However, it is clear that only the water demand side of the equation is enumerable. It is so enumerable in fact that it has indeed been enumerated and its enumeration well defined (e.g. the NACE classification). In contrast, the first part of the Water Scarcity equation, that of water availability, is much harder to enumerate (and hence classify in crisp sets). Although for the sake of popular explanation, the water cycle is described by means of specific steps, it is understood that there are no hard boundaries between the phases of the cycle, nor is there any universally acceptable way of categorizing infrastructure availability or capacity or capability (especially in view of Water Scarcity).

It is therefore suggested, that a series of main water uses is identified and this series is used as a check list to develop a comprehensive (but relevant) Water Scarcity indicator framework. The suggested process is displayed in the form of a flow chart in the figure below.



Figure 5. A process for developing an indicator framework





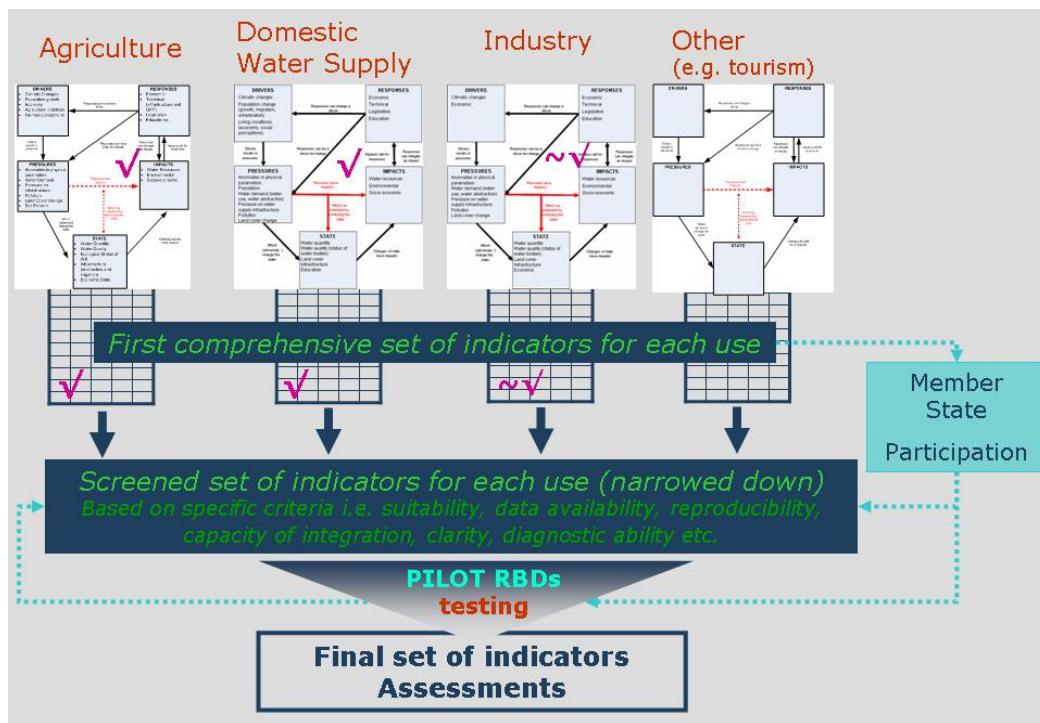
The first methodological step for creating a Water Scarcity and Drought indicator System (WSDiS) for Europe is to identify economic activities that use water. For the purposes of the Water Scarcity and Drought indicators System the grouping of the economic activities is distinguished in the following groups: **Agriculture, Domestic, Industry and Other**.

The logical steps for populating the WSDiS are the following:

1. Selection of economic activities that will be used as a check list for identifying appropriate indicators for WS&D
2. Populate the DPSIR framework for Water Scarcity and Drought for every selected economic sector
3. Screen the resulting set of indicators for each economic sector (narrow down) based on specific criteria (i.e. suitability, data availability, reproducibility, capacity if integration, clarity, diagnostic ability etc. This step will require the participation of Member States for selecting the most appropriate indicators.
4. Select a final set of indicators and create the necessary documents. Each indicator should be associated with three documents:
 1. A fact sheet (explaining what is requested and why)
 2. A Situation Assessment (presenting a view of the spatial and/or temporal development of the indicator in view of the phenomenon of interest (here, Water Scarcity).
 3. Reporting guidelines (defining the format of how to report the indicator).

The above process is also presented schematically in the following figure showing the steps for populating the WS&DiS and the points where the contribution of the Member States is crucial.

Figure 6. Process for populating the WS&DiS





7.4 KEY MESSAGES FOR THE DEVELOPMENT OF A WSDiS

- *Use a DPSIR framework to house descriptive indicators (but not indices)*
- *Use a 2D visualization of the framework to underlie the iterative nature of the process.*
- *Define and rigorously keep the clarity and distinction between DPSIR categories.*
- *Include socio-economic aspects by selecting socio-economic indicators*
- *Include socio-economic decision making context by tailoring indices*
- *Populate the framework using an issues-oriented approach*
- *Populate the framework for each selected economic category*
- *Involve Member States for the final screening of the indicators based on specific criteria such as: suitability, data availability, reproducibility, capacity of integration, clarity, diagnostic ability etc.*
- *Select a final set of indicators that includes both natural and socio economic indicators and that is able to observe and monitor Water Scarcity and Drought.*
- *Present final indicators*
- *Develop Fact Sheets and Situation Assessments for each proposed indicator*
- *Develop stakeholder-tailored indices, on the basis of common descriptive indicators*
- *Develop index "products" in stages as diagnostic and forecasting tools.*
- *Create a roadmap for the inclusion of more "sophisticated" indicators and the creation of indices*
- *Keep the process open*



8 REFERENCES

1. COM (2007) 414. Communication from the Commission to the European Parliament and the Council Addressing the challenge of water scarcity and droughts in the European Union (<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007DC0414:EN:NOT>)
2. 13389/07 ENV 486 DEVGEN 170 AGRI 307. Council of the European Union. Water Scarcity and Drought - draft Council conclusions. (<http://register.consilium.europa.eu/pdf/en/07/st13/st13888.en07.pdf>)
3. MedWSD, 2007, "Mediterranean Water Scarcity and Drought Report", Technical Report - 009 - 2007, produced by the MEDITERRANEAN WATER SCARCITY & DROUGHT WORKING GROUP (MED WS&D WG), April 2007.
4. 2nd Interim Report, 2007, "Water Scarcity and Droughts 2nd Interim Report", produced by the DG Environment, European Commission, June 2007.
5. Iglesias et al, 2007, "Challenges to Manage the Risk of Water Scarcity and Climate Change in the Mediterranean", Ana Iglesias, Luis Garrote, Francisco Flores, Marta Moneo, Water Resources Management (2007) 21:775-788, Springer.
6. CEDEX, 2004, "Task Plan 2004. Task 11 (Activity 4.3.1) Development of background information sheets on potential issues/extreme events of public interest for inland waters. Event: Droughts", ETC/WTR Authors: Manuel Menéndez, Concepción Lallana (CEDEX), July 2004
7. WS Drafting Group, 2006, "WATER SCARCITY MANAGEMENT IN THE CONTEXT OF WFD", Water Scarcity Drafting Group, MED Joint Process WFD /EUWI, June 2006.
8. Wilhite et al., 2007, "Understanding the complex impacts of drought: A key to enhancing drought mitigation and preparedness", Donald A. Wilhite, Mark D. Svoboda, Michael J. Hayes, Water Resources Management (2007) 21:763-774, Springer.
9. Marsily, 2007, "Climate Change and its Links to the Water Scarcity and Drought Problems in Europe", Ghislain de Marsily, included in the publication of the Portuguese Presidency "WATER SCARCITY AND DROUGHT, A Priority of the Portuguese Presidency", Edition: Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, 2007.
10. Afonso, 2007, "Water Scarcity and Droughts: Main issues at European level and the Portuguese Experience", José Rocha Afonso, included in the publication of the Portuguese Presidency "WATER SCARCITY AND DROUGHT, A Priority of the Portuguese Presidency", Edition: Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional, 2007.
11. OECD (1993). OECD core set of indicators for environmental performance reviews: a synthesis report by the group on the state of the environment. Environment Monographs 83, Organisation for Economic Co-operation and Development, Paris.
12. Smeets, E., Weterings, R., (2005). Environmental indicators: typology and overview. Technical report no. 25. European Environment Agency, 19 pp.
13. Aubry, A., Elliott, M., (2006). The use of environmental integrative indicators to assess seabed disturbance in estuaries and coasts: application to the Humber Estuary, UK. Mar. Pollut. Bull. 53, 175-185.
14. Bidone, E.D., Lacerda, L.D. (2004). The use of DPSIR framework to evaluate sustainability in coastal areas. Case study: Guanabara Bay basin, Rio de Janeiro, Brazil. Reg Environ Change (2004) 4, 5-16.
15. Borja A. et al (2006). The European Water Framework Directive and the DPSIR, a methodological approach to assess the risk of failing to achieve good ecological status. Estuarine, Coastal and Shelf Science 66, 84-96



Water Scarcity and Drought: Towards a European WSDNetwork

16. Hameedi, J., (2005). Environmental indicators as performance measures for improving estuarine environmental quality. In: Bortone, S.A. (Ed.), *Estuarine Indicators*. CRC Press, Boca Raton, FL, pp. 451–465.
17. Jorge, M.R., Nelson Lourenço, N., Machado, C.R., Rodrigues, L. (2002). Measuring, monitoring and managing sustainability in Indian coastal areas: the socioeconomic dimension. *Littoral 2002*, 22-26 September. Porto, Portugal.
18. Marsili-Libelli, S., Betti, F., Cavalieri, S. (2004). Introducing River Modelling in the Implementation of the DPSIR Scheme of the Water Framework Directive. Proc. IEMSS 2004 International Congress "Complexity and Integrated Resources Management", Osnabruek, Germany, June 2004



ANNEX 1. DESCRIPTION OF DROUGHT AND WATER SCARCITY ACTIVITIES AT MEMBER STATES

Austria

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Naformátováno:
Francouzština (Francie)

Federal Ministry for Agriculture, Forestry, Environment and Water Management
Department of Water Management
<http://wasser.lebensministerium.at>

<http://lebensministerium.at>

State of Vorarlberg - Water management

www.vorarlberg.at/vorarlberg/wasser_energie/wasser/wasserwirtschaft/start.htm(de)

www.vorarlberg.gv.at/english/vorarlberg-english/water_energy/watermanagement/watermanagement.htm (en)

State of Tirol - Water management

www.tirol.gv.at/themen/umwelt/wasser/wasserkreislauf/wasserstand/hwpegel/

State of Salzburg - Water management

www.salzburg.gv.at/themen/nuw/wasserwirtschaft.htm/64-hydrographie.htm

State of Oberoesterreich - Water management

www.land-oberoesterreich.gv.at

State of Niederoesterreich - Water management

www.noel.gv.at/Externeseiten/wasserstand/htm/wndcms.htm

State of Kaernten - Water management

www.verwaltung.ktn.gv.at/cgi-bin/evoweb.dll/cms/akl/11924_DE-Abt%2e18Wasserwirtschaft-B%fcrgerservice.62B55B8b75c46cf759046049893fc751048226b?#B_online

State of Steiermark - Water management

www.luis.steiermark.at/cms/ziel/25580/DE/

State of Wien - Water management

www.natur-wien.at/partner/ma45

State of Burgenland - Water management

www.burgenland.at/natur-umwelt/landwirtschaft

Geodata for all 9 federal states of Austria & Waterbooks for 5 federal states

www.geoland.at

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002

CP2002-Austria

<http://www.un.org/esa/agenda21/natinfo/wssd/austria.pdf>

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

Austrian Energy Agency - Renewable Energy in Austria

www.energyagency.at/publ/pdf/ren_in_a_en.pdf



Water Scarcity and Drought: Towards a European WSDNetwork

Bundesministrerium fur Wirtschaft und Arbeit

www.bmwa.gv.at

Evaluation – Gaps – Comments

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002

CP2002-Austria

<http://www.un.org/esa/agenda21/natinfo/wssd/austria.pdf>

Belgium

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Brussels Institute for Management of the Environment

www.ibgebim.be

Flemish Environment Agency

www.vmm.be

Walloon Regional Ministry for Environment

mrw.wallonie.be/dgrne

Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation

www.diplomatie.be/en/default.asp

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002

CP2002-Austria

<http://www.un.org/esa/agenda21/natinfo/wssd/austria.pdf>

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002

CP2002-Belgium

<http://www.un.org/esa/agenda21/natinfo/wssd/belgium.pdf>

Flemish Environment Agency

www.vmm.be

Evaluation – Gaps – Comments

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002

CP2002-Belgium

<http://www.un.org/esa/agenda21/natinfo/wssd/belgium.pdf>

Bulgaria

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Ministry of Environment and Water of Bulgaria (MOEW)

www.moew.government.bg

Environment Executive Agency (EEA)

<http://nfp-bq.eionet.eu.int/ncesd/eng/index.html>

Regional Inspectorates for Environment and Water – Plovdiv (RIEW)



Water Scarcity and Drought: Towards a European WSDNetwork

www.riosv-pd.hit.bg

Water Basins Directorates (WBD), and Supreme Water Consultative Committee (SWCC)
http://pdc.ceu.hu/archive/00002941/01/ISPA_Strategy_for_environment_en_2003.pdf

Ministry of agriculture and forest (MAF)
<http://chm.moew.govtment.bg>

Ministry of Regional Development and Public Works (MRDPW)
<http://www.mrrb.govtment.bg>

National institute of Metrology and Hydrology (NIMH)
www.meteo.bg/main.php?page=main&lang=en

National objectives-priorities for drought management
[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Ministry of Environment and Water of Bulgaria (MOEW)
Program concerning the necessary measures in the circumstances of trend to Drought
<http://www.moew.govtment.bg/doc/programs/Netty10.doc>

United Nations Division for Sustainable Development, June 2008
<http://www.un.org/esa/sustdev/natinfo/natinfo.htm>

Ministry of Environment and Water of Bulgaria
Agriculture; Drought; Desertification; Land and Rural Development, July 2007
http://www.un.org/esa/agenda21/natinfo/countr/bulgaria/agriculture_drought_desert_land_rD.pdf

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-Bulgaria
<http://www.un.org/esa/agenda21/natinfo/wssd/bulgaria.pdf>

Current status for drought management
[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

National Statistical Institute
http://www.nsi.bg/Index_e.htm

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-Bulgaria
<http://www.un.org/esa/agenda21/natinfo/wssd/bulgaria.pdf>

Evaluation – Gaps – Comments

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-Bulgaria
<http://www.un.org/esa/agenda21/natinfo/wssd/bulgaria.pdf>

Cyprus

Bodies & structures
[Ministries, Organisations, Authorities etc. & link]

Ministry of Agriculture, Natural Resources and Environment
www.cyprus.gov.cy/moa/Agriculture.nsf/index_en/index_en

Water Development Department
www.moa.gov.cy/moa/wdd/Wdd.nsf/index_en/index_en?OpenDocument

Meteorological Service
www.moa.gov.cy/moa/ms/ms.nsf/DMLindex_en/DMLindex_en?opendocument

National objectives-priorities for drought management
[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]



Water Scarcity and Drought: Towards a European WSDNetwork

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-CYPRUS
<http://www.un.org/esa/agenda21/natinfo/wssd/cyprus.pdf>

Water Development Department
www.moa.gov.cy/moa/wdd/Wdd.nsf/index_en/index_en?OpenDocument

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
<http://www.un.org/esa/sustdev/natinfo/natinfo.htm>

International Herald Tribune, August 2007
Officials say Cyprus' water reserves dangerously low, could drop further if drought holds
<http://www.iht.com/articles/ap/2007/08/14/europe/EU-GEN-Cyprus-Water-Shortage.php>

Young Reporters, January 2008
www.youngreporters.org/IMG/doc/Water_Scarcity_in_Cyprus_JAN_08.doc

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-CYPRUS
<http://www.un.org/esa/agenda21/natinfo/wssd/cyprus.pdf>

MEDROPLAN
www.medawater-rmsu.org/Projects/MEDROPLAN.htm

EMWIS
www.emwis.net

MEDAware
www.uest.gr/medaware

Evaluation – Gaps – Comments

COUNTRY PROFILES SERIES for the JOHANNESBURG SUMMIT, 2002
CP2002-CYPRUS
<http://www.un.org/esa/agenda21/natinfo/wssd/cyprus.pdf>

International Herald Tribune, August 2007
Officials say Cyprus' water reserves dangerously low, could drop further if drought holds
<http://www.iht.com/articles/ap/2007/08/14/europe/EU-GEN-Cyprus-Water-Shortage.php>

Czech Republic

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministry of Agriculture of the Czech Republic
www.mze.cz/en/outside.aspx

Ministry of the Environment of the Czech Republic
www.env.cz/_C1257131004B200Dnsf/index.html

Czech Hydrometeorological Institute – CHMI
www.chmi.cz/indexe.html

Ministry of the Environment
(Geological research - natural hazards - water resources - international development assistance)
www.env.cz
www.env.cz/env.nsf/homeie?OpenFrameSet

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Ministry of the Environment of the Czech Republic
www.env.cz/_C1257131004B200Dnsf/index.html

United Nations Division for Sustainable Development, June 2008



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National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/czech/drought.pdf>

State Environmental Policy, January 2001

MINISTRY OF THE ENVIRONMENT OF THE CZECH REPUBLIC, PRAGUE 1999

[http://www.env.cz/www/zamest.nsf/0/cdc577a3849f7573c1256aaf00262338/\\$FILE/policy%201999.pdf](http://www.env.cz/www/zamest.nsf/0/cdc577a3849f7573c1256aaf00262338/$FILE/policy%201999.pdf)

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

Ministry of Agriculture of the Czech Republic: The water management information Portal
www.voda.gov.cz/portal/en

Portal on Environment of the Czech Republic
<http://portal.env.cz/>

Ministry of the Environment of the Czech Republic: State of Environment – January 2001

<http://www.env.cz/www/zamest.nsf/defc72941c223d62c12564b30064fdcc/cdc577a3849f7573c1256aaf00262338?OpenDocument>

National Program to abate the climate change impacts in the Czech Republic, Ministry of the Environment

[http://www.env.cz/AIS/web-pub-en.nsf\\$pid/MZPOBFKFL7JL/\\$FILE/N%C3%A1rodn%C3%AD_program_EN.pdf](http://www.env.cz/AIS/web-pub-en.nsf$pid/MZPOBFKFL7JL/$FILE/N%C3%A1rodn%C3%AD_program_EN.pdf)

Institute of Atmospheric Physics and the Institute of Thermomechanics of the Academy of Sciences of the Czech Republic

Evaluation – Gaps – Comments

State Environmental Policy, January 2001

MINISTRY OF THE ENVIRONMENT OF THE CZECH REPUBLIC, PRAGUE 1999

[http://www.env.cz/www/zamest.nsf/0/cdc577a3849f7573c1256aaf00262338/\\$FILE/policy%201999.pdf](http://www.env.cz/www/zamest.nsf/0/cdc577a3849f7573c1256aaf00262338/$FILE/policy%201999.pdf)

Denmark

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Danish Meteorological Institute - DMI
www.dmi.dk

Danish Ministry of the Environment
www.mim.dk

Danish Environmental Protection Agency
www.mst.dk/English

Danish Water Forum (DWF)
www.danishwaterforum.dk

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Danish Ministry of the Environment
www.mim.dk

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/countr/czech/drought.pdf>

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation



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measures, policy]

DG Environment, Water Scarcity and Droughts, Second Interim Report, June 2007
http://ec.europa.eu/environment/water/quantity/pdf/comm_droughts/2nd_int_report.pdf

UN Commission on Sustainable Development, Danish National Report
<http://www.un.org/esa/agenda21/natinfo/countr/denmark/africa.pdf>

European Commission
<http://ec.europa.eu>

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/czech/drought.pdf>

Estonia

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministry of the Environment
http://www.envir.ee/vesi/Juhendlyh_EE.pdf

Estonian Meteorological and Hydrological Institute (EMHI)
www.emhi.ee/index.php?nlan=eng

Estonian Environment Information Centre
<http://nfp-ee.eionet.eu.int>
http://www.envir.ee/itk/index_en.htm

Estonian Environmental Research Centre
<http://www.envir.ee/eerc/ku-keskus-ingl.htm> (not working)

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

The Implementation of the EU Sustainable Development Strategy in Estonia, Tallinn June 2007
Estonian input into the European Commissions progress report on the implementation of a European Union Sustainable Development Strategy
http://www.riigikantselei.ee/failid/2007_06_15_Estonian_Report_about_the_Implementation_of_the_EU SDS.pdf

Water Act, 1994

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/countr/estonia/drought.pdf>

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

Tiiina Tammets, Distribution of extreme wet and dry days in Estonia in last 50 years, Proc. Estonian Acad. Sci. Eng., 2007, 13, 3, 252–259

MAPS
<http://register.keskkonnainfo.ee/envreg/main?mount=map>

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/countr/estonia/drought.pdf>

Environment indicators of Estonia
http://eelis.ic.envir.ee:88/seireveeb/envirind_avalik/index.php?l=en&t1=AVALEHT&t2=&t3=&t4=



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Statistical database

www.stat.ee/subject-areas

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/estonia/drought.pdf>

Finland

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Finnish Environment Institute (SYKE)

www.ymparisto.fi/vesistoennusteet

www.environment.fi

Finnish Meteorological Institute (FMI)

www.fmi.fi

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/finland/drought.pdf>

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/finland/drought.pdf>

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/finland/drought.pdf>

France

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Ministry of Environment, Water Directorate

[www.developpement-durable.gouv.fr](http://www developpement-durable.gouv.fr)

Ministère de l'Ecologie et du Développement Durable - Ministry of ecology and sustainable development

www.ecologie.gouv.fr

IFEN - L'Institut français de l'environnement

www.ifen.fr

Sandre: Service d'Administration Nationale des Données et Référentiels sur l'Eau --> Monitoring, data



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<http://sandre.eaufrance.fr/>

DIREN Midi Pyrénées

www.midi-pyrenees.ecologie.gouv.fr

Onema: National Office for Water & Aquatic Environment

www.csp.ecologie.gouv.fr/

Academie de l'Eau

www.oieau.fr/academie/

Agence Eau Seine Normandie

www.aesn.fr/

Institut National de la Recherche Agronomique – INRA

<http://www.inra.fr>

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Policy/legislation in mitigating drought impacts

[www.developpementdurable.gouv.fr/-Textes-relatifs-a-la-gestion-de-la-.html](http://www developpementdurable.gouv.fr/-Textes-relatifs-a-la-gestion-de-la-.html)

[www.developpementdurable.gouv.fr/Guide-methodologique-mesures.html](http://www developpementdurable.gouv.fr/Guide-methodologique-mesures.html)

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/france/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/france/drought_en.pdf

Eaufrance: Water portal

www.eaufrance.fr

WATERDOC: Information portal for water

<http://eaudoc.oieau.fr>

GEST'EAU: Internet website for integrated water management tools

www.gesteau.eaufrance.fr

Drought management plan

www.developpementdurable.gouv.fr/Plan-d-action-secheresse-2004-et.html

Drought Early Warning System (DEWS)

[www.developpementdurable.gouv.fr/ecologie/IMG/pdf/indice_secheresse_20071012.pdf FR 6](http://www.developpementdurable.gouv.fr/ecologie/IMG/pdf/indice_secheresse_20071012.pdf)

www.developpementdurable.gouv.fr/-Dossier-comite-national-de-suivi-.html

Drought mitigation and response plan

<http://www.developpementdurable.gouv.fr/-Dossier-plan-de-gestion-de-la-.html>

National or Regional Drought Information homepage

www.developpementdurable.gouv.fr/-Secheresse-.html

Hydrological bulletins / Water Resources Situation Reports / Hydrological yearbooks

www.eaufrance.fr/document.php3?id_article=1

Drought monitoring (DM) – incl. remote sensing technologies

www.eaufrance.fr/document.php3?id_article=1

www.developpementdurable.gouv.fr/ecologie/IMG/pdf/Arretes_restriction071203.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/france/drought_en.pdf



Germany

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Federal Ministry of Transport, Building and Urban Affairs
www.dwd.de

Federal Environment Agency
www.umweltbundesamt.de

Federal Institute of Hydrology
www.bafg.de
<http://undine.bafg.de>

Electronical Waterway Information System ELWIS
www.elwis.de

German Federal Ministry of Education and Research
www.glowa.org
www.glowa-elbe.de

Bayerischen Landesamt fuer Umwelt
www.hnd.bayern.de

Hochwasser-Zentralen in Deutschland und Nachbarländern
www.hochwasserzentralen.de

National Climate Data Centre
www.dwd.de

Archive of the world-wide Climate Data (ACD)
www.dwd.de

Global Precipitation Climatology Centre (GPCC)
www.dwd.de

Global Climate Observing System Surface Network Monitoring Centre (GSNMC)
www.dwd.de

Umwelt Bundes Amt
www.umweltbundesamt-umwelt-deutschland.de/umweltdaten/public/theme.do?nodeIdent=2303

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/countr/germany/drought.pdf>

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

Federal Ministry of Transport, Building and Urban Affairs, Research Program
www.kliwas.de

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
<http://www.un.org/esa/agenda21/natinfo/countr/germany/drought.pdf>

Greece

Bodies & structures [Ministries, Organisations, Authorities etc. & link]



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Hellenic Ministry of Environment, Physical Planning and Public Works

www.minev.gr

Public Power Corporation S.A. (DEH A.E.)

www.dei.gr

IGME: Greek Institute of Geology & Mineral Exploration

www.igme.gr

National Technical University of Athens

www.ntua.gr

National Water Committee

Central Water Agency

Regional Water Directorates

Regional Water Councils

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/greece/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/greece/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/greece/drought_en.pdf



Hungary

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Ministry of Environment and Water
www.kvvm.hu

Ministry of Agriculture and Rural Development
www.fvm.hu

Hungarian Meteorological Service – HMS
www.met.hu

National Directorate for Environment, Nature and Water
www.ovf.hu

Research Institute of Soil Science and Agro-chemistry (RISSAC)
<http://www.taki.iif.hu/english.htm>

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

UN Department of Economic and Social Affairs, Division for Sustainable Development
www.un.org/esa/sustdev/

Hungarian Meteorological Service - HMS
www.met.hu

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/hungary/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/hungary/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/hungary/drought_en.pdf



Ireland

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministry of Environment
www.environ.ie/en

Environmental Protection Agency
www.epa.ie
<http://maps.epa.ie>

Irish Climate Analysis and Research Unit (ICARUS)
<http://icarus.nuim.ie/research/water.shtml>

Irish National Meteorological Service
www.met.ie

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

The European Union Water Framework Directive – River Basin Management Plans - Ireland
www.wfdireland.ie

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/ireland/drought_en.pdf

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/ireland/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/ireland/drought_en.pdf



Italy

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministro dell'Ambiente e della Tutela del Territorio e del Mare
www.minambiente.it

Italian Environment Protection and Technical Services Agency, APAT (Agenzia per la Protezione dell'Ambiente e per i servizi Tecnici)
www.apat.gov.it

Ministry of Agriculture

Water Research Institute (IRSA-CNR)
www.irsa.cnr.it

Committee to Combat Drought and Desertification

Regions and of Basin Authorities

National Hydrographic Service, the Ufficio Centrale di Ecologia Agraria (UCEA)

Regional Agencies for Environmental Protection (ARPA) centrally co-ordinated by the National Agency for Environmental Protection

CIMA – Centro di ricerca interuniversitario in Monitoraggio Ambientale
www.cima.unige.it

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

National Report on the Implementation of UNCCD Italy, October 2000, Italian Committee to Combat Drought and Desertification
www.unccd.int/cop/reports/northmed/national/2000/italy-eng.pdf

National Action Programme (NAP)

Italian Committee to Combat Drought & Desertification

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/italy/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/italy/drought_en.pdf



Latvia

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Latvian Environment, Geology, and Meteorology Agency – LEGMA
www.meteo.lv/public/27600.html

Ministry of Agriculture
www.zm.gov.lv/?setl=2

Ministry of the Environment
www.vidm.gov.lv/eng

The River Basin Authority under the State Geological Survey
www.lva.gov.lv/

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Law on Water Management

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/latvia/drought_en.pdf

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/latvia/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/latvia/drought_en.pdf



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Lithuania

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministry of Environment of the Republic of Lithuania
www.am.lt/VI/en/VI/index.php

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/lithuania/drought_en.pdf

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/lithuania/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/lithuania/drought_en.pdf

Luxembourg

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Ministry of Environment of the Republic of Lithuania
www.am.lt/VI/en/VI/index.php

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/luxembourg/drought_en.pdf

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/luxembourg/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/luxembourg/drought_en.pdf



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Malta

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Malta Resources Authority (MRA)

www.mra.org.mt;

<ftp://ftp.fao.org/docrep/fao/009/a0994e/a0994e.pdf>

Malta Environment and Planning Authority (MEPA)

www.mepa.org.mt

Water Services Corporation (WSC)

www.wsc.com.mt

Health Department (responsible for regulating drinking-water quality)

www.sahha.gov.mt

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/malta/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/malta/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/malta/drought_en.pdf



Poland

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Polish Ministry of the Environment

www.mos.gov.pl

Polish Geological Institute

www.pgi.gov.pl/

Institute of Meteorology and Water Management (IMGW)

www.imgw.pl

National Water Management Authority

www.kzgw.gov.pl

Institute of Environmental Protection

www.ios.edu.pl/eng/

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/poland/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/poland/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/poland/drought_en.pdf



Portugal

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Ministério do Ambiente, do Ordenamento do Território e do Desenvolvimento Regional
www.maotdr.gov.pt

INAG - Instituto da Água, Planning
www.inaq.pt

Department & Water Resources Department

Instituto de Meteorologia
www.meteo.pt

Agência Portuguesa do Ambiente (APA)
www.apambiente.pt

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/portugal/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/portugal/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

http://www.un.org/esa/agenda21/natinfo/countr/portugal/drought_en.pdf



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Romania

Bodies & structures
[Ministries, Organisations, Authorities etc. & link]

Ministry of Environment & Water Management (MEWM)
www.mmediu.ro

National objectives-priorities for drought management
[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Current status for drought management
[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/romania/drought_en.pdf

Evaluation – Gaps – Comments

Slovakia

Bodies & structures
[Ministries, Organisations, Authorities etc. & link]

Ministry of Environment of the Slovak Republic
www.lifeenv.gov.sk

Slovak Hydro-meteorological Institute
www.shmu.sk

National objectives-priorities for drought management
[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovakia/drought_en.pdf

Current status for drought management
[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovakia/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovakia/drought_en.pdf



Slovenia

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Minister of the Environment and Spatial Planning, Environment Directorate
www.mop.gov.si/en

Inspectorate of the Republic of Slovenia for the Environment and Spatial Planning
<http://www.iop.gov.si/>

Environmental Agency of Slovenia
<http://www.arso.gov.si/en/>

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovenia/drought_en.pdf

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovenia/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/slovenia/drought_en.pdf

**Spain****Bodies & structures
[Ministries, Organisations, Authorities etc. & link]****Government of Spain:**

Ministry of Environment, Rural and Marine Affairs (Including water and agriculture affairs)
Ministry's website: www.marm.es

Ministry's water website:
http://www.mma.es/portal/secciones/aquas_continente_zonas_asoc/

The Spanish Ministry of Environment, Rural and Marine Affairs is developing drought monitoring through the National Drough Observatory where all the Autonomous Communities, River Basin Authorities, users and NGOs are participating.

The Ministry's services are producing the following indexes for all the Autonomous Communities of Spain.

- Actual precipitation; % of normal Rainfall; Precipitation deciles Standardized Precipication Index (SPI); Palmer Drought Severity Index (PDSI); Reconnaissance Drought Index (RDI)
- Soil Moisture Anomaly Index; Palmer Moisture Anomaly Index (Z index); Computed soil moisture; Crop Moisture Index (CMI); Normalized Difference Vegetation Anomaly Index (NDVI)
- Reservoir storage; Cumulative stream flow anomaly; GW levels (compared with values equivalent to percentiles of historical records); Reservoir storage; Snowpack accumulation; IE official national drought index
- Surface Water Supply Index (SWSI): Shafer & Dezman;1982 (complements Palmer Indicator)
- Impacts on economic sectors; Impacts on society (including health issues); Impacts on environment
- Measures of prevention (planning; etc); Specific measures of mitigation and adaptation to droughts
- Hydrological Water balance; Reservoir storage; simulation hydrological models
- Total water abstraction;
Water abstraction by source;
Water abstraction by sectors
Water use/demand by sectors; Per capita water use variation; Irrigation seasonality indicator; Water use restrictions/interruptions by sectors; Water use/removable resource
- Water Exploitation Index (WEI); Aquastress Water Stress Index (AWSI)
- Reservoir storage fluctuations; Surface water low flow; Saltwater intrusion
Aquifer Depletion-changes in water table; Environmental river flows - Wetlands levels & flows
- Impacts on economic sectors; Impacts on society
- Policy instruments; Water saving measures; Water efficiency measures; Use of alternative water resources; Economic instruments-water markets

The Spanish Ministry of Environment is supported in this work by the Hydrographical Studies Centre, the State Agency of Meteorology, the Geologic National Institute and other governmental research bodies.

- Spanish Autonomous Communities

The Spanish Autonomous Communities have full competences only for those river basins that are 100% inside the regional borders (except in Andalusia where the Regional Government has the full competence to manage the Guadalquivir River even if only 91% of the river basin is in Andalusia).

The Regional Governments have full competences for inland and coastal water management and planning, with concrete exceptions for coastal waters. Regarding water availability, scarcity and drought, only few Regional Governments have created special services to monitor and analyse the effects of droughts.

- Andalucía
 - www.agenciaandaluzadelagua.com
 - <http://www.juntadeandalucia.es/medioambiente/site>



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- [/aplica/medioambiente/site/web/menuitem.48ed6f0384107256b935619561525ea0/?vgnextoid=bccb5678c36a6010VgnVCM1000000624e50aRCRD](http://aplica/medioambiente/site/web/menuitem.48ed6f0384107256b935619561525ea0/?vgnextoid=bccb5678c36a6010VgnVCM1000000624e50aRCRD)
- Aragon
 - <http://portal.aragon.es/portal/page/portal/IAA>
 - Principado de Asturias
 - http://www.asturias.es/portal/site/Asturias/menuitem.77b6558ac8616446e44f5310bb30a0a0/?vgnextoid=_da9091b2f157e010VgnVCM100000b0030a0aRCRD&vgnextchannel=0442b8db8222a010VgnVCM100000bb030a0aRCRD&i18n.http.lang=es
 - Illes Balears / Islas Baleares
 - <http://www.caib.es/govern/organigrama/area.es.jsp?coduo=209>
 - Islas Canarias
 - http://www.gobiernodecanarias.org/organizacion/ver_unidad-organica.jsf
 - <http://www.fcca.es/>
 - Castilla-La Mancha
 - <http://www.jccm.es/medioambiente/index2.htm>
 - Castilla y Leon
 - <http://www.jcyl.es/scsiau/Satellite/up/es/MedioAmbiente/Page/PlantillaN3SoloHijos/1131977441946///?asm=jcyl&tipoLetra=x-small>
 - Cantabria
 - http://www.gobcantabria.es/portal/page?_pageid=80,_1884144&_dad=interportal&_schema=INTERPORTAL&org_id=33605
 - Catalunya / Cataluña
 - <http://mediambient.gencat.net/aca>
 - Ciudad Autónoma de Ceuta
 - <http://www.ceuta.es>
 - Euskadi / País Vasco
 - <http://www.uragentzia.euskadi.net>
 - Extremadura
 - <http://www.juntaex.es/consejerias/industria-energia-medioambiente/index-ides-idweb.html>
 - Galicia
 - <http://augasdegalicia.xunta.es/>
 - La Rioja
 - <http://www.larioja.org/npRioja/default/defaultpage.jsp?idtab=395387>
 - Comunidad de Madrid
 - www.madrid.org/medioambiente
 - Ciudad Autónoma de Melilla
 - www.melilla.es
 - Región de Murcia
 - [http://www.carm.es/neweb2/servlet/integra.servlets.ControlPublico?IDCONTENIDO=80&IDTIPO=140&RAS_TRO=c\\$sm120_128](http://www.carm.es/neweb2/servlet/integra.servlets.ControlPublico?IDCONTENIDO=80&IDTIPO=140&RAS_TRO=c$sm120_128)
 - Comunidad Foral de Navarra / Nafarroako Foru Elkartea
 - http://www.navarra.es/home_es/Gobierno+de+Nava+rra/Organigrama/Los+departamentos/Desarrollo+Rural+y+Medio+Ambiente/
 - Comunitat Valenciana / Comunidad Valenciana
 - <http://www.qva.es/isp/portalqv.jsp?br=1&re=1&co=es&chflash=true&force=si>

- River Basin authorities:

The Spanish River Basin authorities (or Districts) were created in 1927 to manage and plan the river basin. River basin authorities are autonomous entities belonging to the Spanish Ministry of Environment, Rural and Marine Affairs. Regional river basin authorities are belonging to the Autonomous Regional Governments.

The Basin authorities are in charge to develop, monitor and review the Hydrological Plan for the basin, it represents the highest administrative body to manage and control the public hydrological domain in order to protect the water resources and the general interest in between the different Spanish regions.



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Basin authorities are also responsible to project, build and exploit water engineering public infrastructures using their own economical resources with the support of the Government of Spain.

For the international cooperation and transboundary basins, the Basin authorities are supported by the Spanish Ministries of Environment and Foreign Affairs.

- Ceuta – www.ceuta.es
- Atlantic basin of Andalusia www.agenciaandaluzadelagua.com
- Mediterranean basin of Andalusia www.agenciaandaluzadelagua.com
- Internal basins of Catalonia <http://mediambiente.gencat.net/aca/es/inici.jsp>
- Internal basins of the Basque Country <http://www.uragentzia.euskadi.net/u81-0002/es/>
- Duero basin <http://www.chduero.es/>
- Ebro basin <http://www.chebro.es/>
- Galician coast basins <http://augasdegalicia.xunta.es/>
- Guadalquivir basin <http://www.chguadalquivir.es>
- Guadiana basin <http://www.chguadiana.es/>
- Balearic Islands <http://www.caib.es/govern/organigrama/area.es.jsp?coduo=209>
- Canary Islands <http://www.gobiernodecanarias.org/cmayot-medioambiente/index.html>
- Jucar basin <http://www.chj.es/>
- Melilla http://www.melilla.es/melillaportal/p_37_menu_nivel_3a.jsp?codMenu=198&language=es&codMenuPN=8
- Cantabric basin <http://www.chcantabrico.es/>
- Miño-Sil basin <http://www.chminosil.es/>
- Segura basin <http://www.chsegura.es>
- Tajo/Tagus basin <http://www.chtajo.es/>

- National Research Centres

- CSIC – Research Centre on Desertification
 - <http://www.uv.es/cide/>
 - Soil degradation and conservation
 - Territorial planning
 - Vegetal ecology
- CSIC – Research Station on Arid Zones
 - <http://www.eeza.csic.es/eeza>
 - Biodiversity and global changes
 - Natural Resources Conservation and management
 - DTM Analysis and developments
 - Landscape ecology
 - Physiologic ecology
 - Fauna and desertification
 - Geo-Ecology
 - Hydrological processes
 - Paleoclimatology

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Traditionally, Spain has developed drought management plans and actions as an emergency situation due the previous legislation allowed the National Government for adoption of urgent measures.

At present time, the Law 10/2001 of the Hydrological National Plan (Art. 27) and the Directive 2000/60/CE (Art. 4.6) are the legal framework to fulfil the national priorities for drought management that determines the phenomenon status, to minimize environmental, social and economic impacts of drought situations.

In Spain public water supply is ensured by the State, nevertheless during dry periods the National,



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Regional and Local Governments limit the supply for domestic uses and introduce restrictions to agriculture, industry and hydroelectric power stations.

The River Basin Authorities in coordination with the Ministry of Environment, Rural and Marine Affairs are the responsible to develop and implement these management plans that are complementary to the River Basin Management Plans. The Ministry is also using different tools for the drought management such as river basin indicators and national indicators on drought and water scarcity

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

- Plans and resolutions

- o White book on Waters – Spain
 - http://www.mma.es/portal/secciones/acm/fondo_doc_u_descargas/libro_blanco/index.htm
- o The drought in Spain
 - http://www.mma.es/secciones/acm/aquas_continente_zonas_asoc/ons/noticias_notaspres/pdf/doc_sequia_espana_new.pdf
- o Drought Special Plans for Basins
 - The drought special plans are complementing the River Basin Management Plans, these plans are organized following this structure: Basin characterization of the basin, drought periods characterization, historical droughts, indicators, typology of measures to be taken in order to prevent and reduce the drought impacts and its management, operational measures, emergency plans and monitoring system. Additionally each plan includes different annexes with basic methodologies for calculating the minimum volume of flow, maps, graphs and complementary data.
 - Tajo
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ch_tajo.htm
 - Guadalquivir (including Ceuta and Melilla)
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ch_quadalquivir.htm
 - Norte
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ct_norte.htm
 - Duero
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ch_duero.htm
 - Ebro
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ch_ebro.htm
 - Guadiana
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ct_guadiana.htm
 - Jucar
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ct_jucar.htm
 - Segura
 - http://www.mma.es/portal/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/ch_segura.htm
 - o Guidelines for the preparation of drought emergency plans at local level
 - http://www.mma.es/secciones/acm/aquas_continente_zonas_asoc/ons/planes_sequia_isas/pdf/GuiaPlanesEmergenciaV9.pdf



- **Actions**
 - o General actions since 2005
 - <http://hispaqua.cedex.es/documentacion/especiales/sequia/medidas.htm>
 - o Agricultural risk management
 - http://www.mma.es/portal/secciones/aguas_continent_zonas_asoc/ons/gestion_riesgos_agric/gestion_riesgo_sequia.htm
 - o National Irrigation Plan
 - <http://www.mapa.es/es/desarrollo/pags/pnr/principal.htm>
- **Legal acts, Royal Decrees and Governmental Resolutions on Drought**
 - o National level
 - http://www.mma.es/portal/secciones/acm/aguas_continente_zonas_asoc/ons/medidas_ons/textos_legales.htm
- **Public Information and Data Centres via Web**
 - o Andalucía – Only for this Autonomous Community
 - InfoSequía:
 - http://www.juntadeandalucia.es/medioambiente/site/web/menuitem_48ed6f0384107256b935619561525ea0/?vnextoid=bccb5678c36a6010VgnVCM1000000624e50aRCRD
 - Water and drought management
 - State of the water resources in Andalucía
 - Water infrastructures in Andalucía
 - EIA and impact indicators
 - News
 - Links
 - o Catalunya – Only for this Autonomous Community
 - Portal de la Sequera:
 - <http://mediambient.gencat.net/aca/sequera/ca/inici.jsp>
 - State of the water resources in Catalonia
 - Public information
 - News and legal acts
 - Links
- **Monitoring data, databases and information portals.**
(Homogeneous data for the 19 Spanish Autonomous Communities)
- o SAIH – Automatic Hydrologic Information System of Spain – Ministry of Environment / Government of Spain
 - http://www.mma.es/portal/secciones/aguas_continente_zonas_asoc/saih/
- o Programa A.G.U.A. – Ministry of Environment / Government of Spain
 - <http://www.mma.es/secciones/agua/entrada.htm>
- o Hispaqua (Spanish Information System on Waters) – Ministries of Public Works and Environment / Government of Spain
 - <http://hispaqua.cedex.es/>
 - News, documents, legislation, water culture, databases, indicators, daily data.
- o Libro Digital del Agua / Water Digital Book – Ministry of Environment / Government of Spain
 - <http://servicios.marm.es:120/siagua/visualizacion/ida/index.jsp>
 - Socio-economic data, Administrative data, water resources, protected areas, scientific studies and reports.
- o Sistema Integrado de Información del Agua - Water



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Integrated Information System - Ministry of Environment /
Government of Spain

- <http://servicios.marm.es:120/siagua/consultas/serv1et/consultas.GlobalFilter?tipo=masiva&sid=generate>
- National indicators on drought
 - http://hispagua.cedex.es/documentacion/especiales/sequia/indicadores_sequia.htm

Evaluation – Gaps – Comments

The specific internal organization of Spain makes difficult the data harmonisation and the common actions against the drought and the water scarcity. Only the remaining River Basin Authorities belonging to the Spanish Ministry of Environment are following homogeneous methodologies and work plans adapted to their basin needs. The River Basins belonging to the Regional Governments are creating independently new methodologies, new indicators and new monitoring systems without connections to the National ones. The Spanish Ministry of Environment is already not including the regional river basins in the maps and reports that this Ministry is producing and publishing through its website, creating «national» gaps due the conflict in between a National government without competences and 19 regional governments developing new ones. This internal regionalization of the country creates conflicts in between regions due the water availability and uses.



Sweden

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Swedish Meteorological and Hydrological Institute (SMHI)
www.smhi.se

Stockholm International Water Institute
www.siwi.org

Swedish International Development Cooperation Agency (Sida)
www.sida.se

Swedish Water House (SWH)
www.swedishwaterhouse.se

Swedish Environmental Protection Agency (SEPA)
www.naturvardsverket.se

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/sweeden/drought_en.pdf

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/sweeden/drought_en.pdf

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008
National SD Reports – Droughts
http://www.un.org/esa/agenda21/natinfo/countr/sweeden/drought_en.pdf



The Netherlands

Bodies & structures

[Ministries, Organisations, Authorities etc. & link]

Ministry of Transport, Public Works and Water Management
www.verkeerenvwaterstaat.nl

Ministry of Transport, Public Works and Water Management / Rijkswaterstaat Waterdienst
<http://lcw.demis.nl>

The Royal Netherlands Meteorological Institute (KNMI)
www.knmi.nl

National objectives-priorities for drought management

[Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/nether/drought.pdf>

Current status for drought management

[Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/nether/drought.pdf>

Evaluation – Gaps – Comments

United Nations Division for Sustainable Development, June 2008

National SD Reports – Droughts

<http://www.un.org/esa/agenda21/natinfo/countr/nether/drought.pdf>



United Kingdom

Bodies & structures [Ministries, Organisations, Authorities etc. & link]

Environment Agency National (England and Wales)
www.environment-agency.gov.uk/drought

National River Flow Archive
www.ceh.ac.uk/data/nrfa/index.html

Department for Environment, Food and Rural Affairs (Defra)
www.defra.gov.uk/environment/water/index.htm

National objectives-priorities for drought management [Secure public water supply, Secure Other Water Uses (agriculture, industry, hydroelectric power, fisheries), Secure Vital flow – Ecological Status, Social Activities Status]

Hydrological Summary for the United Kingdom
www.nwl.ac.uk/ih/nrfa/monthly_summaries/2008/03/summary.html

Current status for drought management [Problem identification, Monitoring, Indices, Drought management plans, Mitigation measures, policy]

Hydrological Summary for the United Kingdom
www.nwl.ac.uk/ih/nrfa/monthly_summaries/2008/03/summary.html

Evaluation – Gaps – Comments

Hydrological Summary for the United Kingdom
www.nwl.ac.uk/ih/nrfa/monthly_summaries/2008/03/summary.html



ANNEX 2. DESCRIPTION OF DROUGHT AND WATER SCARCITY ACTIVITIES AT EUROPEAN LEVEL

EUROPEAN LEVEL

Bodies & structures & link

1. **DG Environment – Directorate General Environment**
(http://ec.europa.eu/environment/index_en.htm)
2. **DG Regional Policy**
(http://ec.europa.eu/regional_policy/index_en.htm)
3. **DG Research**
(ec.europa.eu/research/)
 - **EC-IP WATCH: WATer and global Change: Drought in Europe**
(<http://eu-watch.org>)
 - **AQUASTRESS**
(<http://www.aquastress.net>)
4. **DMCSEE - Drought Management Centre for South-eastern Europe**
(<http://www.dmcsee.org>)
5. **EDC - European Drought Centre**
(<http://www.geo.uio.no/edc/>)
6. **EEA – European Environment Agency**
(www.eea.europa.eu)
7. **ENPI- European Neighbourhood and Partnership Instrument**
(http://ec.europa.eu/europeaid/where/neighbourhood/index_en.htm)
MEDA Water programme: Euro-Mediterranean Regional Water Programme for Local Water Management
(<http://www.medawater-rmsu.org/>)
 - EMWater - Efficient management of wastewater, its treatment and reuse in the Mediterranean countries.
 - EMPOWERS Euro-Med Participatory Water Resources Scenarios
 - ISIIMM - Institutional and social innovations in irrigation Mediterranean management.
 - MEDAware - Development of tools and guidelines for the promotion of sustainable urban wastewater treatment and reuse in agricultural production in the Mediterranean countries.
 - MEDWA - Cooperation with Jordan and Palestine for the stakeholder participatory sustainable water management at farm level.
 - Zer0-M - Sustainable concepts towards a zero outflow municipality.



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8. **EMWIS – SEMIDE - Euro-Mediterranean Information System on know-how in the Water sector** (www.semide.net/initiatives)
- Towards a Mediterranean Water Information Mechanism compatible with the Water Information System for Europe (WISE) Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Tunisia, Turkey, Syria, Palestine EC-ENRTP (2008)
 - Water Scenarios for Europe and for Neighbouring States Finland, Spain, Poland, Netherlands, France, Turkey, United Kingdom, Estonia, Italy, Greece, Hungary, Russian Federation INCO MED (FP6) (2006)
 - Mediterranean Drought Preparedness and Mitigation Planning Spain, Cyprus, Morocco, Greece, Tunisia, Italy MEDA-WATER (2003)
 - Euro-Med Participatory Water Resources Scenarios Improving long-term access and rights to water for local populations in Egypt, Jordan and West Bank/Gaza (2003)
9. **EU-INCO: International Research Cooperation with Mediterranean Partner Countries** (<http://ec.europa.eu/research/iscp/index.cfm>)
- MEDROPLAN Mediterranean Drought Preparedness and Mitigation Planning
 - ASTHyDA Analysis, synthesis and transfer of knowledge and tools on hydrological drought assessment through a European Network
 - DSS-DROUGHT A decision support system for mitigation of drought impacts in the Mediterranean region
 - WAM-ME Water Resources Management under Drought Conditions: Criteria and Tools for Conjunctive Use of Conventional and Marginal Waters in Mediterranean Regions
 - WATERWEB Water resource strategies and drought alleviation in Western Balkan agriculture
10. **EU LIFE, Financial Instrument for the Environment** (<http://ec.europa.eu/environment/life/index.htm>)
11. **EURAQUA**
(<http://www.euraqua.org>)
12. **EUROSTAT**
(<http://epp.eurostat.ec.europa.eu>)
13. **EU-SMAP - The Short and Medium-term Priority Environmental Action Programme**
(<http://ec.europa.eu/environment/smap/home.htm>)
14. **JRC**
(<http://desert.jrc.ec.europa.eu>)
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INTERNATIONAL LEVEL

Bodies & structures & link

1. FRIEND - Flow Regimes from International Experimental and Network Data
(<http://ne-friend.bafg.de/servlet/is/7398/>)
2. GWP- Med - Global Water Partnership – Mediterranean
(www.gwpmed.org)
3. NDMC - National Drought Mitigation Center
(<http://www.drought.unl.edu/>)
4. NIDIS - National Integrated Drought Information System
(<http://www.drought.gov>)
5. UNCCD - United Nations Office for Combat of Drought and Desertification
(<http://www.unccd.int>)
6. UNEP
(www.unep.org)
7. UNESCO – IHP
(<http://typo38.unesco.org/en/about-ihp/ihp-partners/assessment.html>)
8. WMO – World Meteorological Organisation
(www.wmo.int)

Med – HYCOS involved eighteen Mediterranean countries and thirty-one Data Collection Platforms have been installed in selected basins in the participating countries with major output of the first phase has been the establishment of the Mediterranean Hydrological Information System (MHIS)

SADC - HYCOS involved 11 countries of the South African Development Community (SADC) and a network of 43 Data Collection Platforms were installed and the development of an Internet based Information System based in the Regional Centre.

AOC - HYCOS involved 11 countries from the Western and Central Africa sub-region and the major achievement was to consolidate the development of the Regional Hydrological Observatory of Western and Central Africa (OHRAOC) by supporting data collection activities in the countries and reinforcing the regional data bank.