Application of the Drought Management Guidelines in Spain

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SUMMARY

The Spanish case study presents the drought planning process carried in the Tagus Basin. The presentation is structured in four parts: organizational, methodological, operational and public review components. The organizational component presents the framework and specific legislations and the organizations and institutions in Spain that work on drought preparedness and mitigation. The methodological component presents the analytical techniques used for drought risk analysis and management. The operational component describes the proposed structure for the drought management plan and presents the specific actions that are contemplated in it. The process review component identifies stakeholders that are involved in the decision making process and presents their views on the process.

Key words: Tagus Basin, regulated systems, water supply, agricultural, urban, probabilistic, deterministic.

ORGANIZATIONAL COMPONENT

Legal framework

Embid Irujo (2003) recognizes two main legal sources of the Spanish water codes and statutes: derived from the Spanish Constitution and from the European Union Water Framework Directive. These two legal bodies are on top of the hierarchy of laws and statutes pertained to water and droughts. Three instrumental laws are identified as the main precursors of drought preparedness and planning: The Water Law, the Law of the National Hydrological Plan and the Agricultural Insurance Law. The Water Law (WL) was approved in 1985, reformed in 1999, and consolidated in 2001 in a Royal Decree (Real Decreto Legislativo 1/2001, 20 July 2001) with slight amendments with respect to the 1999 version. The Spanish Water Law can be considered a modern and comprehensive water code, covering all issues and aspects related to water policies, organization, procedures, finance, civil works, planning, and public participation. Among the key Water Law provisions that pertain to droughts are:

(i) Water-rights holders can make use of their rights insofar Basin Authorities approve them and issue concrete management plans detailing all possible uses for the current hydrological year (Articles 55 and 58).

(ii) Water use plans and reservoir release decisions are taken by the Basin Authorities, as proposed by the Reservoir Release Commissions and Management Boards (Articles 32 and 33). Droughts are considered exceptional circumstances.

(iii) The formal declaration of a "drought" allows the Government to initiate any project, work, or action under fast track approval procedures.

(iv) Right-holders are allowed to freely exchange their water use rights, but the transfer requires approval of the Basin Authority and is subject to various regulatory provisions (Articles 67-70).Works and projects needed to solve emergent scarcity problems are considered works that promote the general interest (Article 46), and as such, their approval procedures and financing enjoy preferential treatment.

(v) Basin Authorities can create Water Exchanging Centres, through which right holders can offer or demand use rights in periods of droughts or severe water scarcity situations (Article 71). The initiative to create these Centres must be proposed by the Environment Ministry and be approved by the Ministerial Cabinet. If the exchanges

centres or the water rights transfers involve two different basins they must be explicitly approved by the Environment Ministry. All Spanish Hydrological Basin Plans were approved by the Royal Decree 1664/1998 (Real Decreto 1664/1998, of July 24th). In compliance with Article 60 of the Water Law, reliability criteria were established that guarantee minimum allowances for the irrigation and urban sectors for the medium and long term. The criteria are specified by a range of probabilities of supply failure during one, two, or ten consecutive drought years. The Law of the National Hydrological Plan (Ley 10/2001, of July 5th, de Plan Hidrológico Nacional) consolidates all planning decrees pertained to each of the inter-regional basins, and lays down the basic principles of the Water Planning at the national level. Droughts are explicitly mentioned in Article 27 establishing: (i) The Environment Ministry will establish a system of hydrological indicators to support the formal declaration of alert situation and droughts by Basin Authorities. (ii) Basin Authorities should develop special action plans for alert situation and droughts, including the management rules and the programme of measures to be applied on the water public domain under these situations. (iii) All public administrations that are responsible of supplying urban water services to cities with more than 20,000 inhabitants must develop an Emergency Plan. This Plan must be approved by the relevant Basin Authority and take into account the special action plans mentioned in the previous point. The Agricultural Insurance Law (Ley 87/1978, 28 December 1978, de Seguros Agrarios Combinados) lays the framework and institutional organization of the Spanish system of agricultural insurance policy. Droughts are mentioned among the risks recognized in the law to be covered by the insurance policies (Article 3). The specific development of various insurance policies covering yield losses caused by droughts (and other abnormal natural events) has given rise to a menu of options that are currently available to most crops grown under dry-land regimes. Some of these will be described below. In addition to the above, there is also extensive legislation and normative related to water management and water policy. In general the laws, statutes, and norms focus on reactive drought management, providing conditions for emergency actions. In the case of the insurance normative, the laws from 2001 to present have a pro-active character.

INSTITUTIONS INVOLVED IN WATER AND DROUGHT MANAGEMENT *RIVER BASIN AUTHORITIES*

The administrative body that is responsible for providing public service regarding water management in the basin is the Basin Authority, with competence on inland water and groundwater. The Basin Authority is an autonomous public organization that depends from the Ministry of the Environment. The River Basin Authority structure is the following: *Chairman,* appointed by the Council of Ministers at the proposal of Ministry of Environment, for interregional basins, and at the proposal of the Autonomic Communities the when is an intra-regional basin. *Management Board ("Junta de Gobierno").* Headed by the Chairman, includes representatives of the Ministries of Environment, Agriculture, and Energy; and regional governments whose territories are part of the basin and users (at least 33% of the board members). It is in charge of: financial matters, general action plan, definition of aquifer depletion and groundwater protection, and drought by creating an ad-hoc Permanent Committee. *Operation Boards ("Juntas de Explotación").* Co-ordinate the management of hydraulic works and water resources in specific areas. The Waters Act establishes composition of the Board according to the importance of each user group in the basin, but it includes the administration, public and private water supply companies, irrigation associations, hydropower companies, and industrial users. *Assembly of Users ("Asamblea de Usuarios").* Headed by the Chairman, includes all users that are part of the Operation Boards. Co-ordinates the management of hydraulic works and water resources throughout the basin. *Dam Water Releases Commission ("Comisión de Desembalse"*). Headed by the Chairman, and members selected by the Assembly of Users. Responsible for proposing the system for releasing water from reservoirs, and flood measures (through the creation of a special Permanent Committee). *Water Basin Council ("Consejo del Agua de Cuenca").* Headed by the Chairman, and includes representatives the central and regional governments, technical services, and users including NGOs and professionals (at least 33%). It approves the Basin Hydrological Plan, which is then referred to the central Government. *Hydrological Planning*

Office ("Oficina de Planificación"). Defines, monitors, and reviews the Hydrological Basin Plan, and provides technical support to the Water Basin Council. *Other institutions* The Ministry of Agriculture is responsible for irrigation planning, the implementation of publicly funded water schemes and the development of irrigation improvement schemes. The Agricultural Insurance Agency (ENESA), that has the character of an Autonomous Agency dependent on the Ministry of Agriculture, Fisheries and Food through the Under-Secretariat of the Department, acts like a coordination organization and link on behalf of the Administration for the development of Agricultural Insurances. The Institution is headed by the Undersecretary of the Ministry of Agriculture, Fisheries and Food and has a Director that is designated by the Minister of Agriculture, Fisheries and Food. The Insurance Compensation Consortium acts as an essential re-insurer of the system and has been entrusted the monitoring of the consultancies and taking on the percentage of co-insurance not covered by the insurance institutions. The Permanent Office for Adverse Climate and Environmental Situations depends from the Ministry of Agriculture, Fishing and Food, General Secretariat of Agriculture and Food. It is directed to an agricultural environment, and acts through the generation, execution and monitoring of measures undertaken to mitigate drought effects.

METHODOLOGICAL COMPONENT: DROUGHT CHARACTERIZATION AND RISK ANALYSIS

Challenge to water management in Spain

Water resources in Spain are limited, scarce, and difficult to predict from year to year. The average annual potential water availability per capita considering the total freshwater resources is 2,700 m^3 compared to 3,807 m^3 in the EU-15 and 7,000 m^3 worldwide (Aquastat, 2005), but some Spanish regions have less than 1000 m^3 per capita and year, such as the Southeast regions and the Islands. In addition, real available water resources in Spain are less than half of the total freshwater resources. Regulated water resources account for 40% of the total natural resources, compared with 8% worldwide, since the potential use of surface water under natural regime is only 7% (Garrote *et al.*, 1999). Groundwater use is intensive in many areas of the country contributing to an additional 10% of the total available resources. With limited and scarce water resources and demand rising due to demographic shifts, economic development and lifestyle changes, water management problems are significant even without drought events, due to the imbalance between availability and demand.Water use in the country is mainly for agriculture (irrigation accounts for 68% of the water demand), nevertheless the other economic and social water demands are rapidly increasing, such as tourism (current urban demand is 13%) and ecosystem services (Aquastat, 2005). *Options Méditerranéennes, Series B, No. 58* 375 Storage and regulation by reservoirs do not always solve the problem of water scarcity in areas where dry periods are particularly damaging to the natural and human wellbeing. Eutrophication is a major problem in southern areas of Spain, where 40% of the reservoirs show biological oxygen demand, conductivity, and nitrogen and phosphorus concentrations well outside the adequate range (Estrela *et al.*, 1995). These water quality parameters usually get worse during dry periods due to the depletion of reservoir storage. This factor may play a significant role during crises since water from certain reservoirs may not be acceptable for human consumption. In Spain, groundwater resources play a vital role in meeting water demands, not only as regards quality and quantity, but also in space and time, and are of vital importance for alleviating the effects of drought (Garrido *et al.*, 2000; Llamas, 2002). However, groundwater pumping should be controlled because excessive use of the aquifers can cause overexploitation problems with the consequent negative environmental, social and economic impact. Direct use of groundwater in Spain is currently estimated at 5 km^3/year, mainly for irrigation use (80%), but the water quality is easily deteriorated due to point-source pollution or diffuse pollution caused by agricultural and livestock activities (Estrela *et al.,* 1995). Wetland area in Spain has decreased from over 1200 km^2 in the 1970s to less than 800 km^2 in the present time (excluding the Guadalquivir marshlands). This decrease may be in part related to recurrent drought episodes and surface water scarcity, and amplified by the excessive groundwater pumping to compensate for these problems.

THE CASE STUDY: TAGUS BASIN

The Tagus Basin is located in the central part of the Iberian Peninsula. The main river runs on eastwest direction, with a contributing area of 83,678 km2, of which 55,870 km2 are located in Spain and the rest in Portugal. Due to the transboundary nature of the basin, a certain amount of water has to reach the river in Portugal, determined by the Albufeira agreement. The Tagus Basin also supplies water to the Segura Basin, a water scarce basin in eastern Mediterranean area of Spain. Table 1 outlines the water balance of the Tagus Basin. 376 *Options Méditerranéennes, Series B, No. 58*

Table 1. Hydrological balance in the Tagus Basin Water balance Water use Sector Mm3/year Mm3/year
Total available water resources 12180
Demands 5780
Inside the basin Urban 740
Irrigation 1780 Refrigeration 1390
Environmental 1440
Outside the basin Transfer to the Segura Basin 430
Losses Consumption 1650 2210
Evaporation 560
Water leaving the system Transfer to the Segura Basin 430
Water to Portugal 9540

Water resources in the Tagus Basin are dominated by irregularities of the hydrologic regime that originate frequent and severe drought episodes. There is a long tradition of water use in the Basin, with 12 main water supply systems equipped with well-developed infrastructure for regulation, transportation and distribution of water resources (Table 2). In some of these systems, water demand is a large fraction of average resources. Due to the imbalance between water availability and demand in drought years, there is an extensive experience in hydrological management, but recent drought events have questioned the capacity of some systems to meet increasing demands with the available water resources. *Options Méditerranéennes, Series B, No. 58* 377

Table 2. Characteristics of the main water supply systems in the Tagus Basin System Mean flow Coeff. of Min. flow Storage Demand (Mm3/yr) Variation (Mm3/yr) (Mm3) (Mm3/yr)
Cabecera 1200 0.48 350 2400 980
Tajuña 51 0.59 12 68 30 Henares 150 0.56 15 240 110
Sorbe 170 0.46 20 53 50 Madrid 750 0.42 200 900 500
Alberche 650 0.51 110 250 180 Toledo 62 0.73 1 32 12
Tiétar 900 0.52 155 115 170
Alagón 1300 0.48 312 911 510
Árrago 267 0.51 45 125 110
Salor 32 0.66 0.57 14 11 Trujillo 6.4 0.59 0 1.5 1.5

Streamflow regulation in the Basin

The diverse characteristics of regulation systems in the Tagus basin are illustrated in Fig. 1. The figure presents the simulated time evolution of water storage in three systems under current conditions of demand and infrastructure for the period 1940-1993: Alberche, Madrid and Cabecera. The Alberche system consists of two main reservoirs with maximum storage capacity of 250 Mm3. The system supplies a local demand of 180 Mm3/yr with average inflows of 650 Mm3/yr, with a coefficient of variation of 0.51 and a minimum of 110 Mm3/yr. It also supplies a maximum of 120 Mm3/yr to Madrid in drought periods. Fig. 1.