Estrela, Teodoro; Sancho, Tomás

Facing the challenges of water security: the Spanish Water Governance System

Hydrolink

Facing the challenges of water security: the Spanish Water Governance System

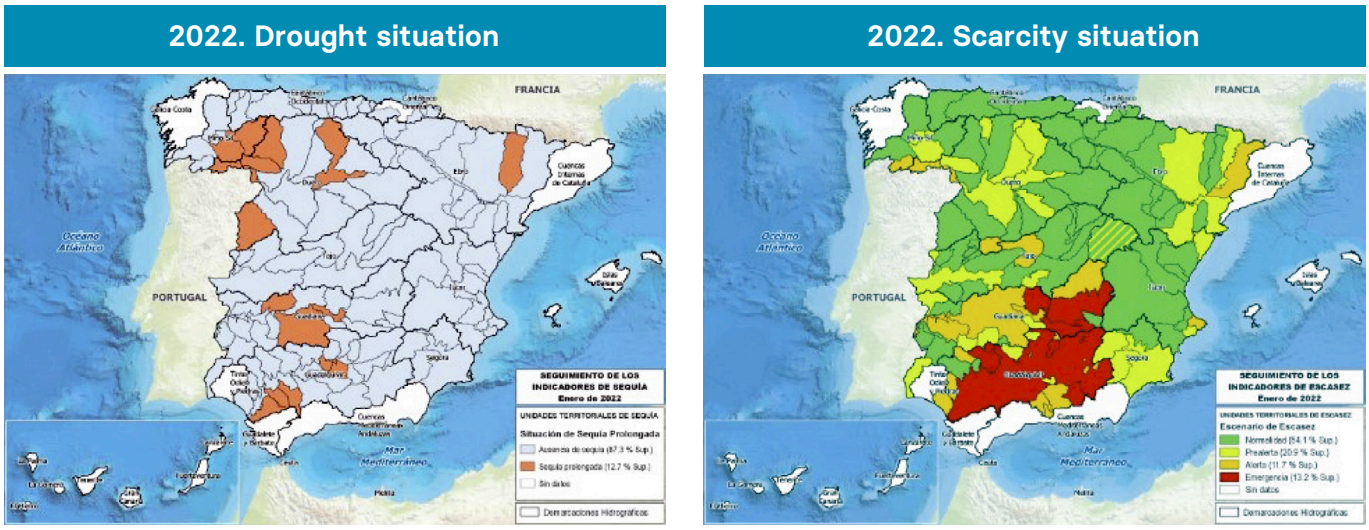
By Teodoro Estrela and Tomás A. Sancho

Due to the climatic and geographic peculiarities of Spain, with great spatial and temporal irregularity in the rainfall, and the severity of water scarcity and periodic droughts (Figure 1) the country a singularity in the European context- needed to develop a Spanish Water Governance System (SEGA) to achieve sustainable development, providing 35,000 hm^3 of both surface water and groundwater to the users (when in the natural regime, i.e. prior to the development of any water infrastructure, only 7,000 hm^3 of guaranteed resources would be available). SEGA is based on 7 pillars: [1] legal certainty; [2] basin river organizations; [3] water users associations; [4]; participatory water management; [5] hydrological planning; [6] technical and scientific knowledge; [7] investment in water infrastructure. However, everything is not solved, and now, when we must face climate change, SEGA's resilience is being analyzed to test if it is able to continue offering water security, in a compatible way with the preservation of the environment linked to water ecosystems. Considering three fundamental factors of water security, we can highlight the main actions and the tools used to study it (see table).

Regarding water security in terms of water supply to the population and to different productive uses, Hydrological River Basin Plans (incorporating coastal waters) have been developed and approved in order to ensure a proper balance between water supply and demand. Here water supply excludes ecological flows, necessary for the preservation of aquatic habitat and associated ecosystems, such as riparian forests. Ecological flows are defined based on technical criteria. Their scope ('always reaching good states for water bodies') is nowadays also taking into account socioeconomic effects through a process of concertation.

These Plans are based on rigorous technical studies and are prepared by a Water Council, in which all the agents involved participate. They contemplate the necessary measures, both to achieve a good status of the water bodies and those necessary to be able to supply water with adequate guarantee to users, including the construction of new hydraulic works to achieve the objectives set in quantity and quality goals. These plans are reviewed every 6 years and those that are currently in the

Goal	Actions	Tools
Supply and Demand Balances	• River basin management plans: Balance sheets and resource allocation. Programme of Measures • Participatory management in the Reservoir Commission and Exploitation Boards of the River Basin Organizations	• Simulation rainfall-runoff models • Model AQUATOOL[1] • Feasibility studies of hydraulic works • Non-conventional resources (desalination and reuse)
Drought management	• Special Drought Management Plans (for each River Basin Organization)[1]	• Drought indicators (for each Drought Technical Unit) • Scarcity indicators (for each Technical Exploitation Unit) • Management measures associated with indicator thresholds • Implementation of measures by river basin bodies and users
Flood management	• Plan de Gestión del Riesgo de Inundación (PGRI) Flood Risk Management Plans (for each River Basin Organization)[1] • National Cartographic System of Flood Zones	• Bidimensional flow models • Structural measures and Nature based Solutions (NbS) • Land use management in flood zones • Technical guidelines for Prevention, Adaptation and Self-Protection • SAIH - Automatic Hydrological Information Systems[4] • Standing Committee on Floods (controlled reservoir and flood management decisions) Coordination with Civil Protection Services



Monitoring every month facilitates to apply adequate measures. So, we are now implementing measures in Spain in order to face drought and scarcity this summer in south and southeast areas, restricting irrigation demands and facilitating to supply water with non conventional resources (desalinitation) from now on.

Figure 1 | Assessment of drought and water scarcity conditions in Spain in 2022.

process of approval already include the effect of climate change, based on detailed and particularized studies developed by the Centro de Estudios Hidrográficos (CEH) – Center for Hydrographic Studies – of the Centro de Estudios y Experimentación de Obras Públicas (CEDEX), the technological center of reference in Spain for water issues – applying to our territory the scenarios contemplated by the Intergovernmental Panel on Climate Change (IPCC).

Once the Plans are approved, those responsible for their implementation program the necessary measures to achieve the agreed goals, and establish an allocation of water resources with a normative character. Their effective application, and the integrated management of water year after year, is carried out by the River Basin Organizations (Spain was a worldwide pioneer in the creation of such organizations in 1926) through their management bodies in a participatory regime, mostly integrated by the water users of each exploitation system, distributing the available water within the framework of what is approved in the Hydrological Plans. The AQUATOOL package has been used in both the planning and in the determination of the optimal exploitation curves of each resource source. Developed by the Polytechnic University of Valencia, this tool allows to simulate each exploitation system with its topology adapted to that of the real system and by introducing algorithms that allow to assess, at a monthly level, the optimal resources that guarantee meeting – in quantity and quality – the annual water demands.

A test of the resilience of each exploitation system, and a determination of the management measures that can be adopted gradually, are those that define the Special Drought Management Plans (PES), which have been demonstrating, since their implementation, a great effectiveness in reducing the socioeconomic and environmental effects of droughts. The selection of indicators and the definition of drought and scarcity thresholds in each part of the river basins allows, through their monthly monitoring, to detect droughts in time and anticipate the adoption of measures to mitigate their effects. The indicators include reservoir volume, water levels in aquifers, measured flows at selected points, rainfall collected, or snow stored.

Temporary exceptional measures are adopted that allow an increase in resources and the limitation and restriction of uses in an equitable and supportive manner among all those affected. The conditions of using the public hydraulic domain are temporarily modified including: reduction or suspension of endowments; modification of priority criteria for the allocation of resources; substitution of all or part of the concessional flows by others of different origin; the use of drought well batteries; modification of the established conditions in the discharge authorizations; adaptation of the exploitation regime of the hydroelectric plants to the needs and the ex officio constitution of the Central Boards of Users that are necessary.

On the other hand, and to manage flood risks and protect goods and people from them, the PGRI studies all the river sections with flood risk and analyse all the properties and other assets in danger of being affected, based on two-dimensional flow models, and determine the structural actions and the most appropriate NbS. A National Cartographic System of Flood Zones has been developed and it is publicly available. And when the floods really occur, the SAIHs have proven to be a very profitable investment, due to the real time information they provide (rainfall, flow measures and situation of reservoirs in strategic points of each river basin), which combined with the experience of the managers of the Standing Committee on Floods of the River Basin Organizations allow to decisively alleviate the damage that would occur in the absence of the adopted measures.

Research centres, private companies and public administration continue making progress and adopting innovations aimed at improving the Decision Support Systems currently available, integrating climate predictions and probabilistic rainfall and hydraulic models.

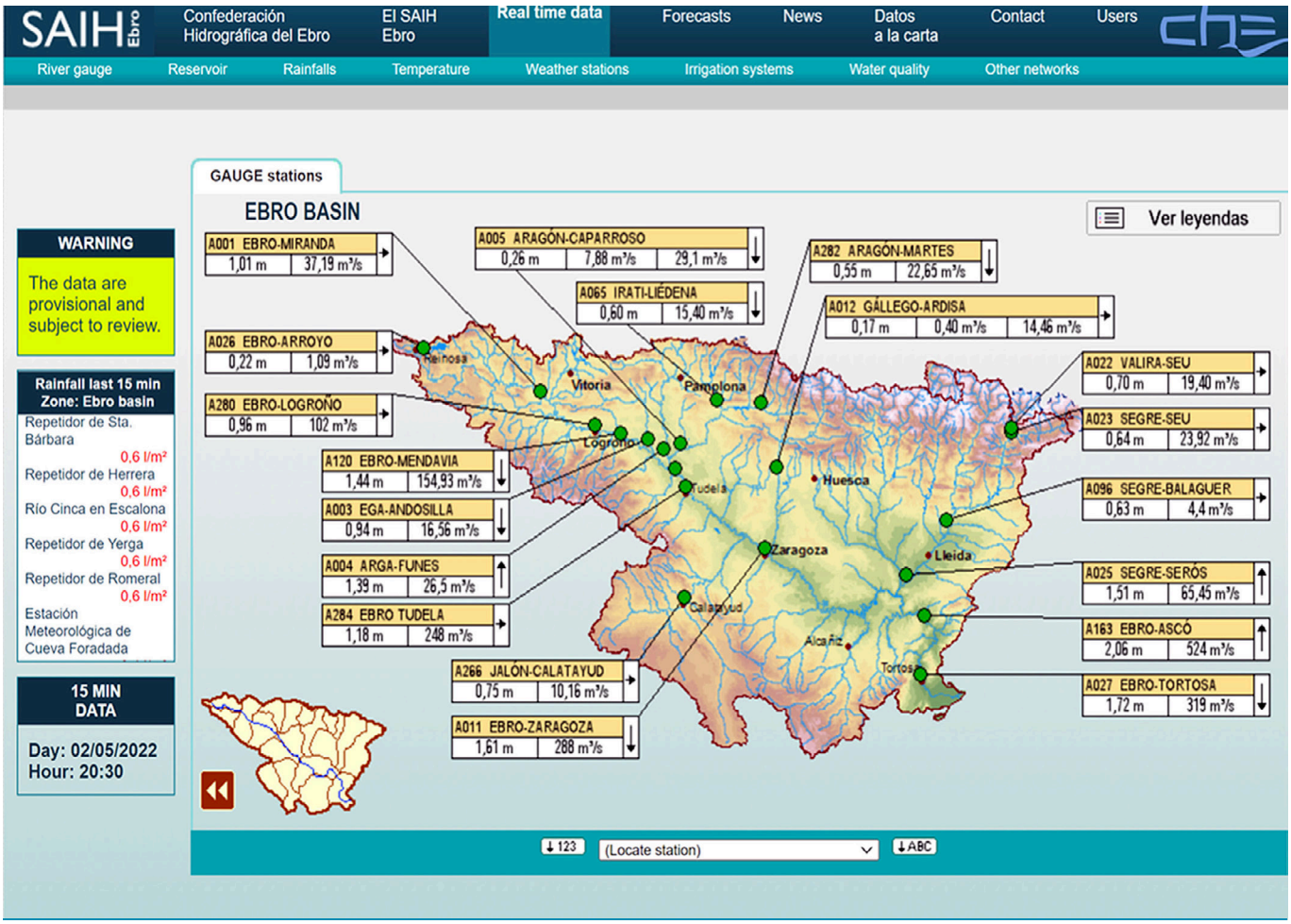


Figure 2 | SAIH web page – for the Ebro River Basin Organization (CHE- Confederación Hidrográfica del Ebro) http://www.saihebro.com/saihebro/index.php

Teodoro Estrela

Teodoro Estrela is a doctor and engineer of Roads, Canals, and Ports from the Polytechnic University of Valencia and has served as a civil servant of the General State Administration since 1989. Prior to his appointment as the new General Director for Water he worked at the CEDEX Hydrographic Studies Centre, where he was technical-scientific coordinator of the Hydrology Area and collaborated with the European Environment Agency as a member of the European Topic Centre for Inland Waters. In the Júcar Hydrographic Confederation he has held the positions of deputy Director and Head of the Hydrological Planning Office.

Tomás A. Sancho

Tomás A. Sancho holds a Master in Civil Engineering, and a degree in Law and in Business Administration and Management. Former President of the Ebro Water Confederation (Spain) and President-founder of 3 State societies related to water. He has been General Manager of Engineering and Consultancy firms. Nowadays, he works as public servant in Spanish Ministry for Ecological Transition. Past President of the WCCE-World Council of Civil Engineers, where he also was the President of the Standing Committee on Water. He has held several positions in the WFEO (World Federation of Engineering Organizations) and many other professional organizations.

References

1 | Aquatool, https://aquatool.webs.upv.es/aqt/en/aquatool-2/

2 | Drought Management Plans
https://www.miteco.gob.es/es/agua/temas/observatorio-nacional-de-la-sequia/planificacion-gestion-sequias/Copia_de_default.aspx

3 | PGRI, Flood Risk Management Plans
https://www.miteco.gob.es/es/agua/temas/gestion-de-los-riesgos-de-inundacion/planes-gestion-riesgos-inundacion/PGRI-Informacion-Publica.aspx

4 | Espinosa, R., J. Yagüe &R. Martinez, 2000: "Le système automatique d'information hydrologique (SAIH) en Espagne dans la gestion des crues fluviales. Expériences d'utilisation, (Automatic system (SAIH) of hydrological information in Spain for river flood management. Using experiences)" La Houille Blanche, vol. 86, no. 1