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Introduction: Water Policy and Management in Spain

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Access to water and water resource management is arousing increasing interest worldwide. International organizations are demanding that greater attention be paid to all the problems related to water management. The Organisation for Economic Co-operation and Development (OECD) has identified water as one of the four critical environmental priorities for the coming two decades (OECD, 2008). Therefore, one of the greatest challenges for the international community in relation to water is related to the increasing levels of water stress observed in many regions. Almost half the world population will be living under severe water stress by 2030 (OECD, 2008). Demand and supply factors explain the situation forecast. Demand for water is expected to increase in the coming years as a result of global population growth, the change in the lifestyles and the industrialization of developing countries, among other factors (Biswas & Tortajada, 2009). In addition, climate change, as announced by the Intergovernmental Panel on Climate Change (Bates *et al.*, 2008), will further aggravate water stress in many regions of the world.

In Spain, water stress is an important challenge for water policy and water management. Furthermore, this problem will become more important in forthcoming years. Around three-quarters of the Spanish territory is currently under severe water stress and the situation is not expected to improve in the coming decades. According to the European Environment Agency (2010), average temperatures are expected to increase, particularly in the Mediterranean basin, while the availability of water is expected to decrease. Droughts and water stress are expected to increase, especially in Southern Europe and particularly in summer.

One of the consequences of the excessive pressure on water resources is frequent disputes over water. These disputes take place between different water users, but also transcend to the regional government level. The conflicts between autonomous regions over water competences have even jeopardized the principle of basin unity in some cases. However, water management is a complex issue that goes beyond the problem of balancing supply with the various demands on the resource. The excessive pressure that exists on water resources, the poor coverage of waste water treatment and the contamination problems

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associated with farming activities are behind the deterioration of water quality. Therefore, it is becoming increasingly evident that the water problem is not exclusively an issue of quantity, but also of quality. Finally, as a consequence of water stress, aquatic ecosystems and the surrounding areas suffer environmental damage. Integrated management of water resources should include ecosystems as legitimate users of water, as they play an important role in the generation of environmental services.

One important question to ask is how this situation came about. Why is so much of the Spanish territory currently under severe water stress? The first step to proposing solutions must be to identify the causes of this situation. The most immediate answer is that the water problem in Spain is largely associated with the culture and customs of the country. Although it may seem quite simple, this poses a serious problem for decision making: breaking with tradition is not an easy task, especially considering that some measures encouraging change are unpopular and must be promoted by politicians.

Spain has traditionally been devoted to agriculture, which is the main user of water in Spain. Consequently, one of the pillars of agricultural policy has been to increase the area of irrigated land—to which, incidentally, illegal irrigation should be added. Additionally, although the value of water in the case of this use is high, the resource has never been an important part of the cost structure in agriculture. As a result, large amounts of water have been devoted to agriculture at a very low price and for a long period of time, too long in fact to change in just a few years. Agriculture, which uses the largest share of water in Spain, consumes water that is heavily subsidized. Irrigated area in 2010 amounted to 3,407,953 ha, with the percentage of irrigated land over total agricultural area equivalent to 13.6%. The agricultural sector is therefore far from complying with the principle of cost recovery promoted by the Water Framework Directive (WFD) (EC, 2000) whereby prices should reflect the costs of the service in full, including the environmental cost.

An additional issue is the uncontrolled use of some aquifers in rural areas, taking advantage of the absence of effective control by the public administration. This is partially due to the fact that until 1985, groundwater belonged to the person who found it, normally the owner of the land where water was extracted. But the situation did not improve much with the Water Act 29/1985 of 2 August (BOE, 1985) and the subsequent Legislative Royal Decree 1/2001 of 20 July, approving the amended text of the Water Act (BOE, 2001a). Although both rules regulate the use of groundwater, nowadays the exploitation of aquifers is in *total chaos* due to authorities not being aware of the number of active wells and the amount of water being extracted from them (Llamas, 2008).

Although agriculture is the largest consumer of water resources, there has been a marked increase in the water demand for other uses over the last few decades. Per capita consumption growth, industrial activity, the use of water for energy production, the construction sector and tourism and leisure activities have all exerted additional pressure on available water resources. It is also fair to say that water has not been used rationally in urban areas either. In this sense, the use of drinking water for street cleaning, washing private vehicles, watering gardens with plant species not suited to drought conditions and filling private swimming pools has been commonplace.

In order to meet the increasing levels of water demand, the Spanish government adopted a strategy for the best part of last century that involved building large water infrastructures to increase the availability of water resources. Water policy in the 20th century was led by engineers and based primarily on the performance of reservoirs and dams, actions that

clearly targeted water supply. As a result, Spain is ranked fourth in the world in terms of the number of dams (Martínez-Cortina, 2010).

Increasing water resources the conventional way, by building new dams and reservoirs, is not a viable proposition nowadays. It is already assumed that the existence of physical and environmental constraints would make it impossible to expect greater availability of resources as a result of the construction of new dams and reservoirs. Therefore, this management strategy is now considered an old water paradigm. Spain has long reached maturity of the water economy, characterized among other things by inelastic supply of the resource in the long term (Randall, 1981). Another separate issue is the unconventional way of increasing water availability that has grown increasingly popular in the recent years.

Water policy has undergone a gradual shift towards more rational and sustainable management of water resources since the 1980s. Having abandoned the old policy of building large dams and reservoirs, the current National Hydrological Plan (BOE, 2001b) contemplates a series of actions based on saving, purification, reutilization and desalination and also provides measures to strengthen public control over the use and quality of water.

The Spanish Government's intention for agriculture to use water resources more rationally is reflected by the Emergency Plan for the Modernization of Irrigation 2006–2008 (BOE, 2006a). The various government-promoted measures aimed at modernizing irrigation systems have been the main instrument used to rationalize water use in agriculture. The objectives of these actions include increasing efficiency in water consumption, which involves obtaining a higher yield of production per unit of water resources and the promotion of savings in the use of those resources. The aim is ultimately to reduce the amount of water that is wasted, without diminishing agricultural output. The measures provided foster the introduction of technological innovation to achieve a thorough control of water used, as well as to encourage an automated use of the irrigation network by irrigation associations. However, the high cost paid by the public administration for the use of more efficient irrigation technology has contributed to only a modest reduction in water consumption in irrigation (Fuentes, 2011).

In the future, the aim is to give continuity to the Emergency Plan for the Modernization of Irrigation by launching the National Strategy for Sustainable Modernization of Irrigation, Timeframe 2015. The contents of the strategy are available in a draft document (Ministerio de Medio Ambiente y Medio Rural y Marino, 2010). This document highlights the government's intention to give a further boost to the modernization of irrigation in Spain, contemplating the objectives of promoting savings, enhancing efficient water use and improving the use of alternative water resources, among other measures. Its objectives also include promoting sustainable and environmentally friendly agriculture. It is certainly necessary to continue implementing plans along the same lines as those initiated by the government of Spain to achieve water savings in agriculture. Priority actions should be to reduce the area of land that is still using gravity irrigation systems (1,043,704 ha in 2010, representing 31% of total irrigated area) and to create pipe systems that minimize water losses.

As regards saving water in urban areas, there has been remarkable investment in awareness campaigns, especially in the less-rainy years in which there were frequent water restrictions during the summer. In addition, it is worth highlighting the incorporation of means to save and control water in newly constructed buildings in the Technical Building Code (TBC), approved by Royal Decree (RD) 314/2006 (BOE, 2006b). Flow reducers and toilet cisterns with dual flushing are water-saving techniques that are becoming increasingly widespread in Spanish households.

However, water tariffs for urban users are so low (despite an increasing proportion being managed in consumption blocks) that they do not constitute an effective tool to encourage a responsible use of water. In Spain, the bill for the service of water supply and purification represents only about 0.4% of disposable income (OECD, 2010). Furthermore, the low price of water is not an incentive for more sustainable resource management on behalf of water utilities. Unaccounted-for water in urban networks represents approximately 26% of the water supplied (Instituto Nacional de Estadística, 2011). The opportunity cost of undertaking work to improve the networks is higher, the lower the price of water (González-Gómez *et al.*, 2011).

In addition to introducing measures to improve the management of water resources, the government of Spain has committed this century to increasing the water supply from unconventional sources. The main aim of the water policy in Spain in recent years, summarized in the AGUA programme (*Actuaciones para la Gestión y la Utilización del Agua*: Actions for the Management and Use of Water), has undoubtedly been the construction of desalination plants, mainly on the Mediterranean coast. The AGUA programme foresees an estimated total investment of €3,900 million. As a result of this programme, Spain is to become the fourth-ranked country in the world in installed capacity and the fifth-ranked in terms of the number of desalination plants. The AGUA programme, as a viable alternative to the Ebro transfer referred to in the 2001 National Hydrological Plan (BOE, 2001b), implied a new paradigm for water policy. However, seawater desalination has been presented as the new cornucopia that would solve all conflicts, when it has proven not to be exempt from problems and does not have the support of all sectors of society.

Furthermore, Spain has decades of experience in water reutilization and is one of the countries in the world where this practice is most widespread. Recycled water in 2008 was estimated at 368 hm^3 per year, about 10% of the purified water in Spain, and according to National Water Reutilization, the figure is expected to reach 1,380 hm^3 per year in 2015 (Moren, 2011). Most of the reused water is employed for agricultural and environmental purposes. RD 1620/2007, 7 December (BOE, 2007), which establishes the legal regime for reusing purified waters, prohibited water reutilization in Spain for certain uses, including human consumption, the food industry and hospitals.

Bearing in mind the scenario described above, it is obvious that water management in Spain will play an increasingly important role in political, economic and social development in forthcoming years. This special issue reviews several situations that have arisen in regard to water policy and management in Spain. Generally speaking, the issue presents several problems that must be confronted and some possible solutions. Clearly the situation is much more complex and extensive than this special issue would appear to suggest, but the selection of pieces of research is certainly a representative sample of the main challenges faced by water policy and management in Spain.

The special issue opens with two contributions on the WFD, an EU standard that conditions and delimits the performance of water policy and water management in EU member states. The Spanish government's water director, Marta Moren Abat, provides an institutional view on the issue (Moren-Abat & Rodríguez-Roldán, 2012). The text begins by emphasizing that it is an environmental standard, oriented more towards the quality of the resource than towards quantity, and in which the influence of countries from central and northern Europe, initiators of the proposal, figures prominently. The author then lists several problems involved in implementing the guiding principles of the WFD and thus in

achieving the main objectives proposed, the protection of waters and the sustainable use of the resource through the main instrument for implementing the management plans, the hydrological plans. In reference to the situation in Spain, the author highlights the complexity of the design, conditioned by the detail in the process of development and the demanding national legislation in several water planning issues, the existence of inter-regional basins, which requires consensus on behalf of several autonomous governments, and finally, the intention of reconciling the interests of different groups of resource users. In addition, external factors are seen as obstacles in the process. These are the rigid deadlines for the preparation of hydrological plans and the lack of financial resources in the midst of an economic crisis like the present one, which is a quite different scenario from that when the WFD was adopted. However, the paper ends with a positive impression of the WFD. The Spanish water director maintains that it is a standard that incorporates modernizing principles into water management and provides an opportunity to improve water policy in Spain.

Francisco Cabezas openly criticizes the myths and misunderstandings of the WFD in Spain (Cabezas, 2012). The author maintains that it is clearly an environmental directive, ignoring other considerations in the water industry that are already contemplated in Spanish legislation. He concludes that the WFD is not a directive on water policy—really a nonexistent policy in Europe today—but on environmental policy relating to water. Additionally, the author highlights that the WFD does not address key issues in Mediterranean countries, such as water scarcity or the impact of climate change on water resources. In this regard, the WFD fails to address the need to consider the changes required to improve water management and governance under water stress. The recommendation made by the author is to prepare a directive on Euro-Mediterranean water.

The paper by Teresa Sánchez-Martínez, Noelina Rodríguez-Ferrero and Manuel Salas-Velasco discusses how the management of different tasks related to water is distributed among the various institutions (Sánchez-Martínez *et al.*, 2012). This paper highlights two key issues on the subject. First, the authors address the excessive fragmentation of responsibility levels and the agents involved in water management in Spain. The problems associated with coordinating several bodies and the overlapping of responsibilities that sometimes occurs between them can even bring decision-making processes to a halt. Secondly, and more surprisingly, the authors highlight the paradoxical situation of the Spanish public administration. While in the rest of the EU, by imposition of the WFD, the river basin is recognized as the unit for carrying out water policy measures and management, in Spain several actions arise against this model due to territorial division for hydrological planning. Regional political interests establish a model of territorial division for the management of water resources that coincides with the administrative division of the regions. This could lead to a breakaway from the management model at the river basin level established in Spain since 1926. The paradox is that with the creation of the Ebro River Basin Confederation that year, water management in river basins in Spain was implemented several decades before similar experiences in other European countries and several years before the creation of the Tennessee Valley Authority.

The next article is an example of how water planning in Spain is implemented using the environmental guidelines set out in the WFD. Researchers Julio Berbel, Solveig Kolberg and Julia Martín-Ortega evaluate and discuss the draft Hydrological Basin Plan (HBP) and the Programme of Measures of the Guadalquivir river basin, located in the region under the greatest water stress in the EU (Berbel *et al.*, 2012). Both instruments are designed to

harmonize the need to ensure future water supply in the river basin with the need to maintain a good ecological status of water bodies. Thus, the paper presents the draft BPH as a sustainable management tool based on two main areas: economic and technical measures to control demand, and the fulfilment of the objectives of waste water treatment. According to the authors, the critical points of the draft BPH are the serious delays in fulfilling the objectives of urban waste water treatment, a complex institutional design that hinders cost recovery, the need to increase water savings in irrigation, and the potential territorial disputes between old water rights holders.

José Antonio Gómez-Limón and Andres Picazo-Tadeo study water for irrigation. Any improvements made to water management for agricultural uses have a particular impact on water policy in Spain, because this sector receives about 60% of the water distributed (Gómez-Limón & Picazo-Tadeo, 2012). The authors highlight that the sector is in the midst of a transition, as it has to face the twofold challenge of the decreased grants and subsidies from Common Agricultural Policy and the stricter environmental requirements contemplated by the WFD. In this context, the authors argue for the need to improve irrigation systems in Spain and thus achieve three objectives: to improve economic performance, to increase the efficiency of water use and to reduce pollution problems. The problem to be solved is how to bear the costs of a transition towards a more efficient agricultural use of water and to reduce the negative impact of the activity on the environment. This is a delicate issue, as in Spain the agricultural sector has been heavily subsidized and, in addition, water prices for agricultural uses have always been far below the real costs. The possible boost from the public administration through incentives and assistance programs and the degree of involvement that a sector in decline could assume would be key elements to achieve the objectives set in regard to the Hydrological Basin Plans.

Another major problem in Spain has to do with the quality of the water. The use of fertilizers and the excessive pressure on water resources in some river basins causes a high concentration of nitrates and phosphorus along much of the Mediterranean coast. Encarna Esteban and José Albiac make an interesting proposal to reduce the levels of nonpoint pollution (Esteban & Albiac, 2012). The question posed by the authors is why water policies seeking to reduce the degradation of water resources have failed. The answer is a lack of biophysical information and the strategic behaviour of stakeholders. The search for cooperation could be the solution, considering that water resources are a common good. The case of the Eastern La Mancha aquifer in Spain is a good example of cooperation, with farmers working together to care for the aquifer.

The paper by Francisco Gonzalez-Gomez, Miguel A. Garcia-Rubio and Jorge Guardiola opens a section dedicated to the politics and management of urban water services (González-Gómez *et al.*, 2012). The study provides an overview of various issues on the topic such as the externalization of the service, the price of water, water quality, unaccounted-for water and the situation of sanitation and water treatment. Throughout the text the authors describe several aspects of each of the foregoing issues and highlight those pending to be solved by the stakeholders with expertise in the industry. According to the authors, the pending issues in Spain are to create a regulatory body that, among other things, could promote efficiency among firms in the industry, to target objective levels of water that is unaccounted by the networks, and the application of water prices that permit cost recovery or greater waste water treatment coverage.

The next two papers focus on the price of water for residential use. Both studies address equity in access to water, although from very different perspectives. In their study, María A. García-Valiñas, Roberto Martínez-Espiñeira and Francisco González-Gómez question the absence of regulations and guidelines in the process of price fixing (Martínez-Espiñeira *et al.*, 2012). The authors uphold that in the absence of minimum guidelines and with local governments being the decision makers on pricing issues, there could be a situation of unequal access to water influenced only by the city of residence. Although price differences are partly explained by the quality of service and by factors not controlled by the service manager, the study reveals that the differences in prices are also due to factors such as local government ideology or the type of ownership of the water supplier. These differences in prices do not currently have a real impact among users. The reason is that prices in Spain are too low and, therefore, the water bill does not represent an important part of the household budget. However, the authors warn that the arbitrariness in pricing which occurs in every city could be a real problem of water affordability in the absence of regulations and without a controlling body, should water prices reach average levels more akin to those in countries such as Denmark or Germany.

The study on the equity of water tariffs by Fernando Arbués and Ramón Barberá focuses on the number of residents in households (Arbués & Barberán, 2012). Albeit from a different perspective, this paper also questions the way that water prices are fixed in cities in Spain. In research conducted with data from 25 Spanish cities, the authors apply a new methodology to analyze per capita differences in water prices according to household size. The study confirms that the application of general tariffs results in unequal access to water. Furthermore, it demonstrates that when special tariffs are applied in cities where bonuses are introduced into the water bill for large families, the equity problem is not resolved, as larger households benefit in excess of the bonuses. Consequently, there is an evident lack of analytical rigor in the introduction of assistance approved in the tariff systems to correct inequities due to different sizes of household.

The paper by Fernando López-Vera analyses the causes behind the poor management of groundwater in Spain, a source that contributes about 30% of total water resources (López-Vera, 2012). As a result of an unsuitable legislative framework and the minimal reliability of statistical information, both regarding the estimation of reserves and the quantification of the different uses, the author is led to speak of groundwater "invisibility". The result is that the resource is subject to overexploitation and contamination as a result of the lack of attention paid by both society and government to the sustainable management of groundwater, despite strategic nature to deal with drought and mitigate the possible effects of climate change. According to the author, in order to address the current situation, more legislative changes are required to unify the management of groundwater and to promote the creation of communities of users to manage the same groundwater bodies responsibly. It is also necessary to increase the training of managers and experts who advise user communities, and to put greater research effort into water- and energy-saving technologies and the fostering of information and public-awareness campaigns.

The following paper focuses on an issue that has not received much attention from research in Spain: the interrelation between water and energy. The pioneering work by Laurent Hardy, Alberto Garrido and Luis Juana analyzes the energy used in the water industry, both in the urban water cycle and in agricultural use (Hardy *et al.*, 2012). They also provide interesting conclusions about the water required to meet demand in the energy sector. In relation to this aspect, they estimate, for example, the water footprint of biofuels

in Spain. In spite of limitations regarding data availability, a situation that the authors themselves point out, the research sheds light on the complexity of the water-energy nexus. Therefore, hydrological and energy planning should not be viewed as unrelated issues when attempting to enhance energy efficiency in water use while reducing water use in energy production facilities.

The special issue ends with a paper by Miguel A. Garcia-Rubio and Jorge Guardiola (Garcia-Rubio & Guardiola, 2012). The authors provide an updated overview of the evolution of water desalination in Spain. In order to do so, the authors review the legal framework for desalination, the stakeholders involved, the development of technologies and associated costs and the environmental impacts of this activity. The significant increase in the desalination capacity of Spain, especially in recent years, is attributed to a combination of technological development, progressive cost reduction, the possibility of reducing environmental impacts and, particularly, a combination of favourable legislation and strong institutional support from the implementation of the recent AGUA programme. Although the authors contemplate desalination as a feasible alternative technology to solve the present water shortage in many Spanish regions, they also conclude that the success of this option depends on its proper incorporation into hydraulic planning. Overestimation of the actual demand for water, especially in the agricultural sector, or the seasonal nature of urban uses associated with tourism, can lead to oversized desalination plants that push up production costs, thereby damaging the image of desalination as a viable alternative.

The sector analyzed in this special issue is characterized by strong growth subject to continuous change in Spain. It is of the utmost importance to assess the performance of the present and forthcoming changes. It would also be recommendable to incorporate other elements and approaches in the future, which are inevitably beyond the scope of this special issue.

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