An overview of the main water conflicts in Spain: proposals for problem-solving

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An overview of the main water conflicts in Spain:
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Summary. Water resources and water availability in Spain is characterized by the spatial and temporal variability of precipitation. While northern part of the country presents a temperate climate with more than 1500 mm of rainfall, south eastern Spain may only get around 300 mm or less. The spatial unbalance of total renewable resources, water use and demand within the territory has historically originated conflicts between users and regions. Several structural and non structural conflict resolution measures have been applied to solve existing problems, especially in the Mediterranean area (water transfers, public participation, water markets, legislation, etc) with minor or greater success. The Water Framework Directive transposition to the Spanish legislation, based in the Integrated Water Resources Management, seems to be the key issue for long term sustainability of water resources and conflict resolution.

Keywords. Water conflict - Integrated Water Resources Management - Spain.

Un aperçu des principaux conflits sur l'eau en Espagne: Les propositions de résolution de problèmes

Résumé. *Les ressources et la disponibilité en eau en Espagne sont caractérisées par la variabilité spatiale et temporelle des précipitations. Tandis que la partie nord du pays présente un climat tempéré avec plus de 1500 millimètres de pluies, le sud-est reçoit seulement 300 millimètres, voire moins. Le déséquilibre spatial des ressources renouvelables, l'utilisation d'eau et sa demande a historiquement produit des conflits entre les utilisateurs et aussi entre les régions. Plusieurs mesures de résolutions structurelles et non structurelles ont été appliquées pour résoudre des problèmes existants, particulièrement dans la région méditerranéenne (transferts d'eau, participation publique, marchés de l'eau, législation, etc.) ayant connu des succès plus ou moins importants. L'application de la WFD à la législation espagnole, basée sur la Gestion Intégrée des Ressources en eau, semble être la solution-clé pour une résolution durable des conflits d'eau.*

Mots-clés. *Conflits d'eau - Gestion Intégrée des Ressources en eau - Espagne.*

I - Introduction

Spain is a country with considerable background in the field of water. Water issues analysis and proposing actions under the different aspects are numerous since the second half of the 19th century: from 1866 (to protect the Júcar river from seasonal floods, Eastern Spain), to water planning, Royal Decrees and Water Acts. Legal regulations have been applied since the first Water Act of 1879 (18 de Junio 1879), derogated by the Water Act of 1985 and subsequent modifications (1/2001; 11/2005) and the actual proposals for modification. Although the Water Act conceived Basin Plans as the central instrument for water regulation, the previous hydraulic policy which includes water management administration and regulation through basin administrations (Confederaciones Hidrográficas) was established in 1926 (R.D. Marzo, 1926). Initially, the objective of Confederaciones was basically water administration for agricultural irrigation and urban water supply.

Although a long tradition and culture of water exist in Spain since the old times, water problems mainly related to management, quality, scarcity and economic instruments are important. Entering

the new millennium, the actual and future conflict consequences derived from water scarcity due to the increase of demand (and the forecasted climate change), need significant efforts in order to improve water management issues that have been downplayed, overlooked or disregarded in the past (system sustainability, supply and demand management, conjunctive use, stakeholders participation, water prizing) and lead to conflict of interest among different users of water.

As this is a long-debated issue and never definitively resolved, and this paper is not the first document to consider these questions it only aims to present the current Spanish situation in a very succinct way, not trying to be neither exhaustive nor intensive in the presentation.

II - Climate and water distribution

For presentation purposes, it seems relevant that before describing current situation of water issues brief introductory features of the natural context (especially climate) need to be introduced. The implication of geographic questions goes beyond of the mere explanation of spatial, seasonal and inter-annual water irregularities as they directly point to situations that determine the problems and solutions for water issues.

Satellite images of Spain demonstrate that most of the Spanish territory resembles North Africa by its arid appearance. These images also verify the noticeable difference between the humid north and the dry south of the Iberian Peninsula. In Spain, it is estimated that about 8 Mha (Galicia, Cantabric cornice and Pyrenees) have a humid climate, whereas approximately 40 Mha present Mediterranean climate. The northern area is characterised by a temperate climate, high humidity and mild temperatures, while the Mediterranean coast is temperate characterised by dry summers, inland climate is continental. Spatial distribution of annual precipitation and temperature is closely linked to the existing mountain systems. Presence of flash floods is also frequent in coastal areas during autumn.

As it is commonly accepted, water resources coincide with its total renewable resources (surface water, groundwater and outputs to the sea) and in the peninsular area, natural regime accounts for 111.000 hm^3/year, which represents about a third of mean annual precipitation and almost total cumulative flow form rivers (Water in Spain, 2003). However, this value is unevenly distributed along time and space. While runoff in northern Spain (wet) accounts for more than 700 mm/year, in some Mediterranean areas, is lower than 250 mm/year (dry). Within these Mediterranean zones, there are regions with structural deficit, like the Segura basin (South-eastern), which do not even reach 50 mm/year. The temporal variability of precipitation controls and affects both quantity and quality of water resources and constitutes a source of inequalities of freshwater availability per inhabitant. Moreover, droughts, as a consequence of temporal irregularities of precipitation are common in all areas originating a temporal water resources deficit.

As precipitation is the origin of water resources it causes and governs the hydrologic response. The spatial climatic situation generates an imbalance between river basins of the North and those of the South, which affects both the quantity and the quality of water available, generating a conflict of interest among users[1] within the river basin and between different river basins. An increase of water conflicts as a consequence of climate change maybe expected in the future (IPCC, 2001).

III - Water use and demand

In Spain, water use purposes according to destination[1] are regulated by law. As regard to water demand, there exist also a regulatory definition, and it is understood to be '*the need of water for one or several use's* and it is common to associate water needs or requirements to the idea of demand[2]. Up to the seventies, apart from agricultural and industrial uses demand, water

supply trend for urban-domestic uses in metropolitan areas was assumed to be in a steady state situation, as changes in urban water demand was considered stable except in big cities, like Madrid. However, this aspect was completely different in coastal areas, were the increase of population and important seasonal water demand by tourism was already observed.

As an example, in the Balearic Islands 25% of the total population are summertime seasonal residents (PHIB, 2002). Moreover, as water demand from agriculture and tourism is concentrated during summer, the problem becomes more complex. This situation has originated a conflict regarding water rights and use between stakeholder groups with varying intensity along time. The development of the conflict is related to the steady tourism growth, loss of natural ecosystems and decrease of agricultural activity in central Spain along the past decades. Some sectors of the population have the feeling of growing socioeconomic injustice produced by the gap in social welfare between the developed (tourist) coastal zones and the less developed (agricultural) inland zones. This is a representative example of conflicts between one of the most demanding sectors (domestic/tourism vs agriculture) implying environmental impacts.

The seasonal water demand has also created an important territorial unbalance not only for the Spanish population, but also for water resources. Moreover, last droughts have evidenced the lack of reliability of urban water supply to the majority of the Spanish territory, either due to the lack of regulation (North) or restrictions (South and central). Following this general pattern it would be naive to think that imbalance between supply and demand are a new issue in the Spanish hydraulic history. A brief review of the socio-economic historical records shows how water availability and their conflicts have been of significant importance since the beginning of the century. The main challenge is to secure a reliable municipal water supply, both in terms of quantity as well as quality that will guarantee a sustainable use and enough resources even during long inter-annual dry periods. Some solutions go through the development of new water supply sources (i.e. seawater desalination), aquifer recharge and a more flexible water management system implementation. Demand management measures such as education campaigns, metering individual households and regulations regarding water-saving-infrastructure in new buildings have also been undertaken in some regions (PHIB, 2002).

A great concern on recreational uses demand (leisure, landscape, reservoirs) has raised up during the last years, although recreational uses in the planning and administration of the water domain has not usually been an important objective. However, environmental requirements constitute one of the main issues of the Water Framework Directive-WFD, and ecological flow definition, reservoir, wetlands, deltas and estuaries protection play an important role in water demand regulations. The Water Framework Directive (2000/60/EC) and the Groundwater Directive (2006/118/CE) have been incorporated into the Spanish legal framework, and according to the corresponding Royal Decree, various measures need to be implemented to achieve a sustainable water policy.

IV - Traditional agrarian uses and landscapes

Seen from the air, Spain is basically a rural country with a very uneven relief creating a rough landscape dominated by sharp edges. Lands below 200m are uncommon and high plains or mountains are the norm. Water distribution in the Iberian Peninsula has traditionally determined the agrarian uses (agricultural activities and livestock) landscapes in the different regions. Traditionally, the high humidity regime in the North has favoured the forests and grass development, and so wood and cattle have been the main economic resources of this area. In the wettest zones of Mediterranean climate, wheat and other cereals have been traditionally cultivated using the winter and spring rainfall (these cultures are harvested before the dry summer arrives). Finally, tree cultures as olive and almond, with low water necessities, have traditionally been planted in the South and East where the soil humidity is lower and the temperature is higher. In addition to uses of rain fed land, irrigation areas traditionally confined to the banks of main rivers (Douro,

Ebro, Guadiana, etc) or costal lowlands (Valencia, Murcia, Almeria) have been used to produce fruits and vegetables.

V - Irrigation development in 20th Century

According to land use distribution, total irrigated land agriculture accounts for 3.4 Mha (6% of the total surface), being more than 24% of the total land area of the Mediterranean coastal region (MAPA, 2001). If at the beginning of the 20th century agricultural production was one of the most important inputs to the economy, from the socio-economic point of view an intense process of adjustment in the sector has been produced since the last 50 years and at present, over 30% of agricultural income comes from EU subsidies.

The traditional water culture that helped the population to coexist with the water shortage of the Mediterranean climate for many centuries has been substituted in some areas, by the expectation of water abundance and in some cases without water use efficiency assessment. Agrarian land uses and landscapes have been affected by the development of an important hydraulic work policy carried out especially during the second half of the twentieth Century. This policy tried to first increase the productivity and to stabilize rural income, and then in the last quarter of the century mainly to alleviate and correct by means of hydraulic infrastructure the imbalance between demand and supply water deficit of some regions. The development of these hydraulic infrastructure triggered important progress for the irrigated agriculture, which allowed a great improvement of agrarian productivity and increased income for most Spanish farmers. However, the million hectares for the traditional irrigable area was tripled, especially in the mildest parts of the country, and the water resources demand increased in all regions especially in the driest ones.

As a result, current agricultural demand in Spain accounts for 70% approximately of total water resources (MIMAM, 2006) demanding new supply sources for this continuous increase. During the last years, there has also been an important reduction in the trend of irrigated land in Valencia and Barcelona (Programa AGUA, 2004) but still an increase has been observed in certain areas (Albacete, Almería, Murcia, among others) (Programa AGUA, 2004). Among the new irrigated areas in some central parts of Spain, common dry-crops (cereals) irrigation through pumping wells is currently taking place.

However, as water resources continue to be limited the conflicts over their distribution as much as between regions as between local users are more and more important. This fact may be aggravated considering future climate change predictions (IPCC, 2001), although specific measures from the technologic point of view have been taken (i.e. drop irrigation) and of non-conventional water application (treated wastewater and desalinated water) in many coastal areas.

VI - Water transfers as a possible conflict resolution measure

Experiences with greater or minor success of structural actions to interconnect river basins in order to alleviate the territorial imbalance have a very old tradition in Spain, as references go back to the sixteen century. The most recent experience to overcome water deficits in some Spanish regions was the proposal and development of the Plan Hidrológico Nacional-PHN (National Hydrologic Plan-PHN, 2001). Within a series of different hydraulic policy actions, the possibility of water transfer (interbasin imports) was included as a tool to solve the water deficit situation in the South and Eastern Spain. The basic assumption of the PHN was that no volume of water at all would be transferred to the receiving basins in order to increase the irrigated area. It was accepted however, that water transfer for drinking water supplies and water allocation for environmental purposes had to be allowed. Regarding irrigation, water transfers should only be assigned to overexploited aquifers recovery and to alleviate low supply and water guarantee

for irrigated areas with non satisfied demand. One prerequisite for possible water export from granting basins was the compulsory proof of the existence of enough amount of water in the original catchment for the long term, and that both the requirements of the maximum development envisaged by the basin hydrological plan and the previously restricted volumes for environmental purposes were satisfied.

As a consequence of these analysis, the PHN considered balancing water demands in critical areas (basically Mediterranean coastal zone) by means of interbasin water transfers, following the guidelines adopted in 1970, when this type of action was initiated by the Tajo-Segura Aqueduct (ATS) and also from the Ebro basin to some internal basins (mini-transfer Ebro-Tarragona). To complement the first phase of ATS, approved in the seventies and consisting in the diversion of 600 hm^3/year from the upper Tajo to the Segura basin, the PHN second stage proposal consisted on a 1050 hm^3/year water transfer to the Mediterranean area (Jucar, Segura and Sur basins and Internal Basins of Catalonia) from the Ebro basin.

At the end, it did not matter that the proposed diversion would only be made only if excess water was available over the present and future demands, as the project had a very strong opposition by the academic and socio-economical sectors, especially from the Ebro basin. In 2004 the PHI was repealed (BOE 2/2004, 19 Junio) and the Programa AGUA (2004) came into action, with the rejection of water transfers and the objective of “better management of existing resources” which also include water desalination and treated wastewater reuse. As a new aspect, the idea of water demand control driven by real cost has been also included .This was a difficult political decision which is still being criticized mainly from the receiving basins population and applauded from people of granting basins. Nevertheless, none of the both Plans gave sound information on the role of environmental considerations and cost-benefit analysis.

VII - Other possible measures to be applied in Spain for conflict resolution in field of the water

The serious existing water problems in several Spanish regions are mainly related to agricultural demand and the agrarian model specially followed in the Mediterranean area besides, seasonal water demand. Moreover, as in some areas water resources are highly dependent on groundwater, intensive groundwater use in order to cover demand needs has led to aquifer overexploitation creating great sustainability problems, and important conflict of interests among the different users and stakeholders.

Up to now, several technical and non-technical ways to mitigate water conflicts have been applied with greater or minor success. Among the non technical, specific public participation programs have been implemented by the regional hydraulic administration in order to get information from representatives of different sectors on water policy options in order to harmonise societal needs and technical measures.

Although in some specific areas with intensive use of water (i.e. The Canary Islands) water markets were ‘naturally regulated’ based on the competitiveness of the assigned use, the last approved reform of the Water Act included water markets implementation as a legal tool. It must be also said that one criticism to this new regulation is basically associated to the lack of consideration of environmental costs and sustainability; sectors which cannot pay cannot participate in the system. Current experience of the legal application include the Irrigators Community of Estremera in the Tajo basin (10 hm^3 to Segura basin were sold in 2006 and 2007) and the irrigators Community of Bemebezar in the Guadalquivir sold to Almanzora Community (Almeria) (10 hm^3) in 2007. Results from the inter-basin ‘almost’ free market transactions indicates that water productivity in coastal areas is higher than inland Spain, and that market forces may finally support a ‘peaceful’ solution to water balance disequilibrium. Additionally, some technical and non-technical solutions need to be considered, such as:

- Implementation of a number of different measures (legal, economic, etc.) to reduce water abstraction especially in overexploited aquifers, in order to allow hydrologic functions recovery. This can be easily carried out through the promotion of 'users' communities'.
- To design a new agrarian model with a multifunctional approach.
- To encourage crops for rain fed farming and the social and economically efficient use of the water.
- To design a program for integrated rural development.
- To develop community involvement in water policy development and sustainable water management.
- To implement water banks procedures in basins following legislation (consensus building including public participation: Administration, irrigators, researchers, NGO's, etc).
- Better assessment of temporal and spatial natural recharge (groundwater and runoff) in some of the critical river basins. (Climate change appears to be an extra element of added uncertainty).
- Increase water availability through groundwater recharge and promoting water harvesting when appropriate.
- Improvement of water saving techniques (control of losses, metering, etc), conjunctive or alternate surface-groundwater use, integrated management of conventional and non-conventional (treated and desalinised) water resources, and application of demand management measures, among others.

However, solving water conflicts can only be achieved through Integrated Water Management-IWRM, which can be described as a 'form of coordinated management of land and water resources within a region, with the objective of preventing land degradation, protecting the quality of the freshwater resource, protecting biodiversity and continuing sustainable use; within a context which includes genuine community/government partnerships and recognition of socio-economic objectives' (Mariño and Simonovic, 2001). IWRM includes all actions and projects aimed at increasing water use efficiency and water conservation (García, 1998) and contemplates the integrated use of all conventional and non conventional water resources (groundwater, surface water, treated and desalinated) according to water needs (agriculture, supply, etc.) and socio-economic aspects. IWRM must be developed at the river basin level district with the appropriate administrative arrangements with the competent authority as defined in the WFD, not from the administrative, regional or autonomous point of view.

VIII -Final conclusions

Water resources and management and water conflicts in Spain have been a relevant subject of attention that can be traced back at least since the end of the 19th century. At the present time, one main interregional problem of Spain is the distribution of water. Certain regions, like the South and East, are at the moment in a critical situation, with a structural water deficit that could hardly be solved if water input/output continues unbalanced.

The inter-basin water transfer approach, structural solution formulated in the PHN (2001), arises the question on river basins feasibility for providing surplus water to the deficit basins in Spain, and to ensure that the important hydraulic infrastructure (like the one constructed during the twentieth century), would be able to solve the problems of water deficit in the dry areas. Or, on the contrary, the new proposed hydraulic works may increase water demand. The situation is not simple. At the moment, while the discussion about new water transfers still continues, the existing

infrastructures and new water treatment technologies (such as seawater desalination and treated wastewater) should be used to alleviate the serious existing problems (Programa AGUA, 2004). But in addition, it is essential to promote the concept of water governance and public participation at the basin level.

The unplanned use of water is no longer acceptable, and water resources have to be managed for long-term sustainability and perhaps the key issue is Integrated Water Resources Management. A new water culture that recognises that water is a limited resource, it is not a commodity, and gives highest priority to efficiency improvements in water use needs to be implemented. At such respect, Integrated Water Resources Management (IWRM) is among today core environmental policies in all EU countries that are transposing the Water Framework Directive-WFD (2000/60/EC)) into national legislation. Since the beginning of the 2000's, the directive has induced water managers and policy makers to entirely develop new approaches and operational actions to plan development, distribution and use of water resources to comply with the Directive.

It is clear that a document aiming to deal with such complex problems and from such different perspectives, given the framework in which water resources operates is not easy to establish. The aim of this contribution was to present a snapshot, at an appraisal level of detail, on the Spanish experience, not to prepare an exhaustive and comprehensive text. Aspects related to water quality, which is the key-issue to cover water demand, and implications in water resources have not been covered.

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[1] Main uses are: agriculture, livestock, urban-domestic, industry, energy, tourism/leisure and environmental 'constraints'.

[2] Water needs is the necessary and sufficient quantity and quality to ensure the application of functions required for various uses. Demand is the volume considered necessary to meet a certain objective in production and consumption. Concepts defined in this way have an absolute regulatory character: demand is the real expression of the need which has an essentially temporal component