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Water Management in Spain: An Example of Changing Paradigms

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Major water policy landmarks

Spain's water policy has undergone a rapid process of piecemeal reforms, beginning in 1985, experiencing fundamental amendment in 1999 and ending in 2007. In this section we review these reforms and summarize their main implications.

The 1985 Water Law

In many respects the 1985 Water Law (WL) forms the core of water legislation in present day Spain. At the time it was enacted, it replaced the 1886 water law and its amended version in 1879. As Embid Irujo contends, the 1985 WL opened a new era for water policy for a number of reasons: (i) water resources were considered to be public domain, saving a few exceptions of groundwater use (which are part of the root of the problems related to groundwater use that this chapter also reviews); (ii) it laid down the water planning principles that eventually would materialize in three failed attempts at establishing national hydrological plans; (iii) it consolidated a financial regime for water users that delivered important benefits, the irrigators being the most favoured group; (iv) it consolidated the institutional role of the basin agencies, granting them autonomy, financial resources and personnel to become the actual decision makers in all water issues within the basin boundaries; and lastly (v) it defined a model of co-decision making, in which direct water users and interested adminstrations have taken an active role in all water planning and management at basin level.

The 1999 Water Law reform

The reform of 1999 amended the 1985 Water Law, changing three fundamental issues (Garrido, 2006). First was the regulation of the exchange of water rights, permitting right-holders to engage in voluntary water transfers and the Basin Authorities (*Organismos de Cuenca*) to set up water banks or trading centres in cases of drought or of severe scarcity. The second aspect focused on public corporations building water works and recovering the costs by means of sounder financial arrangements. The third was a subtle, but crucial consideration of desalinized and reused water as belonging to the public domain, on an equal footing with other water sources, and the issuance of special water rights granted to its users. The first issue was clearly the most controversial and, in retrospect, the most relevant, based on the initiatives reviewed in section 4.1. in light of the 2001 and 2004 Laws of the National Hydrological Plans, reviewed below.]

The European Union's Water Framework Directive (2000)

The European Union's (EU) Water Framework Directive (2000) (WFD)is the most relevant water policy initiative of the last 20 years, perhaps the most advanced international initiative based on world standards. Its mandates include significant changes of focus in areas such as water pricing, ecological objectives, political processes, public participation and a new approach to water planning. It also includes transition waters (estuaries) and coastal waters, a fact that has created serious jurisdiction problems in Spain and the recognition of noteworthy scientific gaps in understanding. For Spain, as well as most other EU countries, the WFD implies a rebalancing of priorities from ensuring water supplies to all economic users to improving the ecological status of all water bodies. To achieve this overarching objective, a programme of measures, included in new water planning documents, that passes the test of cost/effectiveness (not cost/benefit) must be approved for all European water demarcations (main watersheds) by 2009. The general goal is that all surface and groundwater bodies should achieve a good ecological status by 2015. Countries facing unsurmountable difficulties to meeting the quality standards of heavily modified water bodies must pettition the European Commission (EC) to obtain derogations in the time schedule (two potential extensions to 2021 and 2027) or even downgrade the targets of good ecological health, possibly to the point of improving it at all. They must provide cost–benefit analyses demonstrating that meeting the normal standards would entail disproportionate costs. Once the WFD entered into force, no single issue related to water resources would remain unaffected by one or another provision of the WFD.

The 2001 and 2004 Laws of the National Hydrological Plans

The 2001 and 2004 Laws of the National Hydrological Plans (NHP) approved and repealed a major inter-basin water transfer project, the so-called Ebro water transfer (Arrojo, 2001; Albiac et al, 2003). While many other initiatives approved in the 2001 NHP were maintained in the 2004 NHP and have already been partially implemented (for example, the NHP still includes the construction of about 100 new large dams), the Ebro transfer epitomizes the breakdown of consensus of a century-old mode of thinking, planning and executing water policies. By any measure, the Ebro transfer was a flawed and extremely expensive project. And yet the scarcity problems along the Mediterranean coast from Catalonia to the eastern coast of Andalusia have not been solved to the extent most studies indicate. In Catalonia, there are calls to reactivate the project of transferring water from the Rhône in response to the severe drought at the beginning of 2008. The Ebro transfer is still demanded by politicians and users along the Mediterranean arc. However, the implications of the approval and subsequent repeal of such a big project go beyond the discussion of alternative plans to solve water problems, however important the beneficiary regions may be. It is an indicator of the inability to create bipartisan agreements on issues that transcend 4-year political periods. Furthermore, the Ebro transfer paved the way to devolve competences to the Autonomous Commmunities on inter-community basins that had previously been granted to the Central Government (Spanish Government) in the 1985 Water Law, and originated in the creation of the Ebro basin agency in 1926.

As recently as 2007, approval for the reform of the Autonmous Statutes of Catalonia, Andalusia, Aragon and Valence consolidated the power of the regional governments on water affairs. One consequence of this devolution process is the transfer of competences from Madrid to Seville (the Andalusian capital) for the management of the Guadalquivir basin, even though this basin includes territory from two other Autonomous Communities. It should be noted that some of these provisions have been brought to the Constitutional Court (the Spanish equivalent of the American Supreme Court) for being in potential breach of the Constitutional consideration of inter-community basins as being a national jurisdiction. It is ironic that some of these appeals brought to the Constitutional Court have been filed by socialist regional (autonomous) governments, against the Statutes of Autonomous regions that are also controlled by the socialist party. In other words, water issues override the limits of political affiliations.

In 2004, the Government that brought the repeal of the Ebro water transfer to the legislative quickly approved programme AGUA[1] (the acronym in Spanish of the Initiative for Water Management and Utilisation). AGUA was meant to replace future supplies from the transfer arrangement with 20 large seawater desalination and waste water reclamation plants (see Downward and Taylor, 2007). By the final months of the government's term, very few of these plants have been built

and become operative. In total only 214 million cubic metres of desalination capacity of the 700 million cubic metres planned for 2004–2008 have become operative. Some of the planned plants are struggling to sign firm contracts with future customers, totalling a demand that justifies size and capacity So, if history repeats itself, the March 2008 election will dictate whether AGUA continues or whether the Ebro transfer is rescued.

Miscellaneous initiatives: The Guadiana programme, water banks, new planning criteria and programmes of measures

Less important initiatives, such as the Guadiana programme, the establishment of water banks and new criteria for drafting programmes of measures issued by the Minustry of the Environment will be discussed below, where we consider in detail four case sudies that look at different aspects of water policy in Spain in 2007.

Drivers of change

Four main drivers of change are giving rationale and momentum to the most recent policy initiatives. First is the widespread recognition that many water bodies have suffered severe deterioration. It is beyond dispute that restoring water quality is a formidable task that requires large investment, a better administration and a great deal of participation and education. Second, water demand is still growing insatiably, especially where resources are scarce. Economic development and growth, the construction boom, the tourism sector and a competitive export-oriented agricultural sector jointly contribute to worsen already polluted water environments. Third, is the increasingly indisputable fact that climate change poses a serious challenge for the Iberian peninsula. Most models predict larger evapotranspiration, lower and more unstable precipitation regimes and lower river runoff. Agricultural demand is likely to grow, adding further pressure to the catchments and supply systems. And fourth, the Common Agricultural Policy (CAP) has shifted the support measures from production incentives and specific sectorial programmes to completely decoupled support. Farmers are now free to grow the crops they want. Associated with the influence of agricultural policy is the final result of the WTO trade round in order to decrease import barriers which today see most developing countries exporting their agricultural products to the EU (and to Spain). The results of the WTO agreements may have a significant impact on the ecnomic feasibility of a good number of current Spanish crops that today are mainly exported to the EU. Finally, the EC mentioned in its report, 'Health check of the CAP', the objective of ensuring the sustainable use of water resources (EC, 2007). As we will review below, none of these drivers lacks factual and scientific support.

The reports of Article 5 submitted by Spain to the EC in 2007 (MMA, 2007a) contain numerous and updated data proving support to the first two drivers. Schmidt and De Stefano (2008, unpublished paper) identify the reasons behind the bad ecological quality of the main river basins. For decades, industries, animal feedlots and cities have spilled untreated water to rivers and natural waterways, or let it filter to aquifers. Furthermore, MMA (2007a) projects that by 2015 most basins will see their main parameters worsening or stabilizing at best. Groundwater quality is experiencing similar trends. The quality of drinking water is diminishing at alarming rates, while at the same time we see two-digit growth rates in the consumption of bottled water.

Water demand projections are equally worrying. Iglesias et al (2008, unpublished paper) estimate that agricultural water demand will increase by10 points to 30 per cent because of global warming. A recent study of crops' evapotranspiration in the Guadalquivir basin[2] (with 880,000 hectares of irrigated land) show that water demand of crops may range from 3.45 to 5.3 billion cubic metres, depending on whether the spring and summer are wet or dry (Aquavir, 2006). However, the economic feasibility of this demand will depend on factors such as the above-mentioned future WTO agreements and on the implementation of the WFD principle of full cost recovery. Spanish irrigated agriculture has been heavily subsidized in the past. The range of variation of crop demand in the Guadalquivir is equivalent to the urban consumption of 30 million people in one year. However, most analyses show that per capita consumption is stable in Spain (MMA, 2007a), and the economy's growth is increasingly becoming decoupled from water use growth.

Compounding the growth of water demand, the MMA (2007c) projects that runoff in most basins will be lower and more unstable. The impact on the mountain areas and the snow regime will be severely modified, if the findings from the Rhône (Bravard, 2008) can be applied to the Iberian basins. In addition, according to MMA (2007c), runoff regimes will become more unstable and prone to extremes. The consequences for the managing of reservoirs are that security levels for containing floods may need to be increased, reducing in turn the storage capacity. The recognition of these processes and implications is appearing in official documents and political statements alike, becoming a motto for raising awareness and a rationale for numerous initiatives. As dubious as the MMA reports may be, they indicate the major trends and convey information that before the reports were compiled was dispersed or simply ignored.

Changes in the agricultural water demand

The fourth driver is reform of the EU agricultural programmes, and its indirect implication on agricultural water demand. Up until 2003, support granted to the farm industry by the Common Agricultural Policy was based on price

support mechanisms or per hectare direct payments. As a result of both, farmers' incentives to grow certain crops (virtually all crops except fruits and vegatables) were driven by relative subsidy differences as well as quotas and other acreage limits. Examples of these distortions are numerous and telling. Since 2003, farmers are less restricted and may grow the crops they wish; as a result, their decisions are far more influenced by prices and food demand. Furthermore, crops which were rarely irrigated ten years ago, like olive oils and vineyards, now occupy 800,000 hectareas of irrigated acreage. The interesting feature of these crops is that they require less water application and can endure tougher conditions of water stress than the crops experiencing decline, such as sugar beets, cotton, corn and tobacco.

This shift of cropping patterns has huge implications for many water stressed basins. One is that the opportunity cost of water is now more transparent and is connected to farms' different profitability. As a result of this, farmers are more open to market signals and less relunctant to exchange water rights than they were 10 years ago (Garrido et al, 1996). Secondly, in many areas farm water demand is now more flexible in order to accommodate actual hydrological conditions. Flexible allocation and drought contingent programmes can find more room within the farming sector to face water scarcity periods. While water exchanges so far have moved small amounts among different users, they represent a qualitative difference with profound consequences for the future. Third, the water footprint of olives and vineyards altogether is 3.6 billion cubic metres, whereas both crops occupy 3.6 million ha; whereas cereals' internal footprint is 6.3 billion m^3. and acreage is 6.8 million ha (Rodríguez Casado, 2008). Garrido and Varela-Ortega (2008) show that the irrigated acreage of corn and other field crops, like cotton and sugar beet, are losing importance in favour of crops better adapted to the Spanish climate.

Trade in farms products in Spain is also becoming more integrated. Novo (2008) has evaluated the volume of water and its economic value when 'virtually' traded just in the commerce of grains and cereals in Spain. She has demonstrated that the net import of virtual water with cereals was 5 billion m^3. and grew steady from 1997 to 2005, by which time it totalled 9 billion m^3.

The technological and engineering factors connected to farmers' water use are also becoming crucial. At the irrigation district level, the Government has completed modernization and rehabilitation projects in old districts totalling 1.3 million hectares (Barbero, 2005). In most cases, farmers have been requested to pay up to 50 per cent of the cost, although they were given preferential treatment in that they could borrow it back in the form of 50-year loans. These projects entailed, in many cases, a complete refurbishment of the irrigated districts, converting 19th-century design into 21st-century infrastructures. At the farm level, drip irrigation technology is now the commonest in Spain, occupying more than 1.3 million hectares in 2005.

In terms of labour use, agriculture has shown a stable downward trend as Figure 8.1 attests. In terms of macroeconomic profitability, Spanish agriculture has experienced a marked process of capitalization that has been followed by reduced

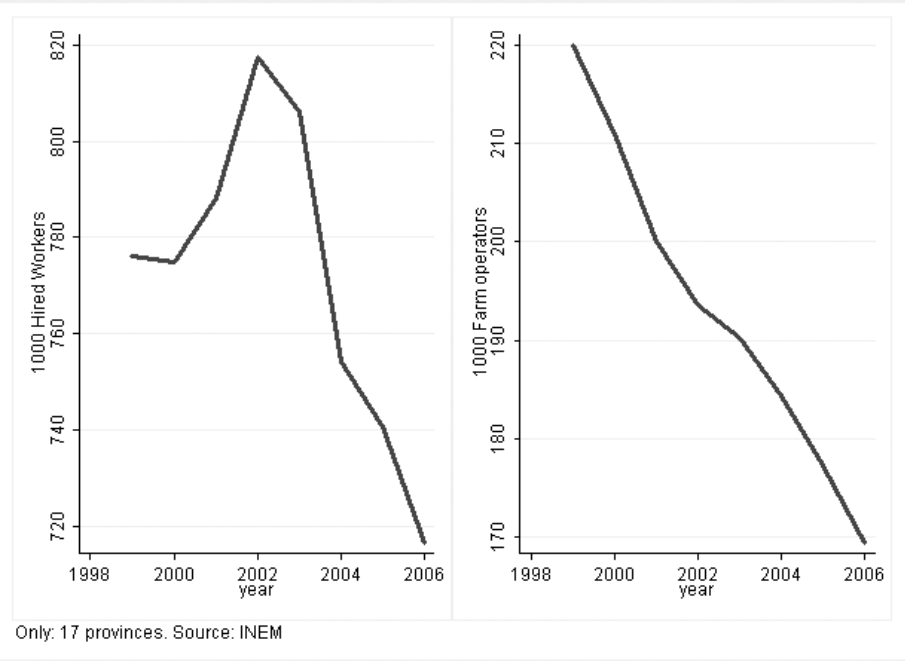


Figure 8.1 *Farm employment trends (hired and farm operators in 1000s)*

margins and tighter economic conditions. While the index of animal and plant prices at the farm gate reached 107.6 and 106.2 in 2006 (with 100 in 2000), the indexes of farm input prices have grown to 133 (fuel and energy), 145 (nitrogen fertilizer) and 123 (farm capital goods) (MAPA, 2007).

The value of food products obtained on irrigated land has kept growing in terms of constant prices since 2000, as shown in Figure 8.2. The figure plots total agricultural output obtained in irrigated land and dry land (evaluated in billion € of 2000), as well as irrigated and dry-land acreage (in million hectares).

Changes in social discourse and the breakdown of consensus

One of the strongest forces underlying Water policy reform in Spain, and yet one which is poorly understood and analysed, has been the breakdown of a century-long consensus. Up until 1994, when the first attempt to pass a Law of National Hydrological Plan failed, civil engineers had provided the intelectual leadership and technical capacity to design and execute water plans. In the last 10 years, many other professional and scientific fields have become as much, if not more,

Figure 8.2 *Total agricultural output and surface (separating rainfed and irrigated crops)*

influential in the most controversial discussions. In particular, hydrogeologists, agronomists, chemists, ecologists, economists and other social scientists are now more prevalent than civil engineers, and are increasingly filling the vacancies in basin agencies and top management positions in the environmental departments of both regional and national governments. In this respect, the Spanish situation is similar to the one described by Dooge (1999) and by Allan (1999) in many other countries.

The consequences of opening the 'water resources' agenda to numerous professions cannot be sufficiently stressed. First, while civil engineers focused almost exclusively on water quantities and flows, the importance of water quality and river systems' ecological status gained prevalence with the enforcement of the WFD. Droughts and floods were soon joined by reports of ecosystem destruction and water pollution in the media, changing the view of the general public and redirecting the discourse of many politicians'.

The discussions and debate about the 2001 NHP gave rise to another equally important breakdown of consensus. In this case, regional disputes over transboundary rivers became explicit and turned into political ammunition. Although the management of inter-community water resources is, according to the Spanish Constitution, a national jurisdiction, some Autonomous Communities claimed area-of-origin rights in order to question the grand Ebro transfer scheme.

The beneficiary regions, in turn, claimed that inter-community basins were a national jurisdiction and inter-basin transfers were strategy projects for the whole country. While the 2001 NHP was stopped soon after the Socialist Administration came into office in 2004, the conflicts subsided but did not disappear. For one thing, the region of Castille-La Mancha demanded that the Tagus–Segura transfer should eventually be phased out, on the basis that the region itself needs the water resources that are transferred annually to the Segura basin. Furthermore, the 2004 political term opened a period of political discussions in Catalonia, Andalusia, Valencia, Castille-La Mancha, Aragón and Basque Country among others, to draft and approve new Autonomous Statutes. These statutes represent the cornerstone of the political autonomy of the Autonomous Communities (ACs)and mark the dividing line between the competencies of the Central administration and those of each AC. The Catalonian Autonomous Statute was the first to be established, but it was soon followed by a number of other ACs. The implications of the redefinition of the Autonomies' regimes for water and the management of inter-community river basins are doubtful. On the one hand, all new Statutes define to a larger or smaller extent new competencies over inter-community basins; the Andalusian being as deep as to declare in article 51 that the region 'has exclusive competencies over the Guadalquivir resources that flow within its territory and do not affect other Autonomous Community', adding that '[those competencies] should not affect the National Planning of the hydrological cycle, … nor be in breach with article 149 of the Constitution', which establishes the exclusive competencies of inter-basin river basins. On the other hand, the Andalusian Statute has been brought to the Constitutional Court on the grounds, among others, that the Guadalquivir provisions of her Statute breach the constitutional principles. While the Court has not pronounced on this issue, the Andalusian regional government has already been given competencies on the Guadalquivir and setup a regional office to manage it.

While it is still too soon to ascertain the impacts of this process of devolution, a prudent judgement would indicate that the role of the Central government in inter-community basins has been diminished. Water policy is increasingly a regional policy, and regions, with the eventual support of their Autonomous Statutes, will surely develop their own legislative initiatives.

Case studies

Against the dynamic process of institutional, environmental and economic changes summarized above, there are processes ocurring at a lower scale that perhaps better exemplify the profound transformation of Spanish water policy. In the first case, we review the way economics has recently permeated many facets that not long ago were totally devoid of aneconomic dimension. In the second case, we look at the way decades-long problems of groundwater overdrafting have been approached.

The following case studies are offered to provide a complementary view of the major trends discussed above. In the first case, focusing on the increasing role of economic instruments, we wish to illustrate how distant water allocation and management in Spain were from any sense of economic rationality. In this we integrate notions such as scarcity values, cost recovery rates, externalities and non-market values, together with rents and profit accruable from productive uses. We wish to show with this example that little progress had been made since 1989 in the economic area until the 1999 WL reform and the WFD of 2000 recognized that water policy could not progress without the support of economic instruments. With the second case study, looking at a succession of attempts to tackle the most pressing problems related to groundwater use, we wish to illustrate how statutes, however clear and sound, fail in the absence of economic compensation and water rights redefnition. The last case sudy, looking at the economic rationale of integrated water management, is proposed against the devolution process in the area of water management among the Autonomous Communities. It shows that cooperative behaviour along the entire watershed is the most cost-effective means to achieve the objectives of the DMA, and provides a rationale to maintain the basin perspective that Spain has had since 1926 and that the DMA extents even to internationally shared river basins.

Changes in the economics of water resources, including flexible allocation instruments, voluntary arrangements, and water prices

An economic analysis and evaluation of the Ebro transfer

The project of the Ebro transfer has been thoroughly documented (Arrojo, 2001; Albiac et al, 2003). A grand scheme of inter-basin connections from the Ebro delta, northeast to Barcelona (with about 200 million m^3 of capacity and 150km long) and southwest to Almeria (800 million m^3 capacity and almost 800km long). The project was made public by the government in 2000, giving rise to five intense years of discussions, debate, street demonstrations and political battles. According to most analysts, including those contracted by the government itself (Hanemann, 2003), the project had three major flaws. First, it disregarded the balance and tides and sedimentation in the lower reaches of the Ebro, including its delta. Second, it was based on shaky evaluations of the demands it was meant to supply, primarily farmers relying on overexploited aquifers or insufficient water sources. And third, its cost–benefit analysis (CBA) was fatally wrong. Different teams reached very negative CBA results (San Martín and Pérez Zabaleta, 2002; Garrido, 2003; Hanemann, 2003; Albiac et al, 2006). Linked to this was the fact that the option to add additional supplies in the most remote locations using desalination was not considered in the analysis of alternatives. The project's costs evaluation was flawed also, according to all external reviewers (Arrojo, 2003). The

project's costs would be shared equally by all users, irrespective of their location and distance from the headwaters. Marginal cost pricing was disregarded, so cross-subsidization effectively kept the price at the end of the project cheap at the cost of the remaining customers. In terms of financing and designing grandwater works, the Ebro project still represents a landmark in wrongdoing and poor design.

The Article 5 Spanish report to the European Commission

WFD's Article 5 establishes that each Member State should carry out, for all its river basins: (i) an analysis of its characteristics; (ii) a review of the impact of human activity on the status of surface waters and on groundwater; and (iii) an economic analysis of water use (see MMA, 2007a). This represents a massive study for the whole country, and a completely new approach to the inherited criteria with which water statistics were previously collected and recorded. Spain submitted its report and was given a good mark by the EC (72 points, ranking 6th out of 27 Member States; EC, 2007). The findings of these reports cannot be sufficiently stressed. They pertain to the evaluation of cost-recovery rates in the agricultural sector – very close to 100 per cent, simply because the costs are evaluated using inadequate rates for the amortization of the infrastructure. They show that about 50 per cent of agricultural water use has a profitability of less than €0.02/m^3 . But groundwater users incur costs that are five to ten times the tariff paid by farmers using surface resources. The reports also illustrate how cheap urban water is in most cities in comparison to other EU countries (a factor of 2 with respect to the mean, and 3 with respect to Germany, Denmark or Sweeden, for example). At present industrial and urban water rates (see MMA, 2007b), sewage treatment can only ensure filtering, oxygenation and decantation. In the metropolitan city of Seville only 20 per cent of urban wastewater undergoes tertiary treatment, and most other medium to large Spanish cities do no better. These figures are taken to indicate that by 2015, on most water quality parameters and with no change in behaviour, the situation will either stabilize or worsen, giving little hope for improvement.

The Article 5 report has three main political implications. First, water prices will need to be raised significantly for all water services. This is because the pressure and impact from water services still have appreciable deleterious effects on the ecological status of most water bodies that will need to be addressed by more expensive water treatment and pollution abatement. Second, out of all agricultural water uses, about 30–40 per cent is still uncompetitive, despite significant growth in the adoption of technology and the intense pace of rehabilitation at the district level in the last ten years. As we review below, with the growth of demands and tighter water balances, incentives to initiate water exchanges will increase, exacerbated by the enforcement of programmes of measures (in pursuant to WFD article 11). Despite its drawbacks, resulting mainly from the fact that it was compiled from information that was not specifically collected for Article 5, the Report provides a clear picture of all surface water uses, with the pressures and impacts mapped for the

whole country; however, it does not address groundwater resources. The value of this information is still dubious, but in the medium term, it is likely to help redefine notions such as 'uses of general interest' or 'structural deficits' in the most arid or semi-arid basins. Although perhaps more subtle than the others, this reveals the third major implication: the fact that so much information – properly organized and readiy accessible– has been generated. Policy actions can now be easily judged on all accounts by the general public, media and the academic community.

The application of article 9 of WFD, regarding the implementation of 'full-cost recovery prices'

Drawing up water tarifs is one of the cornerstones of the WFD (see Article 9). And yet, little is known about the extent to which water charges will 'take into account the environmental and resource costs' in addition to the financial costs. The EC seems to follow the principle of averted environmental costs, which in general generates very narrow and limited definitions of environmental costs. Even more difficult is the notion of resource cost, a concept that needs functioning water markets to become apparent and self-evident. Ironically, if water trading becomes a common practice, there will be no need to incorporate the resource cost component in the charges.

Irrigation is by far the largest consumer of water in Spain and is perhaps the sector that is most vulnerable to higher water prices. It remains to be seen whether Article 9 is applied in its fullest extent to irrigation. In a book edited by Molle and Berkoff (2007), *Irrigation Water Pricing Policy: The Gap Between Theory and Practice*, the contributors came to the conclusion that the role of water pricing in the agricultural sector should be downgraded. In Spain, most studies concur that water charge increases (within the range of political feasibility) results in severe income effects and little reduction in water use (Berbel et al, 2007).

The creation of 'water banks' and the increasing occurrence of voluntary water exchanges

It was stated in the first section that, although the Water Law reform opening the era of water makets was enacted in 1999, the first first effects were not seen for almost seven years. The Law opened two ways for right-holders to lease out their rights, either to the basin authorities or to another user. The simplest way is an agreement between two right-holders and their decision to file a permission to formally exchange the right. The basin agency has 30 days to respond and, unless major technical, environmental or third-party difficulties are encountered, the petition will be granted. Very few, albeit significant, exchanges have been reported.

Consider the case of a big commercial farm in Almería (southeast) that purchases rice fields in the marshes of the Guadalquivir basin, 300km away from Almería and in a different basin. As a water right-holder, the commercial farm files

a request to transfer its water rights linked to the rice paddies to Almería, using an inter-basin water transfer that connects the headwaters of the Guadalquivir with another basin (the Negratin–Almanzora aqueduct). This sale was approved despite the potential third-party effects of water resouces that, in the absence of the transfer, would have flowed to the Atlantic ocean 300km along the Guadalquivir river.

In another case, an irrigation district in the Tagus basin leases out all its water rights to a set of users in the Segura basin, using again another inter-basin aqueduct (the Tagus–Segura aqueduct). The revenue generated for the farmers by the contract is larger than the value of the crop the farmers would have produced in a normal year (Garrido, 2006). The agreement was especially profitable for two reasons: first, the district was undergoing a rehabilitation project to reduce the extremely large water allotments, which were transferred in full in the sale; secondly, during the season for which the rights were transferred and the rehabilitation project was being implemented, farmers would have had difficulties irrigating their fields. The farmers leased-out their full allotments from headwater resources that had been very inefficiently used for years to users located in another basin.

The last case involves a subtler exchange that entailed no water transfer at all, but the obligation to maintain the minimum levels of key reservoirs. These levels are statutorily connected to the management of the Tagus–Segura aqueduct, so that the amount of resources that can be transferred in each year is conditioned by the state of the reservoirs at given dates. Through the purchase of the water rights of users serviced from these reservoirs, the purchasers could effectively increase their rights to transfer resources across the basin, simply keeping the levels above the minimum thresholds.

These three large-scale transfers illustrate the type of exchanges that will be more frequently requested. In general, they serve the purpose of moving water from the south central plateau to the southeast. For the moment, the basin authorities and the Ministry of the Environment have been granted these transfer requests. But once the third-party impacts are identified and evaluated, such transfers will perhaps become more difficult (see Colby (1990), in her seminal work on water trading and its institutional impediments as proxies of environmental taxes). Colby's thinking also fits with the fact that the government of Castille-La Mancha, the main area-of-origin in most exchanges, is erecting institutional barriers to prevent users located in their territories from selling water to others in adjacent Autonomous Communities.

The second route to enable water exchanges is by means of the so-called water banks or exchange centres. Not strictly an office or agency, these centres are hosted, run and located in the basin agencies themselves. Garrido (2007a, 2007b) show that centres are much more efficient medium for promoting water exchanges, for a number of reasons, including transparency, control, avoidance of third-party effects and market activity and scope. And yet, the experience so far has been limited to the Jucar, Segura and Guadiana basins. Since these water centres

have been primariy used to tackle the severe problems of the overexploitation of groundwater resources, we review them in the next section.

Tackling the most pressing problems associated with intensive use of groundwater resources

Since the enactment of the 1985 Water Law, which included special provisions to tackle the problem of overexploited aquifers, there have been at least four major initiatives to manage groundwater resources. In short, these were (i) the declaration of overexploited aquifers and the mandate to enforce regulations and implement management plans; (ii) an EU agri-environmental programme, only applicable to Aquifer 23 in the Guadiana Basin, with subsidies to farmers curtailing their water consumption; (iii) the use of inter-basin transfers, both in the case of the southeast coastal areas and in the Upper Guadiana; and lastly, (iv) The Especial Plan of the Upper Guadiana (PEAG, Spanish acronym), and the creation of exchanging centres in the Segura, Jucar and Guadiana basins (Llamas and Custodio, 2002; Varela-Ortega, 2007).

Varela-Ortega (2007) traces the history of the emblematic Aquifer 23 in the Southern Castillian plateau, linking the ups and downs of its piezometric levels with the first three rounds of initiatives just mentioned. Clearly, option (i) failed; option (ii) succeeded, but the financial cost was very high; option (iii) failed because option (ii) was not sustainable. In the end, the PEAG was approved in 2007 with a total budget for 20 years of 5 billion (equivalent to the proposed Ebro transfer) and part of its subprogrammes are now operating, although under PEAG the basin would reduce to a meagre 200 million m^3.

Underlying these initiatives, but undermining them too, was the recognition that tens of thousands of users in virtually all basins had no legal rights or concessions to the groundwater resources they had been tapping for years. Any effort to reduce total extractions in the overdrafted hydrogeological units had to be accompanied by the closure of the 'alegal' or 'illegal' uses. As López-Gunn (2008, unpublished paper) has made clear, so far all attempts have failed, and any reduction of total extractions has come from the efforts made by both legal and illegal users.

In 2005 it was clear to all managers, analysts and users that something new had to be given a chance. The option to use buyouts of water rights, permanent or temporary, gave a rationale to the establishment of exchanges centres (*centros de intercambio* in Spanish). We will review the different approaches taken in the Jucar and Guadiana. In the Jucar basin, the Offer of Public Purchase (*Oferta pública de adquisición de derechos*, OPA) was targeted to farmers tapping groundwater resources near the Jucar's headwaters. Its objective was to increase the piezometric levels in Castille-La Manche to ensure that Jucar flows to the Valencia region increase from historical lows. Farmers were given the option to lease-out their rights for one year in return for a compensation ranging from 0.13 to 0.19 cents per m^3, the variation depending on the distance of the farmer's location to associated

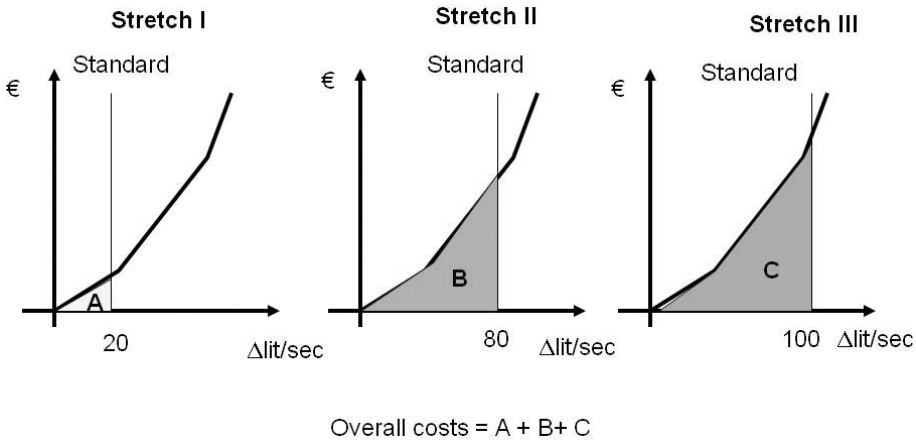
wetlands or to the river alluvial plain. The OPA was launched in two rounds, the first with disappointing results in terms of farmers' response while the second had more success. The purchased waters served the unique purpose of increasing the flows, enabling more use downstream in Valencia. But the OPA did not have not any specific beneficiaries dowstream, other than the increase of flows.

The OPAs of the Guadiana followed a completely different approach and were meant to address serious problems of overexploitation in the Upper Guadiana. As stated before, the OPA formed part of a more ambitious programme of aquifer recovery, called the PEAG. The Guadiana's OPA made offers to purchase permanent water rights to groundwater, paying farmers €6,000–10,000 per hectare of irrigated land. Note that, since these farmers had seen their allotments reduced in preceeding years, what the Guadiana basin was truly purchasing from the farmers was about 1500–2500m^3/ha, effectively 2–4/m^3. The Guadiana basin agency has the objective of 'purchasing' the water rights to 50,000 hectares of irrigated land, and is budgeting €500 million for the whole plan. A marked difference to the Jucar's OPA is that the Guadiana exchange centre will transfer part of these rights to other farmers (growing vegetables) and to the Autonomous Community of Castille-La Mancha. The Guadiana basin will grant less rights than it has purchased, allocating the difference to wetlands and to increasing the piezometric levels of the aquifers. One subtlety of the Guadiana scheme is the fact that, while farmers entering the programme must surrender their private rights (honoured because they were in the catalogue of private waters before the 1985 water law was enacted), those that gain access to them will be granted 30-year 'concession' rights (which is more attenuated property than the others). So the Guadiana operation had this other dimension that in the long term will imply that the basin agency has more users with 'concessions' than with private rights.

Livinsgton and Garrido (2004), reviewing US and Spanish experiences with overexploited aquifers, hypothesized that OPAs such as those of the Jucar and Guadiana would be the only feasible solution. What these authors overlooked was that OPAs would also serve the purpose of water reallocation, entitling government agencies with water rights, that in turn would allot to other users. A question that has not been addressed in the Guadiana case is the price that will be asked of the new users, and whether the exchange centre will incur losses or be able to recoup the costs of the purchase.

The cost-effectiveness rationale of programmes of measures

We will now review the main breakthrough of the Cidacos Pilot project from the third perspective of cost-effectiveness.[3] This project, completed in 2003, was promoted by Spanish institutions to develop a conceptual framework for the application of WFD's Article 11 definitions of 'programmes of measures'. Gómez and Garrido (2007) summarized the rationale of the use of cost-effectiveness in the



Source: Gómez and Garrido (2007).

Figure 8.3 *Cost-effective programme with three independent water bodies*

selection of the programes of measures that are least costly. Consider the parameter of water flow in a given river that is divided into three strechtes. Obtaining Good Ecological Status (GES) implies that rates of flow must be increased by, say, 20, 80 and 100 litres/second respectively in the upper, middle and lower stretches of the river. In Figure 8.3, marginal costs curves are represented against rates of flow on the horizontal axis, for the three stretches of the river.

One is prompted to ask whether this approach is cost effective. Since stretch I is upstream of stretches II and III, it would perhaps be reasonable to go beyond the required level in strecth I (20l/s) and perhaps move the marginal cost curves in stretches II and II to the right (a reduction of costs). Figure 8.4 represents the option to increase the standards in streches I and II, and the resulting cost reduction in strecth III. If the overall cost can be reduced by going beyond the standards in some stretches, the most cost-effective programmes of measures will focus more on the upper than downstream reaches.

What the Cidacos project showed and put into practice goes beyond this simple reasoning. The project designed a cost-effective programme of measures, mapped those in the Cidacos basin, linked them with the different agents (users and pollutants) and, in a final stage, put the programme out to discussions in hearings, following the WFD mandate about public participation. The general public of Navarre (the region of the Cidacos) participating in the discussions understood the whole rationale of the programmes and accepted the differential treatment of pollutants along the basin. They even agreed on a financial scheme and on criteria to share the costs. This case study was taken by the EC and integrated into the WATECO guidelines, jointly with other pilot studies, that were met to

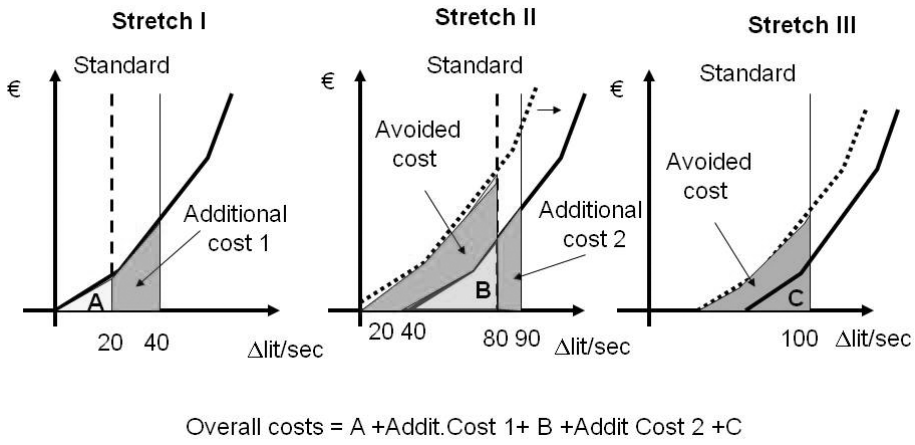


Figure 8.4 *Least cost programme, integrating the standards of three connected water bodies*

help member states to conduct the economic analyses mandated by the WFD, including the selection of a cost-effectiveness analysis of programmes of measures. In Spain, the Cidacos project inspired tens of tenders put out by the basin agencies to conduct similar studies.

Drawing useful lessons from the Spanish example

This paper has summarized the major developments and challenges of the recent history of water policy in Spain. The following lessons can be drawn:

1 Large water projects are not the solution to unsustainable water uses or enhancing water supply reliability. More flexible alternatives (with and without technologies), that ensure some screening of the beneficiaries and a sound financial scheme are prerrequisites for giving the green light to grand water works.
2 Flexible and adaptable solutions, that rely on technlogies, infrastruture and demand management instruments are more complex and require multiple standpoints and longer approval periods. The context must ripen before innovative schemes get through. In general, once crises, major landmarks or thrusts occur, it is easier to plan and implement complex solutions.
3 The actual costs of supplying water at subsidized prices multiply, spilling over on to other users, the taxpayer and the environment, especially when scarcity becomes acute. Cheap water granted in the form of concessions create

perceptions in their holders of being 'entitled' to water resources. When trading systems are established, extraordinary rents will be created by those selling the water. While many would find this offensive, a continuous functioning of the market will tend to erode the rents.

4 Rigid, hierarchical and top-down planning models fails when water hegemonic thinking and political coalitions break down; all the more so if there are also regional disputes.
5 Accessible information, science-based decision making and public participation are key elements in breaking through entrenched and adversarial positions.
6 Innovative water policies require strong budgets, sound finance and equitable burden distribution.

Notes

1 'Agua' means water in Spanish.
2 It includes Guadalete and Barbate Andalusian basins.
3 This section borrows from Gómez and Garrido (2007).

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