SPAIN: MANAGING WATER DEMAND IN THE UPPER GUADIANA BASIN Case #18

This case demonstrates how, under certain circumstances, groundwater depletion can be rapidly reversed through an integrated program of legal, and economic measures.

ABSTRACT

Description

For centuries the Upper Guadiana Basin has been irrigated with groundwater. In the 1980s the irrigated areas increased more than four fold in ten years. This increase resulted in a drop in the water table of more than 20 meters. This had a severe impact on several wetlands; the flooded surface area of the "Tablas de Daimiel" National Park, for instance, declined from about 6,000 Ha to less than 1,000 Ha. Several curative measures were introduced, including new regulations restricting aquifer abstraction and economic incentives to encourage farmers to improve irrigation efficiency and plant alternative crops. Between 1995 and 2000 the water table level recovered by more than 10 meters.

Understanding of the development of the Basin's water resources, and their relation to the legislative and economic measures introduced in the last decade, demonstrate the value of integrated water management. The changes in the Basin irrigation, forced managers to seek to balance economic growth that implied high irrigation water consumption, with wetlands conservation, of significant national importance to the environment.

Lessons learned

The use of administrative tools helped control and reduce the impact of over-exploitation of the aquifer. However, although water use was reduced, many jobs were lost in agriculture and small industries.

The two most important lessons learned from this case are:

- Good water management needs to consider the whole hydrological cycle -- surface and underground waters cannot be managed separately or independently of the ecosystems on which they depend.
- Good water management requires sustaining a balance between pumping of groundwater and recharging the aquifer. Aquifer management needs planning to accommodate medium and long-term use of the resource.

Importance for IWRM

The case study illustrates the importance of taking into account several factors in an integrated manner:

- Water use for irrigation
- Impacts related to the overexploitation of underground water
- Water uses accounts between different water uses
- Incentives for water savings.

Main tools used

C3.1 Improved efficiency of use
C6.2 Regulations for water quantity
C7.4 Subsidies and incentives

MAIN TEXT

1 Background and problems

Basin Characteristics

The Upper Guadiana Basin covers one of Spain's major plains. As shown in the figure below, runoff from the northern rivers, (Cigüela, Riansares and Záncara) and from the southern rivers, (Azuer and Córcoles), drain into the plain, where infiltration and evapotranspiration take place. The natural springs of the infiltrated water are combined with surface flows to create a significant group of wetlands.

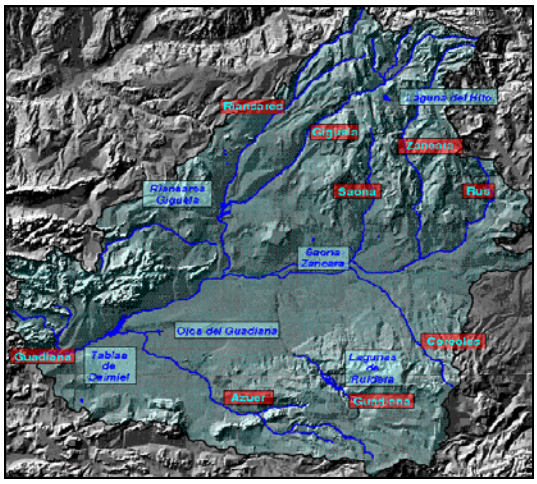

Figure 1: Main watercourses and wetlands in the Upper Guadiana basin

The Basin has the following features:

- Surface area: 16,000 km2
- Mean annual rainfall: 440 mm
- Mean annual potential evapo-transpiration: 960 mm
- Mean annual water resources: 25 mm

Water Abstraction

Traditionally agriculture in the Basin relied on aquifer water. Until 1960, the irrigated area was estimated at 20,000 Ha and the amount of underground water abstracted to irrigate this area through "norias" ranged from between 50 Mm^3 to 100 Mm^3.

From the 1970s to the present, irrigation increased enormously, accompanied by socio-economic development. Through the use of underground water, the irrigated area grew from 30,000 Ha in 1974 to 125,000 Ha in 1987. This increase is 25% of the total national increase recorded during the 1980s. By the end of the 1980s, Guadiana Basin crops were consuming nearly 600 Mm^3 of underground water. This exceeded the recharge to the groundwater resource, and caused a drop in the water table of between 20 and 30 meters as shown in Figure 2.

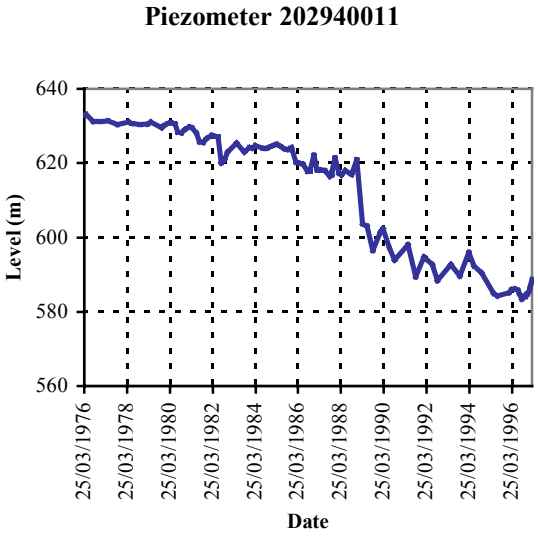

Figure 2: Piezometric level showing its water table decline.
Data collected from the "Confederación Hidrográfica del Guadiana"

The drop in the water table led to deterioration of several wetlands areas of high environmental interest. Approximately 100 of these were declared "Biosphere reserves" by UNESCO in 1981. A typical example of deterioration was the effect on the Daimiel water table area, which was declared a National Park in 1973, expanded in 1980 and was registered as a wetlands in 1982. The Daimiel area decreased from 6,000 Ha in the mid 1960s to less than 1,000 Ha in the early 1980s. Others sites, such as the well-known source of Los Ojos del Guadiana, stopped providing water to the aquifer for several years, and are now completely dry.

2 Actions taken

To ameliorate these effects, a number of measures were taken, including:

- ***The Daimiel Water Table Hydrological Regeneration Plan****:* the Plan was formulated in 1984, and contained a number of measures, including construction of the small Puente Navarro dam in 1985, designed to bring water to the south eastern part of the national park, and to transfer water from the Tajo.

- ***A "Declaration of Overexploitation"*** of the Mancha Occidental and Campos de Montiel aquifers, which allowed the Basin Organisation develop system rules to regulate and limit water abstraction; these have been applied annually since 1991.

- ***An Agrarian Compensation Plan*** was instituted in the areas of Mancha Occidental and Campos de Moniel in 1992. This Plan introduced economic subsidies for farmers who adopted practices compatible measures with wetland conservation, such as irrigation water savings or the growing of less water consuming crops.

The hydrological measures came under the umbrella auspices of the "Confederación Hidrográfica del Guadiana", which was developed with participation of Basin irrigation associations. The economic incentives for water savings were generated by the "Junta de Comunidades de Castilla la Mancha (Regional Administration) and the Ministry of Agriculture, Fisheries and Food (Central Administration) and were largely paid for by European Union funds.

Legal measures

The National Hydrologic Plan for the Guadiana Basin (approved in 1998) took into account the complex situation of the Upper basin. It contained the following legal measures:

- Aquifers linked to natural areas of interest were declared to be under special protection.
- The borders of aquifers, wetlands and others areas of ecological or landscape interest were defined.
- Permission to use water from protected areas with either limited or suspended.
- A ground water police force was established to enforce the laws, and to penalize violators, who took water from the protected areas.

3 Outcomes

Since the mid 1990s, the status of the wetland areas has improved significantly; most of its original area has now recovered. This process was assisted by the good rains of the years between 1995 and 2000.

Of all the above-mentioned measures, that which involved transferring water from another basin, known as the Tajo-Segura scheme, proved controversial. Construction involved dropping the level of the Cigüela River, thereby negatively affecting some river vegetation and wetlands areas. Also, the waters of the rivers Tajo and Guadiana are of different qualities, and by bringing the Tajo waters to Guadiana, there is a possibility that indigenous species may come with it, altering the ecosystem; these important topics are still under discussion today.

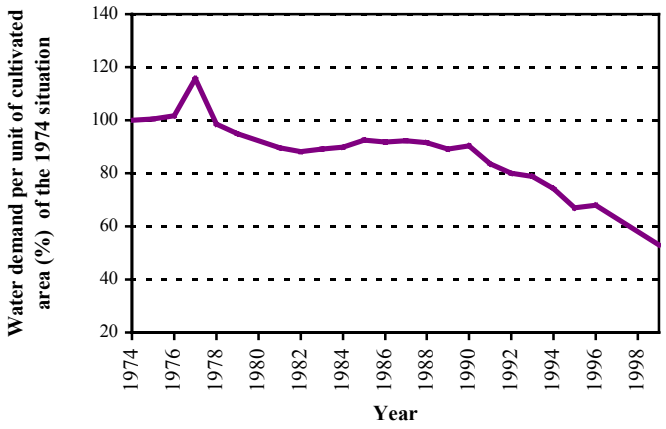

Figure 3: Water consumption per unit of cultivated area (%) 1974 – 1998

Source: European Commission, 2000 (Data by CEDEX).

Figure 3 shows water consumption evolution for a single irrigated hectare over a 24-year period. Between 1980 and 1996, there was a 20% drop in consumption.

Figure 4 plots the level of the Mancha Occidental aquifer water table, along with the cumulative water extraction. The figure shows that over the period 1980 and 1995, some 3,500 Mm3 were extracted. Approximately 1,500 Mm3 of this quantity were

restored between 1996 and 1999. The water table increased by more than 10 meters during the same period.

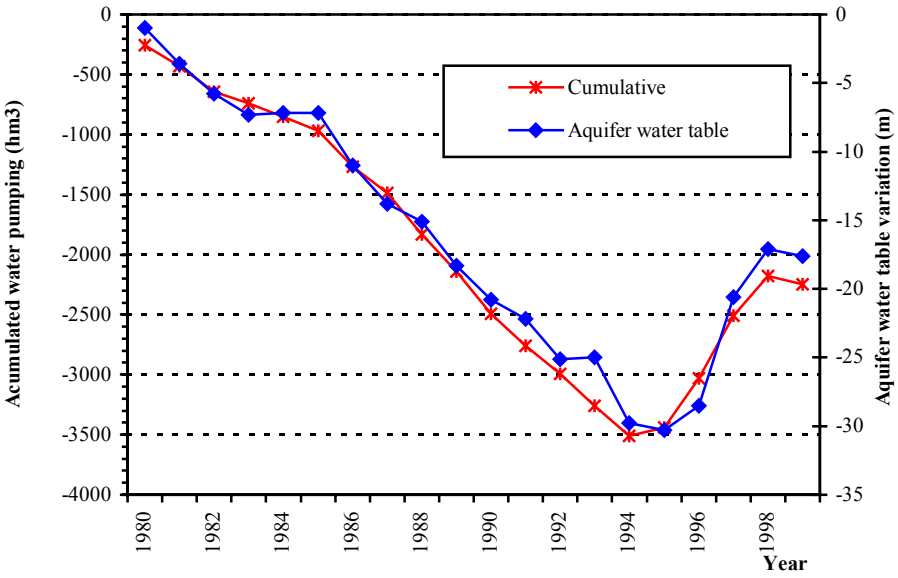

Figure 4: Cumulative abstractions and aquifer water table of Mancha Occidental.

Source: European Commission, 2000 (Data by CEDEX).

Stakeholder reaction

The main stakeholders in the Basin are:

- The *Confederación Hidrográfica del Guadiana*, which manages the basin water. It is under the authority of the Ministry of Environment.
- The *Las Tablas de Daimiel National Park*, which controls the most important wetland area in the region. It is also under the authority of the Ministry of Environment.
- The *Agriculture Department of the Junta de Castilla La Mancha*. This is the branch of the regional government that develops and implements agrarian policy. It channels to the Basin the funds coming from the European Union.
- *Groundwater users' associations*. Recently created, these groups contain most irrigation farmers in the area.
- *Ecological associations* working at national or international level. They have been very active in the region.

All these stakeholders are formally represented in the Patronato de las Tablas de Daimiel, and in various government organizations, including the Confederación Hidrográfica del Guadiana.

Although farmers and ecological associations agreed that the 1970s situation was unsustainable, and that it was essential to use less water for irrigation, the measures adopted were nonetheless controversial.

Farmers were resistant to changes that might negatively affect their incomes. They also believed that the application of the legal measures would lead to a decrease in regional employment (Llamas et al, 2000).

Some ecological associations questioned the value of the adopted measures; others considered the management of the National Park to be inefficient. In 2000, World Wide

Fund/ADENA published a study that criticized the allocation of EU funds, and proposed alternatives they believed would achieve water savings in a more effective and less costly manner. The Sociedad Española de Ornitología (SEO) in 1997 put forward a claim to the EU against the Spanish Government, asserting that the government was not applying certain European directives in the Daimiel National Park.

Sustainability

Two things will be decisive in determining the future sustainability of the new measures: better control of new wells, and compatibility between the economic incentives to save water and the European agriculture policy.

The "declaration of overexploited aquifers" allowed some control over underground water pumping that had previously been totally under the control of the farmers. However, new illegal wells are still being introduced. Strengthening of the Confederación Hidrográfica would mean better central control, and would give both police and farmers more information. Farmers need to be educated to the need to act not only in the short term, but to take into account the need for long term sustainability of water availability.

The sustainability of the economic incentives to save water depends on their compatibility with the European agriculture policy. There may be contradictions between EU environmental concerns and the economics of the Common Agriculture Policy (CAP). The Guadiana Basin program, for instance, uses EU money to promote the elimination of some crops such as maize or beet that consume high amounts of water, whereas the CAP provides subsidies for these crops.

Program Costs

The Agrarian Compensation Plan established the following subsidies (€/ha/year) to reduce water consumption. These subsidies were applied to around 90,000 ha/year, for a total cost of €100 million during the first Plan period (1995/99).

Table 1 Subsidies for reducing consumption

Reduction in Consumption (%)	Subsidies (€/ha/year)
100	380
70	270
50	165

1995 data. Average consumption is estimated at 5,000 m^3/year, and this is the basis for calculating the reduction

4 Lessons learned and replicability

The two most important lessons learned from this case are:

- Good water management needs to consider the whole hydrological cycle -- surface and underground waters cannot be managed separately or independently of the ecosystems on which they depend.

- Good water management requires sustaining a balance between pumping of groundwater and recharging the aquifer. Aquifer management needs planning to accommodate medium and long-term use of the resource.

The Spanish government has developed a set of legislative tools designed to address the problems of overexploited aquifers. To date, 15 hydrological areas in Spain have been declared partially or completely overexploited. This declaration allows the government to call for a halt or a decrease in water abstractions and a reduction in the pumping/recharge ratio.

There are many other places in the world where inadequate aquifer management has caused serious damage to the environment. For example, there are many coastal areas where aquifer overexploitation and a consequent drop in the water table have allowed increased salt-water intrusion. Underground water has become saline, with negative effects on surface waters and associated ecosystems.

Replicating the subsidies program in other parts of Spain, or elsewhere in Europe would be easy, since it is based on a European Union norm. (Specifically, funds are allocated under the EEC regulation n° 2078/1992 7/1999 promulgated by the Council on 30 June 1992, titled "Agro-environmental regulation of CAP" and applied to Spanish law. To accommodate Agenda 2000, the regulation was modified and CAP Rural Development Regulation 1257/1999 added.)

Other basins experiencing the same problems as Guadiana may not be able to apply similar solutions. One requirement is a legal framework that considers water and hydrologic resource management as a public good. Another requirement is the availability of funds to offer farmers subsidies for changing their water demand. In many countries these funds will either not be available, or their need not fully defined. A long-term and complex view of "profitability" is needed to recognize the value of investing in the improvement of the environment for long run gain.

Conjunctive control and use of surface and underground water to achieve both social and economic development can be seen as common objectives for all the basin management in every continent. But to successfully obtain water savings in a basin, it is necessary that both those who administer and those who use the water need to be firmly convinced that economic growth is not acceptable if it leads to wetlands destruction; this conviction is essential, since many measures will likely lead to a slowdown in economic growth at least in the short term.

The case study basin was special in many ways. It is hydrologically very complex, but many studies had been done, providing a good knowledge of the resources and the water uses. This information formed a solid foundation for the appropriate management of the Basin's water resources.

5 Contact

Manuel Menéndez
Centro de Estudios Hidrográficos del CEDEX
Paseo Bajo Virgen del Puerto,3.
28005 Madrid (SPAIN)
Tel: +34-913357939
Fax: +34-913357922
e-mail: manuel.menendez@cedex.es
web site: www.cedex.es

6 References

Main sources – published materials

Confederación Hidrográfica del Guadiana, 1997. Control de Urgencia del regimen de explotación del recurso hidráulico de los acuíferos de la Mancha Occidental y del Campo de Montiel.

European Commission. 2000. GRAPES (Groundwater and River Resources Action Programme on a European Scale). Technical report

Ministerio de Medio Ambiente. 2000. Libro Blanco del Agua en España.

Other sources

Almagro, J.1995. El acuífero de la Mancha Occidental en sus 200 años de esperanza y 10 de la Ley de Aguas. Las Aguas Subterráneas en la Ley de Aguas Española: un decenio de experiencia. Asociación internacional de Hidrogeólogos-Grupo Español. Tomo II.151-156

Alvarez Govelas, M , Cirujano, S. 1996. Las Tablas de Daimiel, ecología acuática y sociedad. Dirección General de Conservación de la Naturaleza. CSIC, Consejo Superior de Investigaciones Científicas.

Cruces, J, Casado M, Llamas, M, De la Hera, A and Martínez L. 1997. El desarrollo sostenido de la cuenca alta del río Guadiana: Aspectos Hidrológicos.

Estrela, T, Marcuello, C and Iglesias, A. 1997. Water resources problems in Southern Europe, an overview report. European topic Centre in Inland Waters, European Environment Agency.

Llamas, Hernández-Mora, Martínez Cortina 2000. El uso sostenible de las aguas subterráneas. Papeles del Proyecto Aguas Subterráneas. Fundación Marcelino Botín.

WWF/Adena .2000. Eco-condicionalidad de la PAC en España: Aplicación práctica en las Tablas de Daimiel. CNR (1996). Intersessional strategy paper on future water resources management: issues and appropriate strategies and policies. Doc E/C7/1996/

Falkenmarck et al (1999). Water, a reflection of land use. Swedish Natural Sciences Research Council. UNESCO-IHP

Mostert et al (1999). River Basin Management and Planning. River Basin Management. UNESCO-IHP. Technical Documents in Hydrology. Nº 31.

UNESCO-IHP. (1998). Water: a looming crisis?. Technical Documents in Hydrology. Nº 18.