Groundwater Challenges in Spain: Lessons from the Western Mancha Aquifer

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Groundwater challenges in Spain

(Lessons from the Western Mancha aquifer)

Pedro Martínez-Santos
Universidad Complutense de Madrid, Spain

Albuquerque, NM
September 25, 2013
Contents

1. Overview
2. The Western Mancha case: a historical perspective
3. Groundwater management challenges
4. Closing remarks
Groundwater challenges in Spain: Lessons from the Western Mancha aquifer

CONTENTS

1. Overview
2. The Western Mancha case
3. Management challenges
4. Concluding remarks

<table>
<thead>
<tr>
<th></th>
<th>New Mexico</th>
<th>Spain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (sqm)</td>
<td>121,589</td>
<td>195,364</td>
</tr>
<tr>
<td>Population</td>
<td>2 million</td>
<td>47 million</td>
</tr>
<tr>
<td>P.C. Income ($)</td>
<td>31,500</td>
<td>29,000</td>
</tr>
</tbody>
</table>
Average rainfall (in/yr) in selected parts of Spain and New Mexico

Water use per sector (%)

**NEW MEXICO**
- 86.4%
- 2.2%
- 1.7%
- 9.7%

**SPAIN**
- 80%
- 6%
- 14%

Source: USGS (2009)
Source: MIMAM (2002)

- Domestic supply
- Irrigation (and livestock)
- Industry and mining
- Power

Groundwater challenges in Spain  Lessons from the Western Mancha aquifer
Groundwater is important in New Mexico and Spain because:

- Irrigation is necessary (and a traditional economic sector)
- They are both generally dry (and subject to droughts)
- In both cases groundwater is...
  - ...relatively abundant
  - ...easily accessible
  - ...of sufficiently good quality
Farmers understand the advantages of groundwater:

- Drought proofing
- Disponibility on demand
- Self-management

As a result, they tend to rely a lot on groundwater, just like any other arid and semiarid regions of the world (Middle East, Australia, China, India, Western US...)

The idea of intensive groundwater use is relatively new (less than one century)
Groundwater withdrawals in Spain

Development carried out by individual farmers

- No master plan
- No control
- Laws and regulations developed after pumping became widespread

The social and economic benefits generally outweigh the disadvantages, but they come with side effects (water table depletion, groundwater contamination, degradation of aquatic ecosystems, land subsidence)

Source: MIMAM (2000)
1. Overview

2. The Western Mancha case

3. Management challenges

4. Concluding remarks

The Western Mancha aquifer

Surface: 2120 mi² (2/3 ABQ Basin)  
Population: 300,000

Rainfall: 14.5 in/yr (≈ Santa Fe)  
Saturated thickness: 1300 ft
Possible solutions to avoid conflicts between water resources development and wetland conservation in the “La Mancha Húmeda” biosphere reserve (Spain)

J. Formés, J.A. Rodríguez, N. Hernández, M.R. Llamas
Dept. Geodynamics, Complutense University, 20040 Madrid, Spain

Abstract

The Upper Guadiana Basin is located in the Central “Meseta” of Spain and has a semiarid climate. About half of the catchment surface is formed by important calcareous aquifers. The hydraulic connection between
A dry region whose main natural resource is ground water
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>Tagus-Segura transfer operational</td>
</tr>
<tr>
<td>1978</td>
<td>English Grand Canal closed</td>
</tr>
<tr>
<td>1983</td>
<td>Ojos del Guadiana springs dry</td>
</tr>
<tr>
<td>1993-2007</td>
<td>Agro-Environmental Plan (AEP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1965</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated surface – Surface water (ha)</td>
<td>7,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Irrigated surface – Groundwater (ha)</td>
<td>&lt; 10,000</td>
<td>140,000</td>
</tr>
<tr>
<td>Wells (legal)</td>
<td>&lt; 1,000</td>
<td>16,000</td>
</tr>
<tr>
<td>Wells (total)</td>
<td>40,000</td>
<td></td>
</tr>
</tbody>
</table>

**Source:** CHG (2005 and 2006)

---

**Graph:**
- Ban on new wells
- No enforcement
- EU subsidies to water-intensive crops

**Timeline:**
- 1976: Tagus-Segura transfer operational
- 1977-1990: Groundwater irrigation boom
- 1978: English Grand Canal closed
- 1983: Ojos del Guadiana springs dry
- 1993-2007: Agro-Environmental Plan (AEP)
- 1988: Pumping all-time maximum
  - Pumping reaches 570Mm³ (official data)
- 1989: Registry Closed
  - Deadline to register wells drilled according to 1985 Water Act
- 1990: Max. pumping impact on Las Tablas
  - Wetlands in Las Tablas de Daimiel fall below 75ha
  - Driest period since the early 1980s
- 1996-1998: Heavy rains
  - Significant water table recovery (up to 15m)
- 2001: Catalogue closes
  - Private groundwater (wells drilled before 1985 Water Act) can no longer join the Catalogue

**Key Terms:**
- 150 ft
- 125 ft
- Peñarroya dam is built
- About 7,000ha put under surface water irrigation
- Groundwater becomes public
- RBA becomes responsible for the resource
- Catalogue and Registry open
- Illegal wells drilled from Jan 1986
- Water Act
- Groundwater becomes public
- RBA becomes responsible for the resource
- Catalogue and Registry open
- Illegal wells drilled from Jan 1986

---

**Legend:**
- Ban on new wells
- No enforcement
- EU subsidies to water-intensive crops

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**Notes:**
- Ban on new wells
- No enforcement
- EU subsidies to water-intensive crops
- Groundwater irrigation boom
- Between 130,000ha and 145,000ha come under groundwater irrigation

---

**Additional Information:**
- 1966: Peñarroya dam is built
  - About 7,000ha put under surface water irrigation
- 1985: Water Act
  - Groundwater becomes public
  - RBA becomes responsible for the resource
  - Catalogue and Registry open
  - Illegal wells drilled from Jan 1986
- 1987: Provisional Overexploitation UH04.04
  - Yearly pumping restrictions
  - Ban from drilling or deepening existing wells
- 1990: Max. pumping impact on Las Tablas
  - Wetlands in Las Tablas de Daimiel fall below 75ha
- 1990-????: New remedial measures in Las Tablas
  - Puente Navarro dam is built
  - Groundwater pumped and put into wetlands
LOS POZOS ILEGALES SECAN EL RÍO
CAUCES FLUVIALES

Río Azuer en Daimiel (Enero 2007)

Las Tablas de Daimiel (Diciembre 2005)

Ojos del Guadiana (permanente)

Río Cigüela en Villarta (Junio 2007)

Río Cigüela en Villarta (Mayo 2007)

Río Záncara en Alameda de Cervera (Marzo 2007)

Río Córcoles en Socuéllamos (Marzo 2007)

Río Guadiana en Peñarroya (Enero 2007)

Río Guadiana en Zuacorta (Mayo 2006)

Río Guadiana en Molemocho (1997)

Foto: S. Castaño
EL DÍA 1 DE JULIO
DEFIENDE LOS POZOS
CON 2 COJONES
TE ESPERO
Social conflicts

- Water Authority vs farmers
- Water Authority vs environmental NGOs
- Farmers vs environmental NGOs
- Farmers vs farmers (legal vs illegal, big vs small land-owners)

No metering, rampant illegal use, no enforcement ability on the part of the Water Authority, legal mess

No political willingness to solve the problem (irrigation subsidies were the economic engine of the region, aquifer overdraft just a side effect)
In 2000 the EU enacted the Water Framework Directive

All Member States need to restore all aquifers and surface water bodies before 2015 (2027)

As a result, Water Authorities renewed their efforts bring the situation under control

A plan was enacted in 2011 (broad consensus)

- Subsidies to water-efficient crops
- Buying water rights
- Re-allocating a part of the water rights to illegal farmers

The economic crisis hampered performance of the plan, to the point that water savings have been marginal

However...
2. The Western Mancha case

3. Management challenges

4. Concluding remarks

Aquifer recovery 2009-2013

Recovery 50-100ft across the board

Groundwater challenges in Spain  Lessons from the Western Mancha aquifer
Groundwater challenges in Spain  Lessons from the Western Mancha aquifer

RAFAEL MÉNDEZ  |  Villarrubia de los Ojos (Ciudad Real)  |  31 MAR 2012 - 20:57 CET
Archivado en:  Parque Nacional Tablas de Daimiel  |  CHG  |  Recursos hídricos  |  Parques nacionales
Embalse  |  Precipitaciones  |  Obras hidráulicas  |  Espacios naturales  |  Obras ampliación  |  España

El encharcimiento de agua en el antiguo cauce del Guadiana, junto al Molino de Zuacorta, el nártex pasado. / LUIS SEVILLANO

Parece un simple charco, un charco grande en mitad de un campo de

Groundwater challenges in Spain  Lessons from the Western Mancha aquifer
## 3. Management challenges

Perhaps the greatest challenge is the burden of the past:

<table>
<thead>
<tr>
<th>Ban on new wells</th>
<th>Turning groundwater into public ownership overnight</th>
<th>Years of “crying wolf”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+ No enforcement ability</td>
<td>+ Unexpected (and timely) recovery of the system</td>
</tr>
<tr>
<td></td>
<td>+ EU subsidies to water-intensive crops</td>
<td>+ Water transfer for drinking supply</td>
</tr>
<tr>
<td></td>
<td>= Thousands of illegal wells</td>
<td>= Economic crisis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>= No incentive to make efforts in the immediate future</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Insufficient information to users (conflict)</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Courts applying different legal doctrine</td>
</tr>
<tr>
<td>= Thousands of open lawsuits</td>
</tr>
</tbody>
</table>
• Quantitatively, irrigation is the only important player in the water business (dry regions)

• Water-saving policies must primarily address the irrigation sector
  • Domestic and corporate savings are good to raise awareness, but are only a drop in the ocean
  • To what extent does it make sense to grow water-intensive crops in dry regions?
  • Is it really possible for farmers to make the shift to water efficient agriculture?

• Will climate change become an unexpected ally?