Application of a WEF nexus framework for the Duero river basin in Spain

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A WEF Nexus framework: understanding and coordination

**WEF nexus conceptualization:** ‘the set of interconnections, tradeoffs and interdependencies existing between water, energy and food as a result of their natural cycles and human use’

**WEF nexus approach basis:**

**Goal:** provide guidance for a good and sustainable WEF resource management  
**Result:** WEF security

1. Provide **understanding** of interconnections
2. Help **coordinate** individual water, energy and food policies: knowhow + emerging synergies
3. **Applicable** at all scales for resource management: policy/insitutional, business, or even household
A three-step methodology - region

1. Identification, accounting and description of main tradeoffs
   Identifies and characterizes the flows and impacts to detect the main tradeoffs and conflicts

2. Analysis of the level of integration and coordination of sectorial policies and institutions

3. Identification of the existing and potential strategies to mitigate conflicts and promote synergies
   Identifies existing mitigation initiatives and provides a discussion on the results of the analysis to identify possible solutions.
Application to the Duero Basin in Spain

**Surface:** 78,859 km²

**Rainfall:** 625 mm/year av.

**Agriculture:** 85% water demand
4% GDP

**Hydropower:** 263 HP plants
44 HP big dams

**Thermal power:** 2 plants (1,171 MW)
## Application to the Duero Basin in Spain

### 1. Identification, accounting and description of main tradeoffs

<table>
<thead>
<tr>
<th></th>
<th>WATER</th>
<th>ENERGY</th>
<th>FOOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>WATER</td>
<td></td>
<td>WW¹: 83,875 Mm³</td>
<td>WW¹: 3,800 Mm³</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WC²: 280 Mm³</td>
<td>WC²: 9,800 Mm³</td>
</tr>
<tr>
<td>ENERGY</td>
<td>690 Gwh</td>
<td></td>
<td>12,642 Gwh</td>
</tr>
<tr>
<td>FOOD</td>
<td></td>
<td>1,500,000 tons</td>
<td></td>
</tr>
</tbody>
</table>

¹ WW: Water withdrawals  
² WC: Water consumption

- WC \(\rightarrow\) F \(3 \times E\)
- WW \(\rightarrow\) E \(5 \times F\)
- EC \(\rightarrow\) F \(18 \times W\)

- **Quality issues:**
  - Diffuse pollution
  - Ecological impacts from massive hydropower
  - Poor wastewater treatment in small villages
Application to the Duero Basin in Spain

2. Analysis of the level of integration and coordination of sectorial policies and institutions

Institutional diagnosis

- Independent sectoral policies
- Planning at different scales (national vs basin) → difficulties
- Poor coordination and communication → inefficiencies
- Increasing signs to look into each other → WFD and Water plans

downward synergies
### Application to the Duero Basin in Spain

#### 3. Identification of the existing and potential strategies to mitigate conflicts and promote synergies

<table>
<thead>
<tr>
<th>Conflicts</th>
<th>Existing strategies</th>
<th>Potential strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groundwater overexploitation by irrigation</strong></td>
<td>GW user associations for controlled management</td>
<td>Introduction of energy footprint accountings in water planning</td>
</tr>
<tr>
<td><strong>Energy footprint of modernized irrigation</strong></td>
<td>Dialogues with energy companies</td>
<td>Ante and ex-post analyses for big infrastructure projects/monitoring</td>
</tr>
<tr>
<td>Low awareness of water-energy problems at local level</td>
<td>‘Schools for Mayors’</td>
<td></td>
</tr>
<tr>
<td>Energy footprint and high cost of water treatment</td>
<td>Alternative water treatment systems for small villages</td>
<td></td>
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</tbody>
</table>
Conclusions

- When operationalized into a structured analysis methodology, the WEF nexus approach can provide valuable information for resource management decision making.

- Importance of **ante and expost analyses** considering crossed variables (planning and infrastructure) → avoid crossed resource security constraints.

- Integration efforts from **one sector alone** can be ineffective.

- **Management scale and differences in regional-institutional competences** are critical aspects to address to avoid bottle necks.
Thank you!

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