Efficient Agricultural irrigation management in Europe and Spain

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Policy Options for Water Efficiency

- The “Blueprint to Safeguard Europe’s Water Resources” has just presented a set of policy options
- In relation to irrigation efficiency:
  - **Pricing** policies
  - **Water accounting** (related to ecological flow)
  - **Control of Rebound** effect on water use / consumption
  - Funding for irrigation **efficiency gains**
- Sustainability also rests on **pollution monitoring and control**
A bit of irrigation hydrology

- **Water use**: water abstraction from source
  - Part of it returns to the hydrological system
- **Water consumption**: the part of the used water which is evapotranspiration by plants (and net evaporation losses)
  - Does not return to the hydrological system
  - Produces economic return to society
  - Productivity (kg/m$^3$ of consumed water) is not easy to change when it comes to producing biomass
  - This productivity can be changed in other crops: deficit irrigation
Average data supports efficiency (m$^3$/ha)

Source: Salvador et al., 2011
Individual data evidences variability (m³/ha)

Crops are water stressed.
Correcting this will:
- Increase crop yield
- Increase water consumption

Crops are over irrigated.
Correcting this will:
- Decrease water use
- Decrease the load of exported pollutants
- Locally increase pollutant concentration

Source: Salvador et al., 2011
The rebound effect

• Modern irrigation techniques increase water consumption in normal years

• But permit to apply Regulated Deficit Irrigation
  - To conserve water
  - To protect yield
  - To obtain additional agronomic benefits

Source: Lecina et al., 2009
An example: the rebound effect in corn:
1) Much less water use
2) More water consumption
3) More yield
Is this “sustainable intensification”? 

Corn Yield (kg/ha)

Water consumption (m$^3$/ha)

Water use (m$^3$/ha)
Water Accounting for Irrigation

- Water use associations are using Information Technologies to:
  - Implement water accounting
  - Support water conservation
  - Effectively and responsible distribute water costs
  - Implement progressive water tariffs
- Water users associations have emerged as the target for:
  - Water management improvement programs
  - Innovation hubs in agricultural water
  - Automatic irrigation scheduling and execution
Modern irrigation and agricultural pollution

<table>
<thead>
<tr>
<th></th>
<th>Traditional Surface Irrigation</th>
<th>Modern Sprinkler Irrigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Losses (m³/ha)</td>
<td>2,500</td>
<td>160</td>
</tr>
<tr>
<td>Fertilization (kg N/ha)</td>
<td>328</td>
<td>224</td>
</tr>
<tr>
<td>Exported Nitrates (kg/ha)</td>
<td>128</td>
<td>19</td>
</tr>
<tr>
<td>Nitrate Concentration (mg/L)</td>
<td>51</td>
<td>119</td>
</tr>
<tr>
<td>Fertilizer loss (%)</td>
<td>39</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: Pratt, 1984
Water Accounting responding to water stress (USGS, 1995)
Conclusions

- Our irrigation systems are becoming very efficient on the average.
- Average values still hide poor efficiency and losses due to water stress.
- Modern irrigation systems are intensifying agriculture:
  - Reduce water use (per hectare)
  - Increase water consumption (per hectare, not per unit of product)
  - Greatly reduce pollution (per hectare and unit of product)
  - ...intensive, sustainable agriculture?
- Irrigation efficiency, full automation, water accounting and pollution control: critical role of water users associations.