Equipments for Sustainable Irrigation

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Including research results from the “Irrigation, Agronomy and the Environment” research group

Colloque
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Summary

- The context of Irrigation in Europe
- The European Irrigation Industry
- Irrigation sustainability
- Irrigation hydrology
- On-farm equipment for different irrigated agroecosystems:
  - Traditional surface irrigated areas
  - Sprinkler irrigation for extensive crops
  - Drip irrigation for intensive agriculture
- Collective equipment:
  - Pressurized networks
  - Open-channel networks
- Protecting water quality
The context of irrigation in Europe

Large differences between countries
Irrigation in Europe

- Production of agricultural raw materials
  - In concurrence with rainfed agriculture
  - Economically tight
  - Low labor, socially sustainable
  - Blend of traditional & modern irrigation systems
  - Low environmental impact per unit of land

- Production of fresh food
  - Outdoor / greenhouse
  - Most of it under irrigation
  - Very specific semiarid areas
  - Economically profitable
  - High labor, socially challenged
  - Modern irrigation systems
  - High environmental impact per unit of land
The European irrigation industry

A fully developed industry, open to the world
European irrigation industry

- Producing / building all elements required for an irrigation system.
- A few specific elements are often imported, but European products are always available.
- The industry is quickly moving:
  - From hardware to software
  - From equipments to management
  - From design to control
- Fueled by Public Programs for Irrigation modernization…the case of Spain
Irrigation sustainability

What will the irrigation landscape be in twenty-year time?
Irrigation sustainability

- **Social**
  - Difficulty to retain in Europe labor intensive fresh food production
  - Producers of raw materials: continued decrease in labor requirement per unit of land, following automation

- **Economic**
  - Irrigation modernization in the south of Europe is often more expensive than the land itself
  - Energy for pumping: critical cost for extensive irrigation

- **Environmental… Water Framework Directive**
  - Reducing water consumption
  - Reducing agricultural pollution… mobilized by excess irrigation water
Irrigation hydrology

An interesting perspective to agricultural water use
Irrigation hydrology

- Societal claims to “save water” in agriculture
- Fate of irrigation water:
  - Evapotranspiration: consumptive use
  - On-farm and conveyance losses: non consumptive use
- Saving water = reducing evapotranspiration
  - Cultivate less land
  - Cultivate less water intensive crops
  - Regulated Deficit Irrigation
- Increased efficiency = water conservation
On farm equipment for sustainable agriculture

Adaptation to different agroecosystems
Surface irrigation

- Millions of hectares... riparian lands
- Some will not change to pressurized irrigation
  - Small farms
  - Not suited for commercial agriculture
  - What to do?
- It is often not difficult to make these systems water efficient (Laser guided land leveling)
- It is much more difficult to find a sustainable exploitation model for it:
  - Agriculture (Fresh food?)
  - Fiber (Drip irrigated riparian forests?)
  - Landscape/Environment (Nitrate filters / CO₂ sinks?)
Sprinkler irrigation

- **Energy as an economic limiting factor**
  - Research on low-pressure irrigation systems
  - There is room for improvements
    - 30% decrease in the pressure measured on farm would have very limited effects on crop yield.

- **Wind as a technical problem**
  - Smart irrigation programmers, sensing wind and locating irrigation in favorable periods
Sprinkler evaporation losses (mostly consumptive)

Wind Drift and Evaporation Losses (%)

<table>
<thead>
<tr>
<th></th>
<th>Day</th>
<th>Night</th>
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<tbody>
<tr>
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<td>5</td>
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<tr>
<td>Pivot Ranger</td>
<td>10</td>
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Drip irrigation

- Great potential for water saving, owing to Regulated Deficit Irrigation
  - Widely implemented by Fruit farmers:
    - Saves water (not economically relevant in many cases)
    - Controls plant growth (great savings in pruning)
    - Promotes fruit quality

- In semi-arid environments, salt accumulation
  - Linked to the use of Deficit Irrigation
  - Can limit the life of a plantation or the rotation of horticultural crops
Irrigation advisory service to farmers

A web page as a communication link with the farmers… irrigation advice

Based on a network of agrometeorological weather stations
Collective equipment for sustainable agriculture

Pressurized and open channel systems
Collective effort

- Groundwater irrigated areas rely on individual efforts
- Surface waters require farmers’ cooperation:
  - Establishment of Water Users Associations
  - Collective structures:
    - Canals
    - Pressurized networks
- Managing a Water Users Association…
Software for irrigation district management
Collective Management: Telemetry and Remote Control

- Collective irrigation projects in Spain include telemetry / remote control systems
- These new systems have limited use today
- They enjoy great possibilities for automated control
  - Particularly in combination with real-time crop water requirements information
  - Need for new, collective tools for irrigation management
  - Irrigation can proceed without farmers!
A simulation experiment

Seasonal water use (m$^3$ ha$^{-1}$)

- Observed
- Manual
- Central

Comparison of water use across different management strategies for corn and alfalfa.
Protecting water and soil quality

Farmers’ responsibility already in implementation
Characterization of the Ebro River Basin surface waters


Estaciones utilizadas

NO$_3$ [µEq l$^{-1}$ año$^{-1}$]

-2 - 0
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
> 12
Farmers’ implementation of WFD

- Farmers associations are beginning to take responsibilities in the quality of irrigation effluents:
  - Measuring discharge in creeks
  - Analyzing water quality
- Who could do better than themselves?
- Technology is being developed for
  - Robust remote water analysis
  - Wireless communication for real-time assessment
Concluding remarks

Quite a few challenges!
Technology for sustainability

- Room for collaboration: farmers, industry, public research...
- Quick improvements in the field of water quality:
  - Adjustment of irrigation efficiency
  - Reduced agricultural inputs
- Slow improvements in the field of water quantity
  - Water conservation is accessible
  - Water saving is not a zero-sum game:
    - Win some, loose some!