Water demand & management in sugarcane production

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Outline of talk

- Crop water demand
- Issues with water demand for cane
- Improving water use efficiency
  - Irrigation systems
  - Water quality
  - Conveyance issues
  - Soil & management interactions
  - Planning for agriculture & ecosystems
- Gaps & challenges

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Relatively high water demand by sugarcane

<table>
<thead>
<tr>
<th>Crop</th>
<th>$E_T$ (mm)</th>
<th>Crop yield (kg/ha)</th>
<th>Prod. Water Use Ratio (kg/m³)</th>
<th>GVP ($US/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>579</td>
<td>1,293</td>
<td>0.22</td>
<td>0.43</td>
</tr>
<tr>
<td>Rice</td>
<td>414</td>
<td>1,756</td>
<td>0.42</td>
<td>0.13</td>
</tr>
<tr>
<td>Wheat</td>
<td>357</td>
<td>2,276</td>
<td>0.64</td>
<td>0.10</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>965</td>
<td>47,929</td>
<td>4.97</td>
<td>0.10 – 0.24</td>
</tr>
</tbody>
</table>

- Cane yield is low; $4.97 \text{ kg/m}^3$ is low water use efficiency, but typical of inefficient furrow irrigation
- After Bastiaanssen et al., 2003, 11% sucrose sugar $0.08 – 0.20/lb
Cane yield depends on crop water use

- Biomass & cane yield are linear functions of $E_T$
  - $TC = 12.21 \times E_T - 17.99$
- Crop Water Index in Australia
  - 3.5 tc/ML furrow irrig. Sandy loam soil
  - 11.4 – 12.8 tc/ML overhead & drip systems
  - 8.5 – 9.5 tc/ML common district values

World view for yield & $E_T$

![Graph showing comparison of Australian cane yield/crop water use model with six functions and three data points from overseas sugar industries; terminating symbols on regression lines indicate the range of data used to derive the functions.]
Issues with water demand & irrigation of cane

• Required for economic yield

• Potential for resource degradation
  – Soils (Salinity, sodicity)
  – Water resources
    • Decline in quantity (exploitation)
      – Deeper wells / new storages
    • Decline in quality (generation of effluents)
      – Contamination / marine intrusion
  – Habitat (Environmental flows)
Irrigation demand for cane

Management factors

- **Water availability**
  - Quantity & quality
- **Water reticulation**
  - Conveyance losses
- **Water application effic.**

- Sprinkler 73.5-88%
- Drip, C. Pivot 72-89%
- Furrow 31-62%
Water quantity & quality

- Quantity often limits yield
  - greater demand??
- Salinity & sodicity
  - Salt & alkalinity issues
  - Options to manage quality
- Dilemmas Asian sub-continent
  - Soil texture, aridity impact
  - Salinity & alkalinity of water
  - Capital, resources, incentives
Conveyance efficiency

Loss in canals & storage – drainage & evaporation

Conveyance efficiency

- Pipes 91-99%
- Channels 49-71%
- Capital, incentives, management
Soil & Management interactions with irrigation efficiency

Major issues with furrow irrigation
- Drainage / Tail-water runoff
- Soil type & contact time effects

Improved furrow efficiency
- Soil type & management
- Furrow length, shape, flow
- Tail-water recycling
- Contact time
Knowledge to Outcomes = Adoption

Extension of BMP

- **Numbers game - corporate agric.**
  
  - *cf. small owners / tenants*

- **Client resources**
  
  - knowledge base, motivation, finances, incentives

Cooperative BMP Aust

- **Government policy initiative**
- **Reduced water 15%**
- **Increased yield 6%**
Socio-economic issues

- Many irrigation systems pre-date full economic & environmental scrutiny
- Concept of catchment needs
  - Water Allocation Management Plans (WAMP)
- Water allocation & charge
  - Inefficiency of allocation & charge by area
  - Metering
Gaps & Challenges

- Managing social & economic impact of resource re-allocation
  - If less water for sugar
  - More efficient systems
- Operators knowledge base & incentives
- Equity within catchments & cultures
  - Aspirational targets & production reality
  - Commodity producer / small tenant farmer
Fig. 9—Comparison of the Australian cane yield/crop water use model with six functions and three data points from overseas sugar industries. Terminating symbols on regression lines indicate the range of data used to derive the functions.