Irrigation Automation in the Burdekin Sugarcane Industry

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AgriTech Solutions
Irrigating into the future
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Overview

• Burdekin sugarcane industry
• Automation system used
• Benefits
• Further Developments
- ~100,000 ha of irrigated land
- Sugarcane dominated
- Harvest 70,000 ha
- 8M tonnes cane
- 1.2M tonnes sugar
- <1,000 ha drip/overhead

- 8 ML/ha (approx.) surface water allocation
- Regulated groundwater extraction
- Low yielding bores

- High yielding bores
- Unregulated groundwater extraction
- 8 ML/ha (approx.) surface water entitlement
System Components

• (WiSA) Radio Base station
  • Connected to PC running control software

• Control system
  • Pump controller
  • Field Control nodes (can connect to two valves)
  • Actuator and valve for each block

• Supply Monitoring
  • Pressure (PST)
  • Flow

• Advance/Drainage Monitoring
  • Water level in drain or
  • advance detection within field

• Other optional sensors (e.g. wind, rain, soil moisture, etc)
Linton Site

- Water source:
  - River pumps for furrow channel and recycle pit for drip
- 45 ha of Drip
  - 350 – 450 m long
- 51 ha of Furrow
  - 350 – 750 m long
- Farm is located 40 minutes drive from home
Linton Site

- 11 Irrigation blocks
  - WHOLE farm is automated
- 6 control nodes & 11 valves
- 2 pumps with flowmeters and pressure transducers
- 3 drain level sensors

Diagram:
- Two pumps labeled Pump 1 and Pump 2
- Drain probe and base station
- Monitoring Node + drain probe
- Control Node

Screen displays:
- Trace Window
- Hydraulic Group
- System Status
- Pumps
- Flow Rates
- Valves
- Irrigation Cycle
- Protection Cycle
- Cycle Status
- Cycle 1: Status Disabled, Cycle 2: Status Disabled
- Current: 0.0 mH2O
- Compass with directions: N, E, S, W
- Speed: 3.0 knots, 408.2 mm, 4.0 mm, 0.0 mm
- Pressure: 32.0 psi
- Last Update: 27 Apr 11:44
Linton Site

- 11 Irrigation blocks – WHOLE farm is automated
- 6 control nodes & 11 valves
- 3 pumps with flowmeters and PST’s
- 3 drain level sensors
• EM flowmeters installed (replacing Sunwater meters)
Linton Site – Drain Level Sensors

- Detect small changes in water level in drain
- Farmer will calibrate:
  - First few furrows = small depth
  - Most furrows completed = larger depth
- Can be used to trigger next block to start
Jordan Site

- 82 ha, 1300m furrows
- 5 Irrigation blocks
- 5 control nodes (1 per valve)
- 1 Pressure transducer + Doppler flowmeter inside supply
- Advance sensors (100–200m from end with nodes outside field)
- Farmer wants to minimise Tail-water
Jordan Site – Advance Sensors

• Not Possible with a fixed time schedule:
  • Sample of Completion times:

<table>
<thead>
<tr>
<th></th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
<th>Block 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max time</td>
<td>1595</td>
<td>1559</td>
<td>1338</td>
<td>1153</td>
</tr>
<tr>
<td>Min Time</td>
<td>568</td>
<td>1273</td>
<td>840</td>
<td>885</td>
</tr>
<tr>
<td>Average (minutes)</td>
<td>869</td>
<td>1442</td>
<td>1006</td>
<td>999</td>
</tr>
</tbody>
</table>

• Water needs to be stopped several hours before reaching the drain
• A “Trigger Distance” determined for each block through SISCO modelling.
• Soil moisture sensors were buried at those locations (100 – 200m from end) and connected to radio node outside field.
• System is now set to switch to next irrigation set at the time at which water is detected
Jordan Site – Advance Sensors
Records from the system indicated Aaron was under-irrigating some fields

- Confirmed with IrrigWeb analysis

Aaron tested surging on problem fields

- Reduced run times & Increased depth infiltrated
Linton Site – Off Peak Power

• Aaron can now schedule all irrigations to occur in off peak power periods
  – Savings of around $122.40 per hectare
  – Measured data approx. 2% usage in peak 98% in off peak
<table>
<thead>
<tr>
<th>Farmer</th>
<th>Russell Jordan</th>
<th>Aaron Linton</th>
<th>Denis Pozzebon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area automated during project (ha)</td>
<td>82</td>
<td>53</td>
<td>27</td>
</tr>
</tbody>
</table>

### Summary of Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Russell Jordan</th>
<th>Aaron Linton</th>
<th>Denis Pozzebon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water saving</td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td>Blocks were being underwatered</td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
</tr>
<tr>
<td>Approx. 10-15%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy use saving—reduced pumping time</td>
<td>Gravity system, no pumping</td>
<td>Not applicable</td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
</tr>
<tr>
<td>Saving from changing electricity tariff</td>
<td>No pumping</td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
<td>Potential saving but not investigated during project</td>
</tr>
<tr>
<td>Labour saving—time spent changing/checking irrigation and travelling to the farm</td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
</tr>
<tr>
<td>Vehicle cost saving</td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
<td><img src="%E2%9C%93" alt="✓" /></td>
</tr>
<tr>
<td>Improved record keeping—irrigation is automatically captured</td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
</tr>
<tr>
<td>Social or family benefits</td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
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</tr>
<tr>
<td>Water quality improvement</td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
</tr>
<tr>
<td>Reduced deep drainage losses (water table impacts)</td>
<td><img src="%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93%E2%9C%93" alt="✓✓✓✓✓" /></td>
<td><img src="%E2%9C%93" alt="✓" /></td>
<td><img src="%E2%9C%93%E2%9C%93" alt="✓✓" /></td>
</tr>
</tbody>
</table>
Jordan – annual costs & savings ($/ha)

<table>
<thead>
<tr>
<th></th>
<th>$/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>$58</td>
</tr>
<tr>
<td>Electricity (energy)</td>
<td>$0</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>$0</td>
</tr>
<tr>
<td>Water purchases</td>
<td>$39</td>
</tr>
<tr>
<td>Water sales</td>
<td>$42</td>
</tr>
<tr>
<td>Vehicle R, M &amp; F</td>
<td>$16</td>
</tr>
<tr>
<td><strong>Total annual benefit</strong></td>
<td><strong>$155</strong></td>
</tr>
<tr>
<td><strong>Annual cost</strong></td>
<td>$87</td>
</tr>
<tr>
<td><strong>Benefit - Cost</strong></td>
<td>$68</td>
</tr>
</tbody>
</table>

* Borrowing costs not included

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**Pie Chart**

- Labour: $58
- Water sale: $42
- Water purchase: $39
- Vehicle: $16
- Total annual benefit: $155

Annual cost: $87
Benefit - Cost: $68
## Linton – annual costs & savings ($/ha)

<table>
<thead>
<tr>
<th></th>
<th>$/ha/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>$149</td>
</tr>
<tr>
<td>Electricity (energy)</td>
<td>$36</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>$122</td>
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<tr>
<td>Water purchases</td>
<td>$1</td>
</tr>
<tr>
<td>Water sales</td>
<td>$0</td>
</tr>
<tr>
<td>Vehicle R, M &amp; F</td>
<td>$70</td>
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<tr>
<td><strong>Total annual benefit</strong></td>
<td><strong>$378</strong></td>
</tr>
<tr>
<td>Annual cost*</td>
<td>$184</td>
</tr>
<tr>
<td><strong>Benefit - Cost</strong></td>
<td><strong>$194</strong></td>
</tr>
</tbody>
</table>

* Borrowing costs not included
Pozzebon – annual costs & savings ($/ha)

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost ($/ha/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>$197</td>
</tr>
<tr>
<td>Electricity (energy)</td>
<td>$38</td>
</tr>
<tr>
<td>Electricity tariff</td>
<td>$0</td>
</tr>
<tr>
<td>Water purchases</td>
<td>$73</td>
</tr>
<tr>
<td>Water sales</td>
<td>$0</td>
</tr>
<tr>
<td>Vehicle R, M &amp; F</td>
<td>$10</td>
</tr>
<tr>
<td><strong>Total annual benefit</strong></td>
<td><strong>$318</strong></td>
</tr>
<tr>
<td><strong>Annual cost</strong>*</td>
<td><strong>$316</strong></td>
</tr>
<tr>
<td><strong>Benefit - Cost</strong></td>
<td><strong>$2</strong></td>
</tr>
</tbody>
</table>

* Borrowing costs not included
Developments

SRA funded project + farmer co-investment
- 3 farms
- 164 Ha

2018 installation
- 3 original farmers
- 3 new farmers
- 550+ ha automated

NESP project 3.1.2
- Automate the irrigation and rainfall data from automation software (WiSA) to irrigation scheduling tool (IrrigWeb)
- Reduce farmer time - Aaron Linton 2016/17 irrigation season
  - 1001 irrigation events
  - 118 rainfall events
  - Between 50 - 100 hours of manual data entry saved