Irrigation in Sugarcane Forum

Brisbane

Forum date: 5 September 2017
By Peter Samson

September 2017

Contact
Dr Peter Samson, Program Manager
Sugar Research Australia
50 Meiers Road, Indooroopilly QLD 4077
Telephone: 07 3331 3303
Email: psamson@sugarresearch.com.au
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1. Executive Summary

The one-day sugarcane irrigation forum involved growers, millers and advisers from the main irrigating regions, as well as researchers, managers, policy personnel and support agencies, a total of 31 participants plus Sugar Research Australia (SRA) support staff and Forum independent facilitator (Michael Williams, Michael Williams and Associates Pty Ltd). The purpose of the day was to help set a strategic direction for SRA in terms of Research, Development and Extension/Adoption in irrigation, and identify topics that could be addressed by projects funded by SRA alone or in collaboration with other funding sources.

SRA is currently funding irrigation projects on automation (due for completion in 2017) and energy innovation (due for completion in 2020), and contributes to the Rural R&D for Profit Smarter Irrigation project with several sugarcane-specific activities (due for completion in 2018). Consideration of the relevance of these projects and of other irrigation-related activities being conducted outside SRA to topics identified at the Forum was not the focus of the Forum.

The process followed was:
- A series of introductory remarks from all participants
- A brief presentation from Dr Guy Roth (SRA Board member and member of the SRA Research Funding Panel, presenting as coordinator of the Rural R&D for Profit Smarter Irrigation project) on innovative irrigation practices in industries other than sugarcane
- Four small-group workshops to list priority irrigated sugarcane RD&A topics and to identify each group’s three highest priorities
- A plenary session to consider and aggregate the individual group priority topics and further develop an agreed list of priority RD&A themes for consideration by the SRA Research Funding Panel and SRA Board for future investment.

The Forum noted the very strong link between water and crop productivity, a link that is probably more direct and more predictable than for any other environmental variable. The Forum also noted that the term ‘water use efficiency’ has passed its use-by date and doesn’t properly convey the productivity gains possible from good irrigation; the term ‘water productivity’ has a more positive connotation.

The cost of energy was acknowledged as a major disincentive to growers using water as needed but research into alternative energy sources was not raised at the Forum. Breeding of water-efficient varieties was raised as a research topic by a few participants but did not feature in the final list of Forum’s highest priorities.

The Forum agreed that irrigation practices could and should be improved. Systems and farm layout may not be optimal. Existing irrigation systems are reaching their use by date and may need replacing. High-pressure irrigation systems are becoming uneconomic due to energy costs. Irrigation volumes and timing may be sub-optimal due to lack of understanding by growers of irrigation principles, including the economics of irrigation. Human error can lead to poor irrigation decisions. Lack of understanding of risk and uncertainty around climate forecasts, as well as doubt about the return on investment in irrigation and consequent energy use, can result in water allocations not being used and productivity losses.
The highest priority topics for investment to improve irrigation productivity and profitability, noting that not all might be suitable topics for SRA-funded projects, were:

1. **Adoption of existing knowledge and use of existing information sources to increase water productivity.** This is a very broad topic with overlapping components that include:
   - Lifting the capability of growers and advisors in regard to irrigation and use of water
   - Providing independent advice to growers for system selection (where growers are installing new systems) and assisting with system optimisation, farm design, and use and interpretation of measurement tools (on-ground support and hand-holding)
   - On-farm measurement, benchmarking, and demonstration sites
   - Identifying and overcoming barriers to adoption
   - Evaluating and promoting the productivity and profitability gains from irrigation (economics)
   - Increasing the use of appropriate sensors and measurement and scheduling tools, and developing new tools as required.

2. **Research to improve water productivity through technology: variable rate irrigation, automation and fully autonomous systems.**

3. **Irrigation platforms for improved irrigation:** with sensors, data and enhanced modelling tools for water-limited irrigation, to select when and how to use limited water for maximum productivity while minimising risk.

These priorities echo the outcomes of the review of soil health in sugarcane: an extensive adoption program to make best use of existing knowledge, a suite of measuring tools to benchmark systems (including economics) and feed into on-farm decisions, and a platform to aid growers to integrate the factors that influence those decisions. Development of more sophisticated irrigation systems with automation that make irrigation more efficient, allow growers to use cheaper electricity tariffs, or remove the human factor by being fully autonomous, was seen as a good long-term goal.

This report will be a public document and will inform decisions on projects received in the SRA funding call for projects to begin in 2018. The report will be sent to all Forum participants and to RD&A personnel within and outside SRA who likely to submit proposals in the current project call, and will be made available on the SRA website.

### 2. Background

Many sugarcane-growing districts rely on either full or supplementary irrigation to grow productive crops. The industry is facing increasing irrigation challenges including:

- The availability and quality of irrigation water
- The cost of irrigation, particularly with high and increasing energy prices
- Loss of production potential through inefficient use of water
- Loss of production potential through failure to use all of the water available for irrigation
- Increasing scrutiny of the off-site impacts of irrigation.

In order to set a strategic direction for Sugar Research Australia (SRA) to help address these challenges, SRA held an irrigation forum at the Riverview Hotel, Brisbane on 5 September 2017. The Agenda for the Forum is given in Appendix 1.
The purpose of the day was to help set a strategic direction for SRA in terms of Research, Development and Extension/Adoption in irrigation, and identify topics that could be addressed by projects funded by SRA alone or in collaboration with other funding sources. A total of 31 people attended the Forum, not including the independent facilitator. Participants were invited by SRA to cover the irrigated sugarcane regions, primarily the Atherton Tableland, Burdekin, Central (Proserpine, Mackay, Plane Creek) and Southern (Bundaberg, Isis, Maryborough), and various industry roles, including growers, advisors, millers, policy and management. A list of participants is given in Appendix 2.

SRA currently funds a limited number of irrigation-related projects. These are:

- **Modernisation of Furrow Irrigation in the Sugar Industry (University of Southern Qld).** This project is setting up automated irrigation systems on three Burdekin farms, with associated sensors; the project is due for completion in late 2017.
- **Smarter Irrigation for Profit,** which is due for completion in 2018. SRA contributes to this cross-sectoral Rural R&D for Profit project which has three specific sugarcane activities:
  - Increased sophistication of one of the Burdekin automation sites above (University of Southern Qld)
  - A review of scheduling tools, including use of satellite imagery (SRA, University of New England)
  - Educating growers in innovative on-farm water management and scheduling practices (SRA, Agritech Solutions)
- **Productivity improvements through energy innovation in the Australian sugar industry (Ag Econ),** which runs until 2020.

These and other RD&A activities underway outside SRA were not the focus of the Forum. However, there is an opportunity to increase the SRA irrigation portfolio.

This report covers the outcomes of the Forum. It will be a public document and will inform the SRA funding call for projects to begin in 2018.
3. **Introductions**

The Forum was independently facilitated by Michael Williams (Michael Williams & Associates Pty Ltd).

The day began with an introduction from each participant – what they hoped to get out of the Forum and what impact they would like to make on the outcome. Detailed responses are given in Appendix 3. Common themes included:

- Water is the main driver of productivity.
- How to maximise profitability of irrigation, noting that systems must be sustainable and affordable?
- What are the barriers to adoption of better irrigation practices?
- Can irrigation practices make better use of weather/climate forecasts? Need to integrate irrigation with rainfall to make best use of both.
- Given the limited availability of water in many regions, and the difficulty in ensuring optimal use of limited water, can we select varieties that make better use of limited water?
- Energy cost is the major reason why growers don’t irrigate and why the full water allocation is not used in some regions.
- Demonstration of economics is critical – need to link water use efficiency and profitability; growers must be convinced of the value of irrigation.
- Need greater understanding by the whole industry of irrigation and greater adoption of known sound irrigation management principles underpinned by R&D.
- More on-ground support is needed to help growers make best use of available information sources (e.g. moisture sensors, weather stations). Individual grower guidance is needed for practice change.
- Growers need advice on system upgrades and/or replacement; many systems are nearing end-of-life. Growers also need advice on farm design to optimise irrigation.
- The sugarcane industry could benefit from collaborative projects with other industries.
- Need adoption of existing knowledge but also need new tools that allow greater resilience in decision-making to get the best result from limited water.
- Can irrigation be improved by systems, including automation, that reduce the human-error factor and improve decisions?
- Need to bring irrigation management into strategies for nutrient management and herbicide management, which currently may ignore irrigation as a contributing factor.

4. **Smarter Irrigation for Profit – Dr Guy Roth**

A presentation was given by Dr Guy Roth, SRA Board Member and member of the SRA Research Funding Panel. Guy also coordinates the Rural R&D for Profit project Smarter Irrigation for Profit, a project supported by a number of research organisations and Research and Development Corporations, including SRA. Guy presented a range of irrigation practices and measurement tools being used in other industries, and fielded questions from the Forum (Appendix 4). In sugarcane, possibilities to improve irrigation practices could be grouped as:

- Opportunities to change practices or attitudes using existing knowledge and technologies (Extension/Adoption strategy)
- Increased understanding of soil-water-plant relationships (Development strategy)
- Investigation of new technologies (Research strategy)
5. **Small Group Workshop**

Participants were pre-selected to sit at each of four small group discussion tables (Appendix 2). Growers, advisors and millers were allocated to tables primarily representing their regions while people with other roles (e.g. researchers and management) were distributed among tables.

In addressing the question posed to each of the four small group discussion tables “What are the highest priority irrigated sugar Research, Development and Extension / Adoption topics to inform future SRA investment?”, small groups worked through a facilitation process to record participants’ highest-priority topics for RD&A that could be addressed by funding from SRA alone or in collaboration with other organisations.

A full list of the topics from each small group is given in Appendix 5.

6. **Presentations from small groups**

Each small group brought their three highest priority topics to a plenary session of the whole forum (Table 1).

Each small group was asked to nominate whether their priority topics were applicable to full or supplementary irrigation; all priorities were nominated as relevant to both situations. Each small group also nominated whether their topics had a research (R), development (D) and/or adoption (A) focus (Table 1).
Table 1. - Highest three priority topics identified by each of four small-group discussions (7-8 people each, composition in Appendix 2), and the groups’ judgement as to whether the topics have a Research (R), Development (D) and/or Adoption (A) focus.

<table>
<thead>
<tr>
<th>Priority</th>
<th>Topic</th>
<th>R, D and/or A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Increase measurements, e.g. soil moisture, run-off volumes, nutrients, $/ML; develop new sensors as required</td>
<td>R, D, A</td>
</tr>
<tr>
<td>2</td>
<td>Increase irrigation efficiency, e.g. limiting deep drainage and irrigation run-off</td>
<td>A</td>
</tr>
<tr>
<td>3</td>
<td>Automation, e.g. furrows/application/drainage/measurement (encompasses priorities 1 and 2.)</td>
<td>D, A</td>
</tr>
<tr>
<td>Group 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Overcoming barriers to water use</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Improvements in water productivity</td>
<td>D, A</td>
</tr>
<tr>
<td>3</td>
<td>Variety selection based on water productivity</td>
<td>R</td>
</tr>
<tr>
<td>Group 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Lifting background capability of growers/industry in regard to irrigation and use of water, by assessing economics and system performance</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Irrigation platform for improved irrigation systems with sensors, data and enhanced modelling tools for water-limited irrigation, to select when and how to use limited water for maximum productivity</td>
<td>D, A</td>
</tr>
<tr>
<td>3</td>
<td>Research to enable fully autonomous irrigation with new sensors for plant, soil and water to improve irrigated productivity</td>
<td>R, D</td>
</tr>
<tr>
<td>Group 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Measurement – agronomy, profitability and economics</td>
<td>D, A</td>
</tr>
<tr>
<td>2</td>
<td>Water use efficiency – existing research. Research better ways to use current systems.</td>
<td>R, D</td>
</tr>
<tr>
<td>3</td>
<td>Water use efficiency – new research. Variable rate irrigation.</td>
<td>R</td>
</tr>
</tbody>
</table>

**Group 1**

**Priority 1, increase measurements**
Irrigation cannot be managed successfully without measurement. This should include not just physical measures of water use, run-off etc. but also economic measures of the return to the grower from irrigation as against the cost. Measurements may use methods that are already available but some new sensors might need to be developed for particular purposes.

**Priority 2, increase irrigation efficiency**
A range of adoption strategies could be used to increase water use efficiency and water productivity:
- On-farm measurement and benchmarking, e.g. using sensors; benchmarking - seeing where you sit among your peers can be a strong motivator to improve performance
• A network of on-farm demonstration sites; multiple local sites representative of, for example, soil types
• On-going support for the scheduling tool IrrigWeb
• Assistance to growers to use new technology on-site.
Growers must be able to see what is in it for them.

Priority 3, automation
This requires not just the appropriate automation technology but also the necessary sensors and measurements and grower understanding of irrigation principles.

Group 2

Priority 1, overcoming barriers to water use
In Mackay in particular, the available water allocation across the district is not all used. This is all about understanding the economic impacts (costs and benefits) of irrigation and adoption of improved practice to increase growers’ productivity and profitability.

Priority 2, improve water productivity
Achieving this requires the irrigation platform outlined below by Group 3 Priority 2.

Priority 3, variety selection based on water productivity
This is a research question for the SRA plant breeding team.

Group 3

Priority 1, lift background capability of growers/industry
There is a significant lack of background knowledge in the industry, especially in terms of equipment. Many irrigation systems are nearing end-of-life and growers may get poor advice on replacement from the suppliers. In addition, growers may choose a system based on a low price rather than by a proper assessment of their irrigation needs and the system’s performance. This requires an adoption program that:
• Lifts background knowledge
• Trains industry people
• Provides advice on irrigation system design, irrigation strategy, and economics (the value proposition and return on investment)
• Targets growers, advisors, resellers, R&D personnel
• Includes systems thinking, benchmarking and risk management principles

Priority 2, an irrigation platform
How should growers make decisions given their water allocation and their risk given the climate forecast (risk of failing to irrigate when needed, risk of irrigating at the wrong time and exhausting water allocation). A platform is needed that integrates measurements, scheduling tools and irrigation strategies, and would require:
• Access to data for decisions: soil moisture, weather forecast, climate forecast, satellite imagery etc.
• Models and tools: farm management, irrigation decisions (how/why/when to irrigate), risk strategies
Priority 3, new technologies
- Autonomous systems
- Variety interactions
- Water and soil interactions and sensing systems
- Crop sensors
- Any other new technologies?

The move to autonomous systems will be slow; there is a need to first work within the current irrigation landscape but with the long-term aim of autonomous systems.

Group 4

Priority 1, measurement (agronomy and profitability)
Irrigation is the single largest on-farm infrastructure investment. High-pressure irrigation is being phased out due to its high energy cost, and growers must decide what to invest in next. Growers need to better utilise existing systems, and understand each system and its productivity and profitability relationships. Productivity, water and energy cost should be demonstrated based on good data. This is about:
- Agronomy and profitability
- Optimising capital, economics of change
- Technical skills, knowledge to make changes
- Farm layout
- Climate forecast
- Environmental impact

Priority 2, water use efficiency (current knowledge)
Growers need to get the most out of the water they use. More studies need to be done on better ways to use existing systems, including pivot, drip and flood (there is a current perception that flood irrigation is inefficient - can it be made more efficient)?

Priority 3, water use efficiency (new research)
Variable rate irrigation will be the next step in irrigation efficiency, based on a map of Plant Available Water Capacity (PAWC). Thermal imaging could be used to develop PAWC maps. This includes automation.

7. Plenary discussion of overall priorities

The outcomes of the discussion during the plenary session (without attribution to the individual contributors) were:
- The term ‘water use efficiency’ would be better replaced with the term ‘water productivity’.
- There is a need for greater measurement (of plant, crop, soil, water use, economics). Measurements are the best way to provide proof of concept to growers and to increase productivity, overcome barriers to adoption, and allow the value chain to more fully understand the value of inputs, productivity gains and profitability outcomes and the measured relationships between these factors. Continuous measurement is needed; no two years are the same.
• There is a great diversity of irrigation knowledge and sophistication within the industry. Barriers to water productivity are different in different regions and for different people, and extension packages must accommodate this. Principles may be the same across regions but the metrics may differ.

• Measurements were listed as a stand-alone priority but other topics have measurements embedded in them. Measurements allow growers to know where they have been, where they are and where they are going; they improve the ability to make decisions. Measurement should be seen as an enabler for other productivity improvement activities.

• Overcoming barriers to water use (Group 2 Priority 1) could also nest under Improving water productivity; improving water productivity may overcome barriers to water use.

Via a process of facilitated plenary discussion, collaboration and consensus building, the three priority topics from each of the four small groups were aggregated into similar themes. This process resulted in four broad themes. As in any distillation and synthesis of broad themes, there were considered many ways to re-express, re-imagine and aggregate the four groups’ three highest priority topics as outlined in Table 1. The aggregation process of 12 themes resulted in four broad agreed themes as outlined in Table 2. Particular note was made that topics from Table 1 that were measurement-focused, including those relating to economics including cost benefit analysis and system performance (Priority 1 for Groups 1, 3 and 4), are enablers of other themes and so were not specifically included in the final four themes which participants then further prioritised. The results of the participants’ prioritisation process are outlined in Table 2.

Improving water productivity was clearly judged as the highest priority by the participants. This is not surprising, as it is a high-order objective under which many other topics nest. Variety selection for WUE came well down the priority list.

Table 2. - Forum priorities for SRA RD&A irrigation investments

<table>
<thead>
<tr>
<th>Priority</th>
<th>SRA RD&amp;A Irrigation Investments Themes</th>
</tr>
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</table>
| 1        | Improving water productivity (Grp 2 Priority 2)  
          | Includes from Table 1, Increased irrigation efficiency (Grp 1 Priority 2), Overcoming barriers to water use (Grp 2 Priority 1), and Water use efficiency – existing research (Grp 4 Priority 2) |
| 2        | Water use efficiency – new research  
          | Includes from Table 1, Variable rate irrigation (Grp 4 Priority 3), Automation (Grp 1 Priority 3) and Fully autonomous systems (Grp 3 Priority 3) |
| 3        | Irrigation platforms for improved irrigation (Grp 3 Priority 2) |
| 4        | Variety selection based on water productivity (Grp 2 Priority 3) |

In conclusion, as voiced by participants in the room, improving water productivity is not necessarily a topic requiring ‘blue sky’ research, the priority is for investment to ensure that proven profitable and productive irrigation management is adopted. It has been a focus for many years; however, it must be re-invigorated and the fundamentals of enhancing irrigation
and water use knowledge must be an area of focus. Some answers are needed sooner rather than later; there is a risk of losing growers without short-term gains.
### Appendix 1. Forum agenda

**Meeting Agenda**

**Date:** Tuesday 5 September 2017  
**Time:** 8.45am – 3.30pm  
**Location:** Clayfield-Albion Room Riverview Hotel, Kingsford Smith Drive & Hunt Street, Hamilton QLD 4007

**Purpose of Forum:** To collaborate and identify the highest priority irrigated sugar Research, Development and Extension / Adoption topics to inform future SRA investment

**Independent Facilitator:** Michael Williams – Michael Williams & Associates Pty Ltd

<table>
<thead>
<tr>
<th>1. Time</th>
<th>Items</th>
<th>Presenter</th>
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<tr>
<td>From 8.45am</td>
<td>Registration, Tea &amp; Coffee on Arrival</td>
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</table>
| 9.00am        | Welcome                                                              | Neil Fisher  
CEO - SRA                                    |
| 9.10am        | Purpose and context of forum                                         | Dr Michael O’Shea  
General Manager RFU SRA                        |
| 9.20am        | Forum agenda, introductions and opening discussions                  | Michael Williams  
Independent Facilitator                        |
| 10.15am       | Smarter Irrigation for Profit – other industries                     | Dr Guy Roth  
SRA RFP & Board Member                          |
| 10.30am       | Morning Tea                                                          |                                               |
| 11.00am       | Small group workshop: What are the highest priority irrigated sugar Research, Development and Extension / Adoption topics to inform future SRA investment? |                                               |
| 12.30pm       | Lunch                                                                |                                               |
| 1.30pm        | Presentations from small groups                                      |                                               |
| 2.10pm        | Views, discussion and identification of Forum’s priorities           |                                               |
| 3.10pm        | Distillation of key messages from Forum, where to from here and next steps |                                               |
| 3.30pm        | Thanks and close of workshop                                         | Michael Williams                              |
| 3.30pm        | Afternoon Tea                                                        |                                               |
### Appendix 2. Forum participants and allocation to small group discussions

<table>
<thead>
<tr>
<th>Name</th>
<th>Region</th>
<th>Affiliation</th>
<th>Organisation*</th>
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<tbody>
<tr>
<td><strong>Group 1 – Burdekin</strong></td>
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<tr>
<td>Aaron Linton</td>
<td>Burdekin</td>
<td>Grower</td>
<td>Burdekin</td>
</tr>
<tr>
<td>Alison Theobald</td>
<td>NA</td>
<td>Policy</td>
<td>DEHP</td>
</tr>
<tr>
<td>Guy Roth</td>
<td>NA</td>
<td>Management</td>
<td>SRA</td>
</tr>
<tr>
<td>Ian Davies</td>
<td>Burdekin</td>
<td>Advisor</td>
<td>Wilmars</td>
</tr>
<tr>
<td>Peter Gibson</td>
<td>Burdekin</td>
<td>NRM</td>
<td>NQ Dry Tropics</td>
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<tr>
<td>Rob Milla</td>
<td>Burdekin</td>
<td>Advisor</td>
<td>BPS</td>
</tr>
<tr>
<td>Russ McNee</td>
<td>Burdekin</td>
<td>Management</td>
<td>BRIA Irrigators Comm.</td>
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<tr>
<td><strong>Group 2 – Central</strong></td>
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<tr>
<td>Andres Jaramillo</td>
<td>NA</td>
<td>Advisor</td>
<td>SRA</td>
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<tr>
<td>Burn Ashburner</td>
<td>NA</td>
<td>Policy</td>
<td>CANEGROWERS</td>
</tr>
<tr>
<td>Drewe Burgess</td>
<td>Tableland</td>
<td>Advisor</td>
<td>CANEGROWERS</td>
</tr>
<tr>
<td>Felice Driver</td>
<td>NA</td>
<td>Management</td>
<td>SRA</td>
</tr>
<tr>
<td>Graham Harris</td>
<td>NA</td>
<td>Researcher</td>
<td>DAF</td>
</tr>
<tr>
<td>John Agnew</td>
<td>Central</td>
<td>Advisor</td>
<td>MAPS</td>
</tr>
<tr>
<td>Tony Buggeja</td>
<td>Central</td>
<td>Grower</td>
<td>Mackay</td>
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<tr>
<td><strong>Group 3 - Southern</strong></td>
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<tr>
<td>Joe Foley</td>
<td>NA</td>
<td>Researcher</td>
<td>USQ</td>
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<tr>
<td>Mark Hickman</td>
<td>NA</td>
<td>Management</td>
<td>QDAF</td>
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<tr>
<td>Michael O'Shea</td>
<td>NA</td>
<td>Management</td>
<td>SRA</td>
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<tr>
<td>Neil Fisher</td>
<td>NA</td>
<td>Management</td>
<td>SRA</td>
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<tr>
<td>Neil Kingston</td>
<td>Southern</td>
<td>Grower</td>
<td>Isis</td>
</tr>
<tr>
<td>Peter Russo</td>
<td>Southern</td>
<td>Miller</td>
<td>Isis Central Mill</td>
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<tr>
<td>Steve Attard</td>
<td>NA</td>
<td>Researcher</td>
<td>Agritech Solutions</td>
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<td><strong>Group 4 - Southern</strong></td>
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<td></td>
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<tr>
<td>Andrea Evers</td>
<td>NA</td>
<td>Communications</td>
<td>SRA</td>
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<tr>
<td>Andrew Chamberlin</td>
<td>NA</td>
<td>Policy</td>
<td>QFF</td>
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<tr>
<td>Andrew Dougall</td>
<td>Southern</td>
<td>Advisor</td>
<td>MSF</td>
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<tr>
<td>Geoff Inman-Bamber</td>
<td>NA</td>
<td>Researcher</td>
<td>Ex-CSIRO</td>
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<tr>
<td>Jeff Atkinson</td>
<td>Southern</td>
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<td>Maryborough</td>
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<tr>
<td>Mark Poggio</td>
<td>NA</td>
<td>Researcher</td>
<td>QDAF</td>
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<tr>
<td>Maurie Haines</td>
<td>Southern</td>
<td>Advisor</td>
<td>BSS</td>
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<td>Paul Nicol</td>
<td>Southern</td>
<td>Miller</td>
<td>Isis Central Mill</td>
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* BPS, Burdekin Productivity Services; BRIA, Burdekin River Irrigation Area; BSS, Bundaberg Sugar Services; DAF, Qld. Dept. of Agriculture and Fisheries; DEHP, Qld. Dept. of Environment and Heritage Protection; MAPS, Mackay Area Productivity Services; QFF, Qld. Farmers’ Federation; USQ, University of Southern Qld.

Peter Samson and Kim Jones (SRA Research Funding Unit) also attended but did not contribute to the small-group discussions.
Appendix 3. Introductions and initial discussion

These notes are compiled from participants’ statements in a ‘round the room’ introduction of every Forum participant, with each participant asked why they had given up their time to come to the day and what they hoped to get out of it.

In addition four participants (marked * below) were asked for more detail on topics chosen by the organisers.

(Advisor Burdekin) How to maximise sustainably the profit from a megalitre of water; can an answer be reached more efficiently by working across regions?

*(Grower Burdekin) In the Burdekin, water is the number 1 driver of productivity. Is heading down the line of automation, crop models and different types of systems including drip. It should be possible to automate and remove human error. The barriers to better irrigation practice are knowledge and understanding.

(Management Burdekin) Wants ideas that are sustainable but also affordable – it is not a hugely profitable industry.

(NRM Burdekin) Burdekin has a unique opportunity to meet water quality targets because it is fully irrigated.

(Policy) Interested in hearing barriers to adoption of better irrigation practices.

(Researcher) Interested in hearing industry’s priorities.

(Management) Can work that is being done in climate forecasting be used to improve irrigation, and can outcomes of the Forum be fed back into climate variability and forecasting RD&A projects?

(Advisor Tableland) Water is the main driver of production on the Tableland, top producers are irrigating well and poor producers are not irrigating properly. Have spent decades trying to get Tableland growers to use water productively, believe that varieties and their response to water should be looked at more closely.

(Grower Central) Water quality is the number 1 priority. Energy cost is the biggest reason for people not irrigating, efficiency is critical.

(Policy) Wants to see a link between water use efficiency and profitability, it is about cost benefit economics. Priority is more information based on actual measurements and change in on-ground behaviour.

(Advisor Central) Not all water allocation is used because cost of irrigating is seen as too high; however, some growers were not irrigating even before the current surge in energy prices. Need to use what information we have to convince growers of the value and profitability of sound irrigation.

*(Advisor) In delivering irrigation courses across the industry, the big question that comes across is how to irrigate, why and when? Need is for greater understanding of irrigation and greater adoption of known irrigation principles.

(Researcher) How can economics be embedded in possible RD&E projects?

(Advisor Burdekin) Irrigation is the number 1 driver of productivity in the Burdekin. The Burdekin now has a network of weather stations with data outputs available to all growers. Demand for irrigation advice is growing and more on-ground support is needed.
Industry is very diverse in terms of understanding of irrigation. Aim should be to get expertise from outside the sugar industry into sugar and vice versa. Connections could be better at the strategy level but it needs collaborative projects, not strategy documents.

* (Researcher) There is definitely diversity in the industry. Clearly a need for greater adoption but must also look to the future. Growers need tools that allow greater resilience in decision-making and to get the best result from limited water; decisions on when to irrigate are not simple. Also need to bring irrigation management into strategies for nutrient management and herbicide management, these high-priority topics are currently too compartmentalised.

(Management) SRA management will be looking for simple high-impact consistent ideas to come from the Forum to give strategic direction to SRA RD&A future investments.

(Grower Southern) Isis relies on irrigation. Some current irrigation systems are nearing end-of-life, what are the best options for infrastructure replacement? Answers are needed now, not in 2-3 years.

(Miller Southern) Delivery of a program to growers will be a challenge, one size does not fit all. Hand-holding is need for practice change, must have people on the ground.

(Researcher) Can see both good and bad irrigation events even on well-managed farms, due to human decision-making. A re-visioned irrigation system in the future would be autonomous to remove the human factor. In terms of adoption in sugar compared with other industries, there is a lack of excitement in the sugar industry as a whole – we need to get excitement back into the industry.

(Management) SRA Board is looking for two to three researchable questions from the Forum, to be undertaken by SRA or in partnership with others. Investment could be across the whole RD&A spectrum.

(Grower Southern) Maryborough is always short of water, interested in efficiency including use of new technologies, even as a proof-of-concept.

(Advisor Southern) Water and soil health are the biggest drivers of yield. Maryborough is particularly complex with a mix of soil types, topography and water sources.

(Communications) Wants to see what industry stakeholders need in terms of irrigation RD&A.

(Miller Southern) Sugar mills depend on throughput, climate is changing, wants growers to use available water and use it efficiently, and to be able to do this relatively simply.

* (Advisor Southern) Cost of irrigation can be reduced by reducing energy use or using an alternative energy source. Bundaberg is looking at potential crop productivity; if grower can reach maximum productivity then energy cost won’t be a problem. The Bundaberg program is based on demonstration. Need to integrate irrigation with rainfall to make best use of both, need to look at both irrigation systems and farm design. Renewable energy has a place but there are many variables to consider regarding its economics. Big opportunity is adoption – need to make decisions based on sound information.

(Researcher) Would like to see current knowledge being fully utilised.

(Policy) QFF is working with Ergon on energy audits to improve energy efficiency.
Appendix 4. Smarter Irrigation for Profit – other industries; Dr Guy Roth

Guy presented examples of technologies being used or researched in industries other than sugarcane to improve irrigation productivity.

In sugarcane, possibilities to improve irrigation practices could be grouped as:

- Opportunities to change practices or attitudes using existing knowledge and technologies (Extension/Adoption strategy)
- Increased understanding of soil-water-plant relationships (Development strategy)
- Investigation of new technologies (Research strategy)

Questions were then taken from Forum participants.

Q: will growers listen more to other growers?
   A: yes, but personal contact with people other than growers and case studies are also important.

Q: what was catalyst for changes in cotton industry, which is seen as an advanced industry?
   A: for cotton, water is critical and drought in 2007 (a crisis) sharpened focus.
   A: Murray-Darling Basin Plan also important.
   A: a lot more measurement (e.g. sensors) is being done in cotton than in sugarcane.
   A: cotton industry is young, every cotton farmer decided to be a cotton farmer and were all adopters by definition; in sugarcane, many farmers are descendants of sugarcane-growing families.

Key message from presentation: other industries have similar issues, the sugarcane industry can look beyond its own industry for guidance, research and adoption knowledge as well as assistance.
Appendix 5. Small group workshop

**Group 1 (Focus on Burdekin, fully irrigated farming system)**

*Emerging issues*

**Delta**
- Maintaining water levels (ground water)

**BRIA (Burdekin River Irrigation Area)**
- Rising ground water

**Both areas**
- Limited water allocations (e.g. 6-7 ML peak flow entitlement)
- Rising electricity prices
- Lack of measurement of water use (including unreliable metering in BRIA)
- Water-nitrogen relationships
- Nutrient uptake knowledge
- People’s knowledge of irrigation principles
- Inappropriate application volume: over-watering plant cane and under-watering ratoons
- Focus on surface irrigation
- Old infrastructure

*Opportunities (Prioritised from highest to lowest)*

1. Increased measurements: of soil moisture (including new sensors), runoff volumes, nutrients, $/ML
2. Increased irrigation efficiency, by limiting deep drainage and limiting run-off
3. Automation: application, drainage, measurement
4. Interaction between nutrients and irrigation
4. More demonstration sites
4. Increasing water-holding capacity of soils (e.g. using mill mud)
7. Refining water use information for different varieties: for incorporation in crop models for scheduling and to improve WUE by breeding
   - Knowledge to improve uptake: irrigation extension and knowledge package
   - New generation products
   - Green cane trash blanket options for furrow irrigation
   - Climate prediction integrated with irrigation system
   - Increased extension capacity

*Adoption strategies*

- On-farm measurement: benchmarking
- On-farm demonstration network: broad, multiple local sites representative of (for example) soil types
- On-going support for the scheduling tool IrrigWeb
- Farmer-managed section:
  - Demonstration of new technology
  - IrrigWeb
- What’s in it for the grower?
- How to make technology work on site
Group 2 (Focus on supplementary irrigation, especially Mackay)

Table ideas

- Review status quo and identify knowledge gaps; make best use of available knowledge:
  - Benchmark practices at regional level
  - Understand yield variability and irrigation management impacts
  - Identify key regional practices that are successful
  - Identify barriers to adoption by some growers, e.g. cost impediments and equipment age
  - Identify return on investment of practice change and production benefits
- Role of variety selection in context of soil type and climatic conditions
  - Variety selection for WUE
  - Local variety trials
- Value proposition of efficiently using water
  - Demonstration farms to measure/showcase impacts of optimised practice
  - Value of using full water allocation
  - Demonstrate water productivity and profitability (e.g. tonnes and $ per ML)
- Adoption
  - What are barriers to change?
  - How to manage irrigation in a water limited situation, given the climate/weather signal
  - More expertise on the ground to conduct audits (when, how, why)
  - Nodes for change (similar to RP20 project and soil health project)
  - Grower action learning sites, integration of complex information and decision making
- Sustained investment and support needed over time; willingness of growers to pay for services?
- Productivity target
  - How to grow 200 t/ha consistently and identify irrigation (and farming system) to achieve that
  - Integration of information: maps of soil, topography, hydrology and Plant Available Water Capacity, climate forecasts
  - Variable rate irrigation and technological solutions to manage energy costs and labour inputs
- Measure and monitor to manage
  - Identify strengths and weaknesses to give direction and set targets

Opportunities (Prioritised from highest to lowest)

1. Overcoming barriers to water use
2. Improvements in water productivity (energy x water x technology nexus)
3. Variety selection based on water productivity

Group 3 (Focus on supplementary irrigation, especially Southern districts)

Table ideas

- Irrigation vs. energy: improve efficiency of existing systems (e.g. different pump) or replace with new system
Requires advice, how to optimise existing system, how to replace with appropriate new system (not just cheapest system)

- What is the value proposition?
  - Strategic irrigation
  - Benchmark as productivity per ML or per MW
  - Why/when/how, including assessment of risk (running out of water); the value proposition

- Adoption/Education: needed now
- Water/soil interactions
- Varieties:
  - Terms, ‘Water Use Efficiency’ vs. ‘Water Productivity’
  - Data on canopy closure, transpiration efficiency etc. for crop models
- Models using current tools, link to forecasting; education resource and for strategy development
- Automation

**Opportunities (Prioritised from highest to lowest)**

1. An adoption/education resource
   - Lift background knowledge
   - Train industry people
   - Provide advice on irrigation system design, irrigation strategy, and economics (the value proposition)
   - Target growers, advisors, resellers, R&D personnel
   - Includes systems thinking, benchmarking and risk management principles

2. An irrigation platform
   - Access data for decisions: moisture, weather forecast, climate forecast, satellite imagery etc.
   - Develop models and tools: farm management, irrigation decisions (how/why/when to irrigate), risk strategies (if irrigation is delayed, if it doesn’t rain, if water allocation is exhausted)

3. Research: what is next?
   - Autonomous systems
   - Variety interactions
   - Water and soil interactions and sensing systems
   - Crop sensors
   - Any other new technologies?

**Group 4 (Focus on supplementary irrigation, especially southern districts)**

**Issues**

- Water use: are we up to date, is the research known by industry and growers?
- Adoption process: should focus on water saving, not cost of energy
- High pressure is dead: what are the options, depending on topography etc.
- Don’t rule out flood irrigation; cheap and easy, could it be more efficient?
- Drip irrigation: how to optimise investment
- Automation
- Fertigation
- The best avenue for adoption is demonstration
• Need cost/benefit analyses: what suits?
• Variable rate irrigation: thermal imaging and link thermal image to crop model, develop Plant Available Water Capacity (PAWC) maps
• Growers don’t have confidence in weather/climate forecasts
• Environmental: ground water and reef
• For limited water, need 6 month rainfall forecast, PAWC relevant (and can change as crop grows and roots penetrate more deeply)
• Full irrigation: need to understand water requirements for efficiency, what about lodged crops, older ratoons?
• Feed it: benefits are amazing!
• Irrigation system is biggest single investment, growers not sure what system to use

Key Topics
• Adoption/demonstration/extension
• Water Use Efficiency:
  o Getting the most out of water (based on profitability), optimise based on region
  o What is known, where do I find it?
  o New research: technology, thermal mapping, variable rate
• Measurement:
  o Agronomy and profitability
  o Optimising capital, economics of change
  o Technical skills, knowledge to make changes
  o Farm layout
  o Climate forecast
  o Environmental impact
• Varieties for full irrigation
• Varieties for dry conditions

Opportunities (Prioritised from highest to lowest)
1. Measurement: agronomy and profitability, economics
   o Irrigation is the single biggest investment on the farm. Growers must decide what decisions to make.
   o Growers need to better utilise existing systems, understand each system and profitability.
   o Productivity, water and energy cost should be demonstrated based on good data.
2. Water use efficiency: making use of current knowledge
   o Need to get the most out of water, WUE should be optimised based on region.
   o More studies need to be done on better ways to use existing systems: pivot, drip, flood (perception is that it is inefficient, can it be made more efficient)?
3. Water use efficiency: new research
   o Variable rate irrigation based on PAWC (from thermal imaging) and crop models.
4. Measurement: optimising of capital, technical skills, environment
5. Knowledge of the crop: water use by older ratoons and lodged crops, varietal differences in water use
   – Adoption and on-farm demonstration
   – Farming systems to better suit water management needs