The economics of automated high flow irrigation in sugarcane

Burdekin Irrigation Project
Increasing industry productivity and profitability through transformational, whole of systems sugarcane approaches that deliver water quality benefits

Burdekin Irrigation Project
Making irrigation work for you

This publication has been compiled by Edward Vaggelas of Regional Economic Development, Department of Primary Industries.

The Department of Primary Industries proudly acknowledges all First Nations peoples (Aboriginal peoples and Torres Strait Islanders) and the Traditional Owners and Custodians of the country on which we live and work. We acknowledge their continuing connection to land, waters and culture and commit to ongoing reconciliation. We pay our respect to their Elders past, present and emerging.

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Summary

This case study evaluates the economic impact of irrigation changes trialled as part of the Burdekin Irrigation Project (BIP). The control reflected the grower's conventional, manual irrigation management on the farm.[1] This was compared to a high flow automated irrigation (HFAI) system. This study considers the economic aspects of each system and incorporates agronomic and environmental information provided by BIP project partners.

Overview of the project site

Compared to intensive manual management of irrigations, the automated system reduced irrigation labour requirements. It allowed for irrigations to be remotely controlled and analysed through the Farm in ONE software and IrrigWeb software.

The implementation of the HFAI system enabled the shift from a standard flow, 24hr 'rigid' irrigation schedule to a high flow 'dynamic' irrigation schedule that resulted in reduced total season irrigating time and water usage.[1] This site had various equipment installed, including automated T-piece valves, end of furrow soil moisture sensors, a logging rain gauge, and more.[2]

Key findings (plant cane crop)

Irrigation variable cost changes

Expected variable costs for the HFAI treatment were $440/ha less than the control in the plant crop. This shifts to $213/ha less than the control when irrigation labour savings are not considered.

Production results

Plant crop results suggest (in the absence of statistical analysis) that the HFAI treatment maintained similar production to the control, whilst reducing total volume of applied water by 35%, or 5.4ML/ha.

Net return

When accounting for production results and differences in cash costs (e.g. harvesting costs, variable irrigation costs and software subscription fees), the average net return for the HFAI treatment was $599/ha (11.0%) higher than the control.

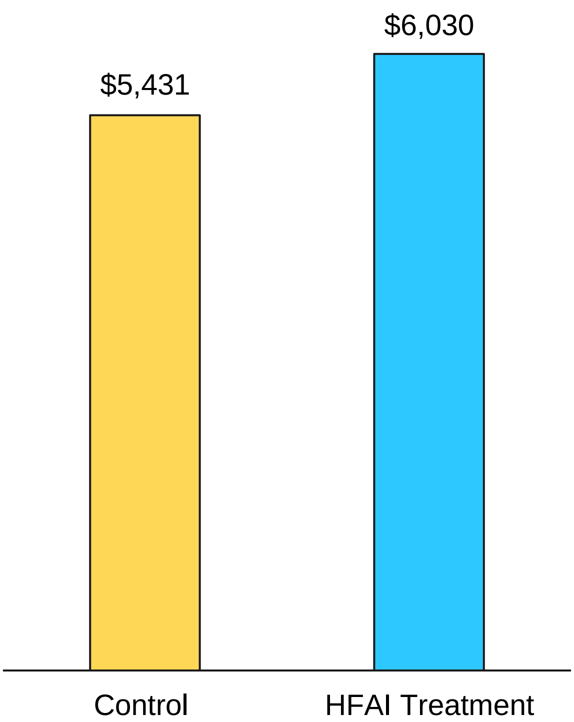

Figure 1 Trial plant crop net return ($/ha)

[1] There were two replicates each for the control and treatment (not randomised). Whilst the whole trial site was automated, the irrigation events for the control were scheduled to reflect conventional, manual irrigation management (and the economic analysis of the control factors in this standard approach).

[2] Recorded trial irrigation data as well as typical economic and farm management data (supplied by the grower) was entered into the Farm Economic Analysis Tool (FEAT) https://featonline.com.au/ and factored into the economic analysis. While a recycle pit was not utilised for the trial area, in order to reflect the farm's typical situation, it is factored into the expected costings reported in this study.

How did irrigation costs change?

Compared to the control, the HFAI treatment resulted in reductions in the number of irrigation events, in the amount of water applied and in the irrigation labour requirements.
Although the HFAI treatment had additional expected repairs and maintenance (R&M) with the upkeep of solar panels, actuators, and batteries, other R&M costs reduced due to a reduction in total irrigation time.

This meant that there was little difference in overall R&M costs, relative to the control.
Expected HFAI variable cost savings of $440/ha (plant crop) including irrigation labour savings (or $213 if labour is not considered) are partially offset by increases in fixed costs of $113/ha (plant crop) relating to subscription fees of the Farm in One software ($17/ha) and HFAI equipment depreciation ($96/ha).[3]

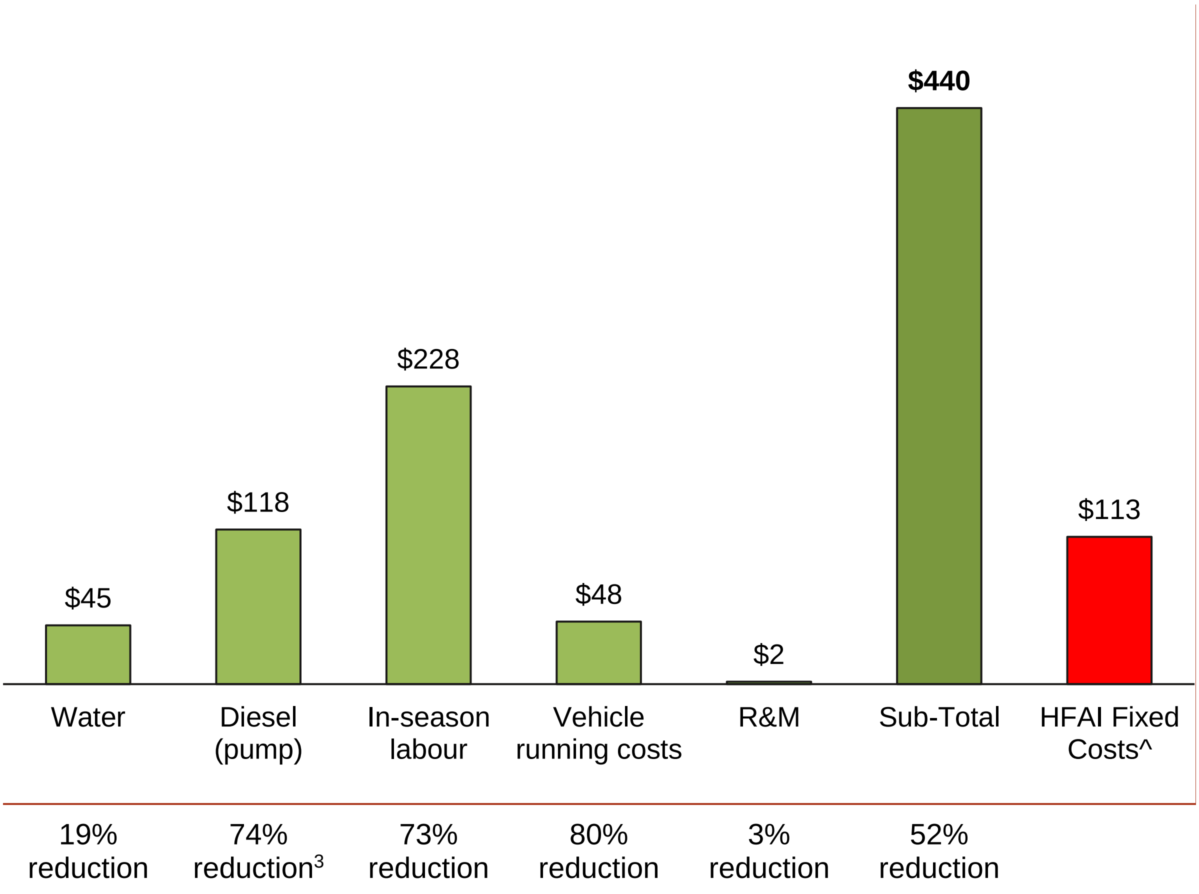

Figure 2 Differences in HFAI treatment irrigation costs, relative to control (plant crop)

Note: In Figure 2, $/ha/crop and % reductions are relative to the control's variable irrigation costs. Cost reductions (i.e. savings) are shown in green. Increases in fixed costs are shown in red.
^The HFAI Fixed Costs incorporate depreciation and a recurring software subscription cost.

[3] The depreciation cost is based on HFAI capital expenditure of $72,300 across a 132-ha farm, and assuming full depreciation after a seven-year useful equipment life.

How were irrigations different for the HFAI system?

During the plant crop, the gravity fed water source remained the same for the control and the HFAI treatment.[4] In the HFAI treatment, however, smaller areas were irrigated at a time, increasing the flow rate per furrow.

Each irrigation ‘event’ for the control involved irrigating around 120 furrows per set, while each ‘event’ for the HFAI treatment involved two rounds (i.e. sub-events) of 60 furrows per set. The HFAI irrigations depended on a dynamic, tailored crop irrigation schedule that determined when irrigations should occur based on soil moisture deficits reaching a pre-defined threshold.

This enabled reductions in water applied, in irrigating time and in the number of irrigation events, relative to the control (Table 1).

Table 1 Irrigation management aspects (plant crop)

Irrigation aspect	Control Standard system	Treatment HFAI system	Change[3]
Flow rate per furrow	~0.95 L/s/furrow	~1.55 L/s/furrow	~0.6 L/s increase
Total irrigation events	**24 events**	**15 events**	**9 events less**
Via channel system[5]	17 events	14 events	3 events less
Via recycle pit[5]	7 events	1 event	6 events less
Total applied irrigation	**15.4 ML/ha**	**10.0 ML/ha**	**5.4 ML/ha less**
Via channel system[5]	10.8 ML/ha	8.8 ML/ha	2.0 ML/ha less
Via recycle pit[5]	4.6 ML/ha	1.2 ML/ha	3.4 ML/ha less

[4] In order to better reflect the farm’s typical situation, a recycle pit water source (with a diesel pump) is factored into the expected cost changes that are explored in this study (Figure 3).

Was there an impact on production and revenue?

The plant crop production results suggest (in the absence of statistical analysis) that the HFAI treatment maintained similar production to the control (Table 2).[5] Based on the provided production results, the grower revenue (referring to revenue minus harvesting and levies) for the HFAI treatment is $161/ha higher than the control (Table 2 and Figure 4).

Table 2 Production and grower revenue results (plant cane crop)

	TCH	CCS	TSH	Grower Revenue[6]
Control				
Replicate 1	134.2	15.0	20.1	$6,346/ha
Replicate 2	132.9	14.9	19.8	$6,208/ha
Simple Average[2]	**133.5**	**14.9**	**19.9**	**$6,277/ha**
Treatment (HFAI)				
Replicate 1	133.5	15.1	20.1	$6,354/ha
Replicate 2	131.8	15.4	20.3	$6,518/ha
Simple Average[2]	**132.6**	**15.2**	**20.1**	**$6,436/ha**

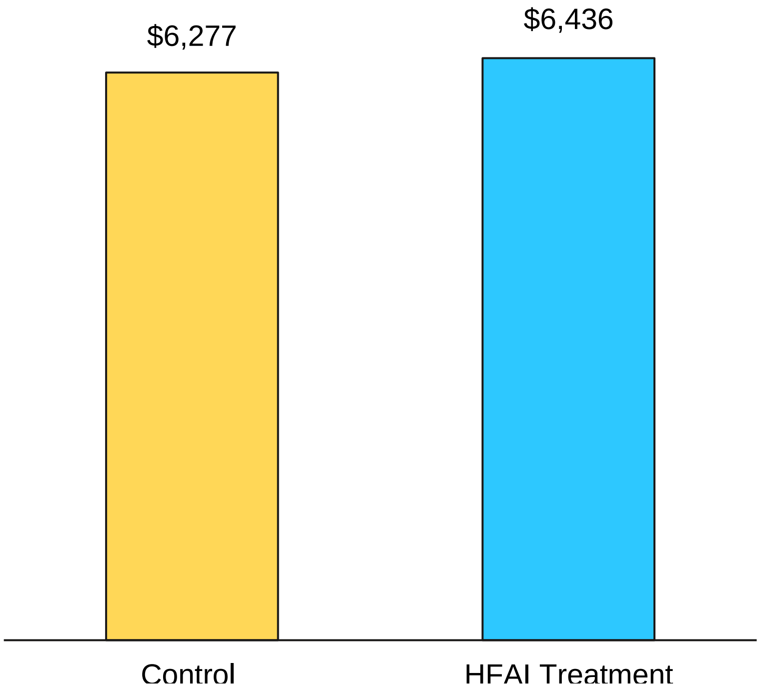

Figure 3 Plant cane crop average grower revenue results ($/ha)

Given farm specific circumstances and seasonal conditions can influence production and economic outcomes, some additional information is provided in table 3.

[5] Simple averages of replicate results are presented in table 2. The trial is not randomised and a statistical analysis has not been undertaken to explore whether there was a statistically significant difference in the results.

[6] Grower revenue is based on a sugar price of $559/t Net IPS and calculated by deducting harvesting costs and levies from revenue.

Overview of trial information and parameters

Table 3 Trial information and study parameters

Trial crop class

Plant cane (Q240-P)

Rainfall information

1,410mm at the site (15-month crop)

1,128mm at the site (Adjusted to 12 month, annual basis)

Compared to, Bureau of Meteorology (BOM) Clare station

- Long-term annual median of 882mm (1896-2014)
- Long-term annual average of 840mm (1896-2014)

Region

Burdekin River Irrigation Area (BRIA)

Trial site farm distance from base farm

7km travel each way (14km return trip)

Farm water source 1

Gravity fed SunWater channel system

Farm water source 2

Diesel pump recycle pit system[2]

Other information

The trial farm (132 ha) has ~700m row lengths (uniform across the farm, given its rectangular shape). The total trial area (25.35ha) included a HFAI treatment area of 12.73 ha (approx. 120 furrows) split into two replicates (and a similar area for the control, split into two replicates).

Image 2 BIP equipment at a project site in the Burdekin Region

What about the environment?

The trial site was equipped with sensors that measured paddock run-off. The provided data indicates a 34% reduction in the load of dissolved inorganic nitrogen (DIN) load in the HFAI treatment runoff water, relative to the control (Table 4).

Table 4 Trial (plant cane) cumulative DIN load measurements

Control DIN load	4.10 kg/ha
HFAI DIN load	2.69 kg/ha
HFAI DIN load reduction	**1.41 kg/ha (34% less)**

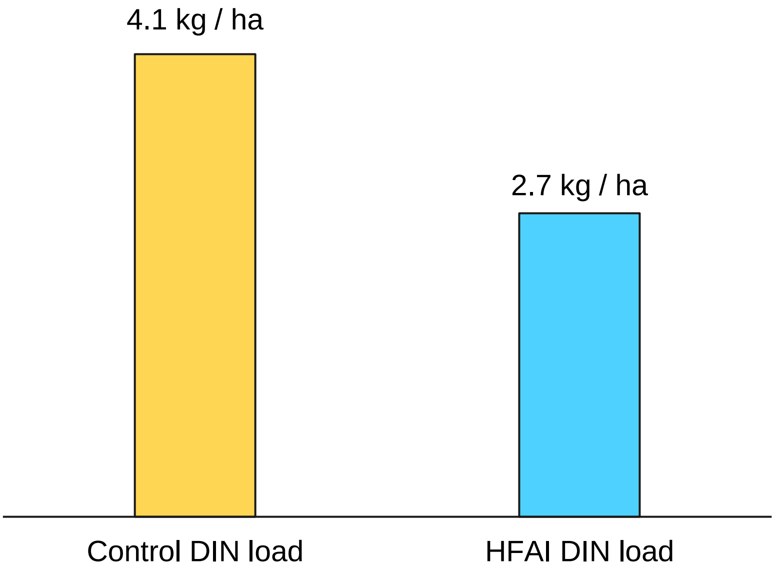

Figure 4 Trial (plant cane) cumulative DIN load measurements

What else can be considered?

This study analysed plant cane crop data, and future studies could investigate other aspects of the implementation of the HFAI system on this farm, such as:

a. Results across ratoon cane crops and any fallow crops (i.e. production, economic and environmental results).

b. A full investment analysis of this farm's implementation of a HFAI system (investigating if the HFAI system would be worthwhile to the grower from a whole-of-farm perspective).

c. The sensitivity of economic results to any changes in key variables, such as production.

d. Potential or expected efficiency gains or other benefits after implementation the HFAI system and grower insights.

For further information on the economics included in this publication, please contact the Townsville DPI office on 13 25 23. For further information on BIP project activities in the Burdekin region, please contact Terry Granshaw, Sugar Research Australia (SRA) on 0457 650 181.

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The Farm Economic Analysis Tool (FEAT Online) was utilised to analyse results. Each farming business is unique in its circumstances and therefore the parameters and assumptions used in this study are only intended to reflect the situation of the specific trial and farming enterprise. Consideration of individual circumstances must be made before applying the findings of this study to another situation.