Assessing the economic benefits of supplementary irrigation - Central Region QLD

KEY MESSAGES

- Opportunities to optimise plant available water through irrigation occurs more frequently in September, October, November and December – early in the growing season.
- **The economic impact of additional 1 ML/ha irrigation was negligible when a 3 t/ha additional yield resulted. Return on Investment increased rapidly when crop yield response to irrigation exceeded 6 t/ha additional yield benefit.**
- The price of sugar does impact on the marginal benefit of applying additional irrigation water under current energy pricing scenarios. When sensitivity tested, a high energy price and a low sugar price combination resulted in a negative crop Gross Margin (GM) outcome.
- Assuming a 37-kW pump size and a reduction in annualised cost of energy from a solar PV install, the marginal benefit of applying irrigation water showed the greatest gain in crop GM and the highest resilience to sugar cane price fluctuations.

High energy prices and sub-optimal irrigation application

Energy is one of the fastest growing costs for irrigated sugarcane growers, with electricity from pumps accounting for a significant portion of total farm input costs. In Queensland, electricity costs have increased by approximately 400% since the year 2000. Inflation over the same period has been around 45%.[1] In the Central Region around Mackay, supplementary irrigation occurs at various times throughout the season and irrigation water is often relied upon early in the crop development stage until monsoon rains arrive. Industry and advisor feedback suggest high energy prices have stifled timely use of irrigation water, at the expense of sugar cane yield and cane gross margins.

Figure 1 shows a simple Co-efficient of Variation (CoV) test on growing season rainfall from 1996-2020, found January and February to have the largest monthly rainfall totals (line graph) and highest reliability (lowest CoV values – blue bars) from the September to March growing period. With smaller, less reliable monthly totals occurring in Sep/Oct/Nov, crop moisture deficits and yield penalties are most likely to occur in the first half of the growing season. With these findings in mind, the next section investigates the economic outcomes associated with applying additional irrigation water in the Central Region.

[1] https://www.irrigators.org.au/wp-content/uploads/2018/03/NIC_Submission_Energy_Green_Paper_FINAL_4_Nov_2014.pdf

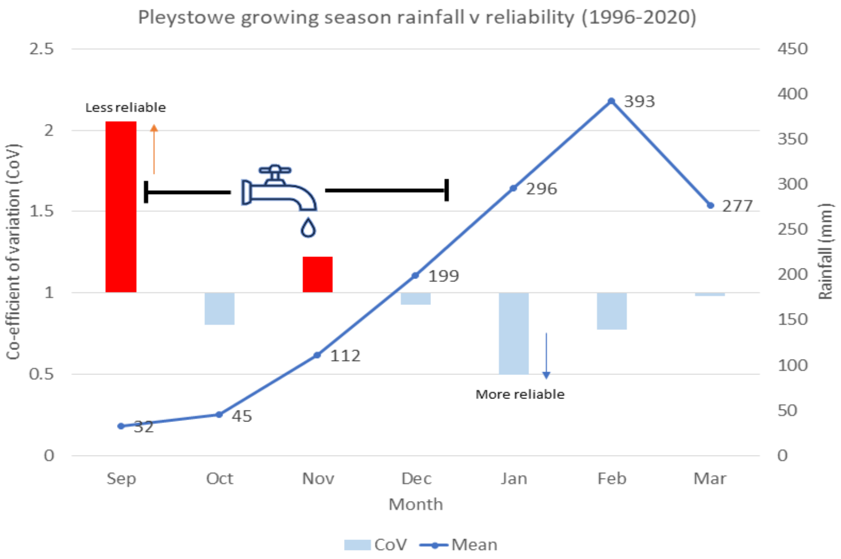

Figure 1 Pleystowe (Central Region) rainfall reliability analysis (red and blue bars) vs monthly rainfall totals (line graph) over the period 1996-2020.

Gross Margin sensitivity yield analysis – applying an additional 1 ML/Ha

To model the impact of an additional 1ML/Ha, the crop Gross Margin (GM) was calculated to identify the contribution to farm total GM and the Farm Economic Analysis Tool (FEAT) was used to investigate the economic outcomes of additional irrigation water[2]. A custom-built GM model for the Central cane growing region around Mackay was used to further refine the analysis, benefitting from prepopulated regional data, developed in consultation with industry advisors.

The baseline production assumptions are summarised below.

Table 1 Central Region sugarcane Gross Margin baseline assumptions

Water Use = 2 ML/Ha	**37 KW Electric pump**	**R&M Irrigation = $16 /ML**
Big Gun irrigation	**Pumping day (20%) night (80%)**	**Water charges = $16.26 /ML**
Sugar Price (IPS) = $400[3]	**Time of Use energy rates Day = 31 c/kWh Night = 17 c/kWh**	**Labour = $35/hr**

To estimate changes to crop GM with an additional 1 ML/Ha applied, a sensitivity analysis was undertaken to better understand economic impacts. The relationship between resources used in production (in this case water) and the production which results (output – sugar cane yield) is called a response function. Irrigation yield response data from SIP 2 research[4] was used to derive an irrigation/yield response function showing a range of outcomes, dependent on current individual soil and rainfall plant available water. In this example, analysis undertaken assumed four separate yield responses from a constant irrigation amount – 1 ML/Ha. These yield responses attempt to capture what may occur when additional water is applied. The yield responses are a function of timing, access to nutrients, plant growth stage etc. on an individual field. Changes in crop GM and subsequent Return on Investment (%) from new costs incurred was calculated to establish the marginal benefit of this practice change.

[2] https://www.daf.qld.gov.au/business-priorities/agriculture/plants/crops-pastures/sugar/farm-economic-analysis-tool
[3] https://www.msfsugar.com.au/2020/10/20/pool-price-market-update-october-2020/#:~:text=As%20at%20the%201st%20of,from%20the%20August%20Advance%20value.
[4] Scobie, M. (2020) Pers. Comms. Sugarcane crop water production function. Received via email 16 Oct. 2020.

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Sensitivity testing sugar cane and energy prices with 1 ML/ha additional irrigation

The higher the cane yield response, the higher the ROI from additional water applied.

Further analysis was undertaken to test the sensitivity of sugar cane price and energy tariff structure and energy prices under a generic assumption of a 10 t/ha irrigation yield response (additional 1 ML/ha). The results found the model was indeed sensitive to various combinations of sugarcane price, energy rate and tariff configuration. The energy tariffs applied reflect various iterations of Tariffs 20[5] (T20 - flat rate), Tariff 22 (T22: time of use – TOU) and a reduced annualised energy rate, assuming the addition of a 39 kW solar PV array, based in previous SRA research[6]. This is an average rate based on solar PV energy blended with grid tariff whilst achieving a Feed-in-tariff.

The analysis found a flat rate tariff, similar to T20 concurrently with a low cane price ($380) delivered the greatest exposure to economic losses. An inflated pricing of T22 under the current model was negative or close to break-even (red shading), under the lowest sugarcane price scenario ($380). As sugar cane price increased, so too did the marginal benefit of applying irrigation water. As energy prices eased, reflecting a lower marginal cost of pumping – per hectare gross margin responded positively (green shading), with the low-cost solar option turning a profitable gross margin at even the lowest sugar cane price. It should be noted that daytime energy usage profile will impact results (and has not been considered in this analysis). Table 2 provides a summary of the sensitivity results.

Table 2 sensitivity test results of combined per hectare economic ($/ha) Gross Margin response, assuming 10t ha sugarcane yield increase from an additional 1 ML/ha irrigation water applied.

		Energy price configuration			
		Flat 26 c/kWh	TOU 36/20c kWh	TOU 31/17c KWh	Solar 15c/kWh
Sugar cane price (IPS)	$380	-$37	-$2	+$40	+$124
	$390	+$45	+$80	+$121	+$205
	$400	+$127	+$161	+$203	+$286
	$410	+$208	+$243	+$286	+$368
	$420	+$290	+$324	+$367	+$450

Assuming a 37 kW pump size and a reduction in annualised cost of energy from a solar PV install, the marginal benefit of applying irrigation water showed the greatest gain in crop GM and the highest resilience to sugar cane price fluctuations.

For information on the SIP 2 Program research visit https://smarterirrigation.com.au/ or contact Sugar Research Australia.

For more information on this economic analysis, please contact Jon Welsh, Principal Economist at Ag Econ, through jon@agecon.com.au.

[5] https://www.ergon.com.au/retail/business/tariffs-and-prices/small-business-tariffs
[6] https://research-repository.uwa.edu.au/en/publications/can-applying-renewable-energy-for-australian-sugarcane-irrigation

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