# Implications for sugarcane nutrient management following a green manure crop of sunn hemp – an economic analysis

Queensland Government

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*The Department of Agriculture and Fisheries 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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# Introduction

This report presents an economic analysis of the results of a field trial established through a partnership between DAF, SRA and a sugarcane grower located in Aloomba, approximately 30km south of Cairns. The aim of the trial is to investigate the impact of different nitrogen rates in plant cane following a sunn hemp legume fallow crop. Data from replicated and randomised strips are used to compare the economic efficiency of applying nitrogen (N) at the rate of 120 kilograms per hectare (the SIX EASY STEPS recommended application rate) with no legume discount and N applied at 60 and 28 kilograms per hectare. The results have so far been compiled for a plant crop.

# Methodology

The economic analysis applied in this report aims to encompass all variables influencing the profitability of each N treatment, focusing on the plant cane crop (and assuming all other factors relating to the sunn hemp fallow and plant cane crop were held constant across all treatments). The analysis considers plant cane revenue, fertiliser costs, harvesting costs and levies. Key aspects include:

- Gross cane revenue calculation: Grower cane revenue is computed as an average at the plot (replicate) level using the cane payment formula[1]. This includes relative CCS and cane yield values sourced from mill data and utilises a five-year average sugar price[2] of $463 per tonne (net IPS) to determine revenue per tonne of cane.
- N treatment costs[3]: Costs related to N treatment are determined from the price of urea, encompassing delivery and application costs. Other nutrients apart from N are excluded from the calculation.
- Harvesting costs and levies[4]: Harvesting costs are derived from the site's regional cost, including GST and fuel expenses. Levies in this calculation encompass ACFA and SRA levies. The analysis assumes that all other variable costs (e.g., cost of growing sunn hemp, pest control, etc) remain the same for each fertiliser treatment.

To determine the grower economic benefits in this report, the net revenue calculations from different N rates are compared, with the highest of the net revenue deemed to have the greatest economic benefit. The formula used in this report for net revenue is as follows (and includes fertiliser product costs):

*Net revenue (Dollars per Hectare, $/ha) =*
*Gross revenue ($) – Nitrogen costs ($/ha) – Harvesting costs ($/ha) – Levies ($/ha)*

*Note that nitrogen costs ($/ha) include application costs and not just the product.*

[1] Cane payment formula = sugar price x 0.009 x (CCS – 4) + mill constant. Mulgrave mill constant is used for the calculation.
[2] $463 is the five-year average sugar price (Net AUD/tIPS) for the Mulgrave Collective Forward Pricing Pool between 2018-2022.
[3] Based on urea price of $750/t including delivery and application costs (ASQ 2023).
[4] Based on the harvesting cost and levies of $10.81/tc. (MSF Sugar 2023).

# Results

| Nitrogen Fertiliser Applied and Production Summary | | | |
|---|---|---|---|
| **Treatment** | **28 kg (N/ha)** | **60 kg (N/ha)** | **120 kg (N/ha)** |
| Urea (kg/ha) | 60.9 | 130.4 | 260.9 |
| Urea ($/ha) | $45.65 | $97.83 | $195.65 |
| Average Cane Yield (TCH) | 133.0 | 139.0 | 142.0 |
| Average Relative CCS^ | 11.0 | 10.7 | 10.7 |
| Average Sugar Yield (TSH)^^ | 13.3 | 13.6 | 13.9 |

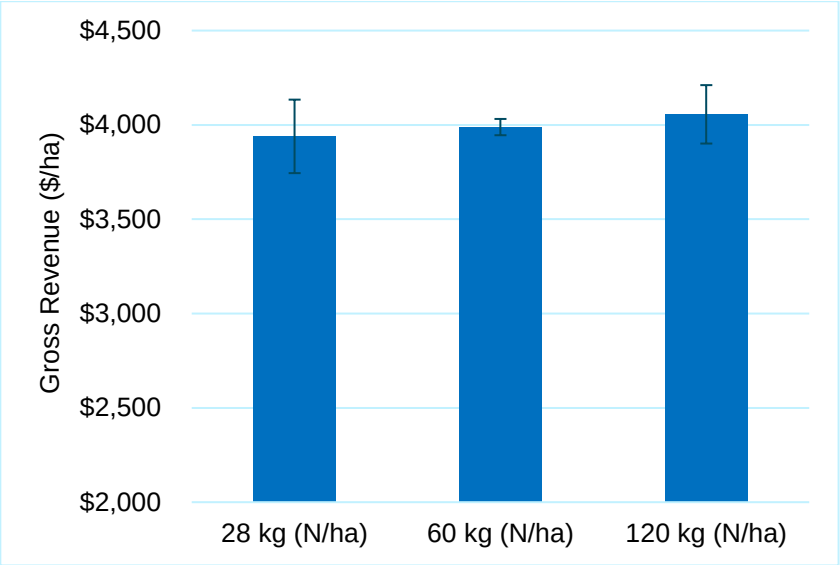


**Figure 1** Gross Revenue - mean and standard deviation for each treatment

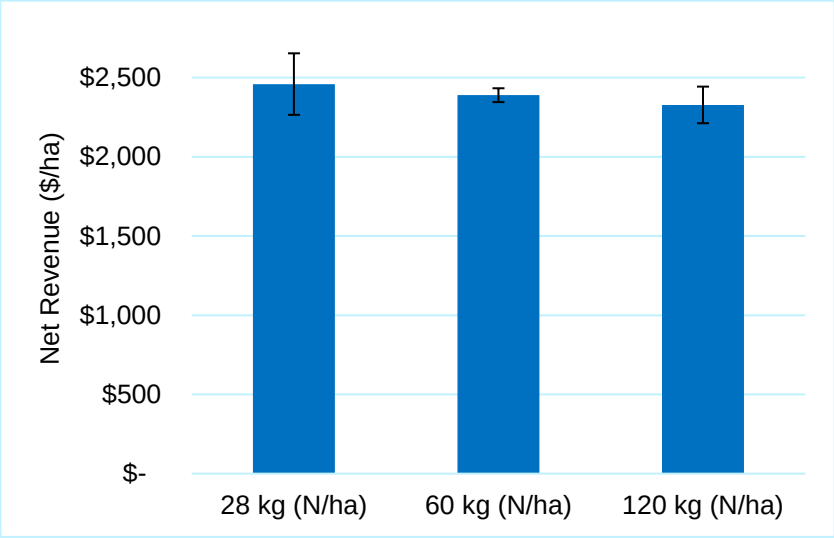


**Figure 2** Net Revenue - mean and standard deviation for each treatment

^ Average relative CCS values are used in this economic analysis and are linked to the cane payment formula. These relative CCS differ from the actual CCS.

^^The average sugar yield (TSH) shown in the table is based on actual CCS. Sugar yields are not used in the calculation of the economic results.

The results depict varying financial outcomes across different nitrogen treatments. Notably, the 28 kg (N/ha) treatment yielded the highest net revenue, surpassing both the 60 kg (N/ha) and 120 kg (N/ha) treatments.

Despite showing the highest gross revenue, the 120 kg (N/ha) treatment appeared to be the least profitable among the treatments due to higher N treatment costs.

Conversely, the 28 kg (N/ha) treatment, although exhibiting slightly lower gross revenue, achieved the highest net revenue. This treatment demonstrated improved profitability and cost-effectiveness. With a net revenue of $2,459/ha, the 28 kg (N/ha) outperformed the 60 kg (N/ha) and 120 kg (N/ha) treatments by $70/ha and $131/ha, respectively.

Considering the trial results and input costs, the 28 kg (N/ha) treatment emerges as the most financially viable option, providing the highest net revenue among the N treatment trial rates. These results indicate that there is no evidence across these replicates of a consistent positive relationship between the rate of N fertiliser applied and profitability following a sunn hemp legume fallow crop. Please refer to the appendix 1 for the complete results.

## Statistical Analysis

Statistical analysis was conducted, at the 0.05 level, on the net revenue values for the three nitrogen rates, revealing no significant difference between the treatment rates ($F(2,4) = 1.93$; $p=0.259$). The table below displays the results of the analysis.

**Table 1** Statistical Analysis for the three nitrogen rates

| **Rate (N/ha)** | **Mean** |
|---|---|
| 28 kg | 2459 |
| 60 kg | 2389 |
| 120 kg | 2327 |
| $F_{(2,4)}$ | 1.93 |
| p-value | 0.259 |
| se | 47.4 |
| 95% lsd | 186.0 |

## Sensitivity Analysis

Economic results can be sensitive to changes in key drivers, such as input costs and sugar price. The sensitivity of the mean net revenue results (simple average) to changes in fertiliser costs and sugar price is explored below.

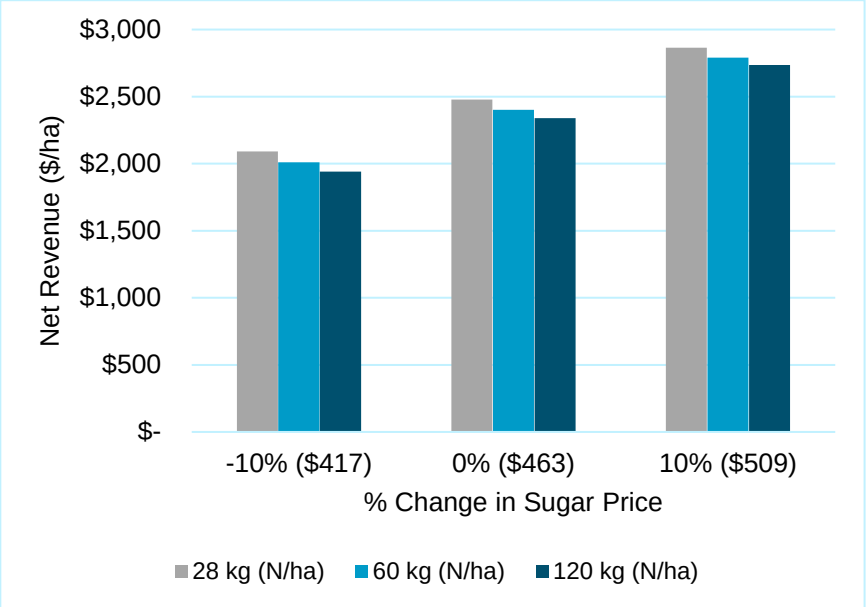


**Figure 3** Sensitivity of average net revenue to change in sugar price

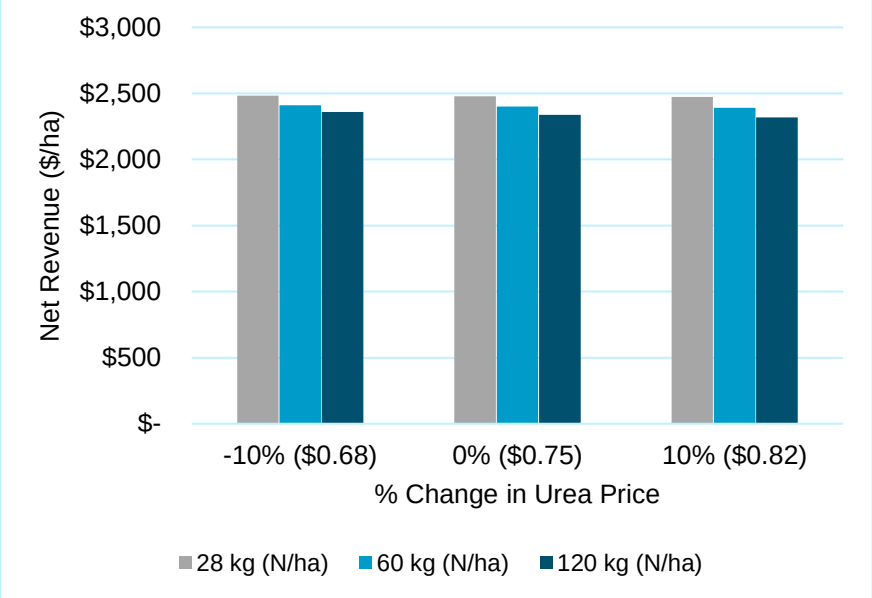


**Figure 4** Sensitivity of average net revenue to change in urea cost

The analyses suggest that variations in both sugar price and urea cost do not change the most profitable treatment outcomes (when simple averages are compared). In both cases, the 28 kg (N/ha) treatment consistently emerges as the option with the highest net revenue. Notably, the impact on net revenue from urea price movement is more prominent in 120 kg (N/ha) treatment, ranging from $2,319/ha to $2,358/ha with a +/- 10% movement in urea price, due to higher urea usage rate compared to other treatments. As expected, the higher the urea price, the better the relative performance of the lower N rate treatments. Please refer to the appendix 2 for the complete results.

## Conclusion and Future Analysis

This report analyses the results of replicated and randomised strip trials, comparing the economic efficiency of several nitrogen rates applied at 28, 60 and 120 kg (N/ha) following a sunn hemp legume fallow crop. Data has been compiled for the plant crop cycle and the net revenue results for the crop in this case study do not show statistically significant differences between trial treatments. A comparison of the trial treatment means tentatively suggests that the lower nitrogen rate application may result in higher net revenue, largely due to fertiliser cost savings. Future analysis will be conducted incorporating first and second ratoon results to better understand the overall economic performance of the trial treatments.

# Appendices

**Appendix 1** Average cane yield, average CCS, average sugar yield, gross revenue, costs, and net revenue for plant crop cycle

| Treatment | 28 kg (N/ha) | 60 kg (N/ha) | 120 kg (N/ha) |
|---|---|---|---|
| Urea (kg/ha) | 60.9 | 130.4 | 260.9 |
| Urea ($/ha) | $45.65 | $97.83 | $195.65 |
| Average Cane Yield (TCH) | 133.0 | 139.0 | 142.0 |
| Average Relative CCS^ | 11.0 | 10.7 | 10.7 |
| Average Sugar Yield (TSH)^^ | 13.3 | 13.6 | 13.9 |
| Avg Gross Revenue ($/ha) | $3,939 | $3,988 | $4,056 |
| *less* Harvesting Cost ($/ha) | ($1,327) | ($1,389) | ($1,418) |
| *less* Levies ($/ha) | ($108) | ($113) | ($115) |
| *less* Urea Costs ($/ha) | ($46) | ($98) | ($196) |
| Avg Net Revenue ($/ha) | $2,459 | $2,389 | $2,327 |

**Appendix 2** Sensitivity analysis on the impact of sugar price and urea price movement to the net revenue per hectare

| | | Sugar Price Movement | | | | |
|---|---|---|---|---|---|---|
| | | -20% | -10% | 0% | 10% | 20% |
| | | 28 kg (N/ha) Treatment | | | | |
| Urea Price Movement | -20% | $ 1,713 | $ 2,100 | $ 2,487 | $ 2,874 | $ 3,261 |
| | -10% | $ 1,709 | $ 2,096 | $ 2,482 | $ 2,869 | $ 3,256 |
| | 0% | $ 1,704 | $ 2,091 | $ 2,478 | $ 2,865 | $ 3,252 |
| | 10% | $ 1,699 | $ 2,086 | $ 2,473 | $ 2,860 | $ 3,247 |
| | 20% | $ 1,695 | $ 2,082 | $ 2,469 | $ 2,856 | $ 3,243 |
| | | 60 kg (N/ha) Treatment | | | | |
| | -20% | $ 1,639 | $ 2,030 | $ 2,420 | $ 2,811 | $ 3,201 |
| | -10% | $ 1,629 | $ 2,020 | $ 2,410 | $ 2,801 | $ 3,191 |
| | 0% | $ 1,619 | $ 2,010 | $ 2,401 | $ 2,791 | $ 3,182 |
| | 10% | $ 1,610 | $ 2,000 | $ 2,391 | $ 2,781 | $ 3,172 |
| | 20% | $ 1,600 | $ 1,990 | $ 2,381 | $ 2,772 | $ 3,162 |
| | | 120 kg (N/ha) Treatment | | | | |
| | -20% | $ 1,584 | $ 1,981 | $ 2,378 | $ 2,775 | $ 3,172 |
| | -10% | $ 1,564 | $ 1,961 | $ 2,358 | $ 2,756 | $ 3,153 |
| | 0% | $ 1,544 | $ 1,942 | $ 2,339 | $ 2,736 | $ 3,133 |
| | 10% | $ 1,525 | $ 1,922 | $ 2,319 | $ 2,716 | $ 3,114 |
| | 20% | $ 1,505 | $ 1,903 | $ 2,300 | $ 2,697 | $ 3,094 |

^ Average relative CCS values are used in this economic analysis and are linked to the cane payment formula. These relative CCS differ from the actual CCS.

^^ The average sugar yield (TSH) shown in the table is based on actual CCS. Sugar yields are not used in the calculation of the economic results.