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QUANTIFYING THE SOCIO-ECONOMIC IMPACTS OF HARVESTING RESIDUE RETENTION SYSTEMS

COST-BENEFIT ANALYSIS OF GREEN CANE TRASH BLANKETING FOR THE FARM AND REGIONAL SECTORS

by

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1.0 INTRODUCTION

This document is a collation of economic analyses carried out as a requirement for the SRDC and LWA funded project BSS173 *"Quantifying the socio-economic impacts of harvesting residue retention systems"*. The project aims to support and extend the adoption of trash retention systems based on agronomic and economic suitability. This analysis fulfils the requirements for the final milestone report.

This report has two major components, firstly the cost-benefit analysis of the adoption of green cane trash blanketing (GCTB) at a farm level, which demonstrates implications of GCTB through the use of a partial budget and also a case study of one farm. The second component of the report is the cost-benefit analysis for the Burdekin district for a change from a 100% burnt cane production system to a system with 70% burnt cane and 30% GCTB cane. This analysis is conducted at three sugar price levels, low, medium and high.

2.0 COST-BENEFIT ANALYSIS FOR ADOPTION OF GCTB AT A FARM LEVEL

2.1 A partial budget to show a change from burnt to GCTB

A partial budget is a useful tool used to evaluate proposed changes to a farming operation. It compares the extra expenses and revenues from a proposed change to the existing activity. All of the favourable aspects of the change are balanced against all the unfavourable aspects, and are given a dollar value where possible. A partial budget will be able to tell you if there is going to be a net gain or loss from a change.

When calculating a partial budget, the following steps are taken:

1. Establish a clear picture of the proposal or alternative to be considered.
2. Determine the relevant physical information and assumptions on production and prices.
3. Identify any changes in capital requirements.
4. List changes in costs and income over time.
5. Establish the return on extra capital invested and compare the result with other opportunities for investment.
6. Evaluate any changes in asset value over time.
7. Take account of intangible factors which cannot be considered in the budget, eg risk (Makeham, J.P. and Malcolm, L.R., 1993).

In this study we are using a partial budget to evaluate a proposed change on a hypothetical farm which is currently growing 100 hectares of sugarcane, yielding 115 tonnes of cane per hectare with a ccs of 14.95. Approximately 30% of the soil on this farm is sodic or deep draining, and it is believed that this area would benefit from GCTB. The proposed change would be to replace the 30 hectares of burnt cane with GCTB cane.

Research has shown that there is minimal difference in cane yield under a GCTB system. However, ccs is likely to rise, so we will assume that yield in the GCTB areas will be 115 tonnes per hectare with a ccs of 15.95. It has been shown that GCTB systems can use more water than burnt cane, so we will also assume that one megalitre of water per

hectare extra is used in GCTB. From grower surveys in the Burdekin, the average cost of producing burnt cane is $1,640 per hectare, while the cost of producing cane under a GCTB system is $1,629.70 per hectare. This is inclusive of extra harvesting costs and the extra water cost.

We will also assume that the sugar price is $300 per tonne, which means that the price for burnt cane will be $30.14 per tonne, and the price for GCTB cane will be $32.84 per tonne.

To make the 30 hectares of land suitable for GCTB, it would need to be laser levelled, and the farmer would need to either hire or purchase a stool splitter for fertiliser application. We will assume that the cost of redesigning the block is $1,000 per hectare, and that the farmer purchases a stool splitter for $6,500. Capital can be released upon undertaking a new activity, for example, by selling any implements not needed by GCTB. However, since 70 hectares of the farm will still be producing burnt cane, this will not be possible.

If the farmer has to borrow money to finance this change, we will assume that the farmer borrows $36,500 at 8% interest per annum. The average borrowing would be $18,250 and the interest on this will be $1,460. There will also be a tax on the extra taxable income, which is calculated at 20 cents in the dollar to be $1,858.76.

The farmer may experience decreased production costs over time through the reduction in fertiliser inputs after the first crop cycle as a result of improved soil fertility. It may also be possible that water use will decrease as a result of the improved soil structure over time, which will also lower production costs in the GCTB area. Income for both the GCTB cane and the burnt cane will vary over time according to the sugar price and ccs levels.

It may also be possible for the farmer to reduce harvesting costs considerably in time as contractors are pressured by GCTB growers and market competition to reduce their prices. On the other hand, it is possible that the harvesting costs for the GCTB cane may be higher than $5.75 per tonne, as cases of up to $6.60 per tonne are not uncommon.

Another minor cost in producing burnt cane is the 9.8 c per tonne penalty it incurs from the mill, which at 115 tonnes per hectare is around $338.10 per hectare.

The partial budget is shown in full in Table 1.

TABLE 1

A partial budget for changing 30 ha of burnt cane land into 30 ha of GCTB land

30 hectares burnt			**30 hectares GCTB**	
A. Revenue forgone			**C. Revenue gained**	
30 ha burnt, 115 t/ha, 14.95 ccs	$	103,983.00	30 ha GCTB, 115 t/ha, 15.95 ccs	$ 113,298.00
Price @ $30.14/t			Price @ $32.84/t	
B. Costs avoided			**D. Costs incurred**	
9.8c/t burnt cane penalty	$	338.10	*Increased water 1 ML/ha @ $18/ML*	$ 540.00
Harvesting cost	$	18,285.00	*Harvesting cost*	$ 19,837.50
Production cost for burnt cane	$	30,917.70	*Production cost for GCTB cane*	$ 28,909.20
Total	$	49,540.80	Total	$ 49,286.70
E. Gain from present activity	**$**	**54,442.20**	**F. Gain from proposed activity**	**$ 64,011.30**
G. Difference (F-E)	**$**	**9,569.10**		
			Average borrowings	$ 18,250.00
H. Total gain	**$**	**9,569.10**	Interest at 8%	$ 1,460.00
I. Average marginal tax rate	$	0.20	Tax on extra taxable income	$ 1,621.82
J. Extra taxable income	$	8,109.10		
K. Gain after tax	$	7,947.28		
L. Capital required	$	36,500.00		
M. Capital released		0	Net extra initial capital investment	$ 36,500.00
N. Net capital investment (L-M)	$	36,500.00	Net gain after tax	$ 7,947.28
O. Extra capital return after tax (K/N)		0.22	Net gain after tax (%)	21.8
			Opportunity interest cost	$ 2,920.00

2.2 Interpretation of the partial budget

The main factors to take into consideration when deciding whether to undertake a new activity include risk, financial aspects, capital gains prospects, and other more intangible aspects.

2.2.1 Risk

When changing from burnt cane farming to GCTB, there are a number of risks involved. These include production risks, such as a cold, wet snap occurring after harvest, which may result in slow and uneven ratoon development and the possibility of diseases such as pineapple disease. There is also the risk that the harvesting contractor may harvest the crop carelessly, resulting in stool damage, harvesting losses and increased dirt levels. There are also price risks which occur if the sugar price falls; however, this would affect burnt cane as well.

The before-tax break-even income from GCTB is calculated in Table 2.

TABLE 2
Break-even income

Break-even income	
Gain from GCTB	$ 64,011.30
Gain from burning	$ 54,442.20
Balance	$ 9,569.10
Break-even income (yields and prices) required is:	
Income 'x' = burning gain + GCTB costs	
+ opportunity interest cost	
Income x = $ 106,648.90	

To break even with the burning activity, the income from the GCTB crop has to be $106,648.90 in total or $3,554.96/ha. There are many combinations of yields (tonnes of cane and ccs), sugar price, harvesting and irrigation costs that could achieve this income. Table 3 shows three 'negative' combinations, where in each case either the cane yield (tonnes per hectare), ccs or sugar price is significantly reduced.

In the 'Most likely' column, there are combinations of cane yield, ccs and sugar price that are most likely to be achieved if the proposal to change from burnt cane production to GCTB is undertaken. The most likely income is $113,298, which is well above the break-even income.

In the first case, cane yield is reduced from 115 tonnes per hectare to 110 tonnes per hectare, giving an income of $108,372, which is still above the break-even income. Therefore, if the change from a burnt cane production system to GCTB is made and results in reduced yields of up to 5 tonnes per hectare, the grower is still making a financial gain.

The second combination shows the effect of low ccs, thus reducing the income to $94,668, which is significantly lower than the break-even income; however, trials have shown that it is unlikely that ccs will be reduced - in fact it is more likely to be higher under a GCTB system. The third case shows that income will be $98,463 when the sugar price is at $260 per tonne, which is also well below the break-even income; however, a reduced sugar price would also have a similar effect on the burnt cane systems.

TABLE 3
Most likely and potential combinations of cane yields and sugar price

	Most likely	Possible
Lower tonnes of cane		
tonnes per hectare	115	110
ccs	15.95	15.95
sugar price $/tonne	300	300
Income	**$ 113,298.00**	**$ 108,372.00**
Lower ccs		
tonnes per hectare	115	115
ccs	15.95	13.95
sugar price $/tonne	300	300
Income	**$ 113,298.00**	**$ 94,668.00**
Lower sugar price		
tonnes per hectare	115	115
ccs	15.95	15.95
sugar price $/tonne	300	260
Income	**$ 113,298.00**	**$ 98,463.00**

2.2.2 Financial aspects

The critical values in the budget are the yields and prices of cane, and the variable costs of producing both burnt and green cane.

The proposal is also financially feasible, as it will more than pay for its overhead and variable costs, as well as extra interest repayments. The farmer will experience more tax on any extra taxable income that may be generated as a result of the project, but this is also easily covered.

This proposal to convert 30 hectares of burnt cane into 30 hectares of cane under a GCTB system is economically sound. The extra returns from the GCTB area exceeds the earnings from the burnt cane, as well as the amount a similar investment could earn in an alternative use that the farmer may consider. There is return on investment of 21.8%, which is exceptional when compared to other investment opportunities using the opportunity interest cost.

The opportunity interest cost is the gain that the money could earn in another use, in this case calculated at 8% to be $2,920, which is around $6,600 less than the gain from the proposed change to GCTB.

2.2.3 Capital gains aspects

The likelihood of capital gains being made is small, since the land will probably retain its value with inflation, whether it is under GCTB or not. It may be possible to make small capital gains in the future as the soil quality improves, or even further into the future as cane burning becomes a rare practice for whatever reason. If the GCTB area is well established its value may be increased.

2.2.4 Other aspects

The change to GCTB has a number of other advantages which are a little more difficult to place a monetary value on. These are things such as improved weed and grub control, better relationships with close neighbours and community by reducing the farm's smoke and ash emissions, and more personal leisure time for the farmer because fewer ground workings are required once the crop is planted.

The farmer and/or employees' skills is another issue to take into consideration. The inexperience in GCTB may cause some problems in the initial stages, but by seeking advice from more experienced farmers or professional advisers, irrigation scheduling, and good record keeping, these problems should be overcome.

On a broad scale, by changing to GCTB in this highly suitable area, the farmer is fulfilling the CANEGROWERS Code of Practice, which aims to provide "reasonable and practicable measures for minimising the risk of harm to the environment" (CANEGROWERS).

2.2.5 Summary of partial budget

If the most likely outcomes occur, the farmer will gain around $9,500 per year more from the 30 hectares of land under a GCTB system than would have been received if the cane in that 30 hectares had been burnt. This is a gain of approximately $320 per hectare. The yields and prices required to achieve a break-even income are easily obtainable, while the most likely yields and prices will give the farmer greater rewards if achieved.

2.3 A cost-benefit analysis on a case study farm

A cane farmer in the Burdekin River Irrigation Area with a 100 hectare farm on relatively flat country, with average row lengths of 1 km and slope of 0.01%, decides to change from conventional, ie burning cane before harvest, to GCTB. In a 'normal' year in most of the fields, this farmer would burn cane prior to harvest and then rake the trash and burn it after harvest. There would then be two cultivations and one herbicide application in each ratoon for weed control, as well as applying 12 megalitres of water in eight irrigations. The farmer employs contract harvesters, and has received the average results in Table 4.

TABLE 4
Average yields for case study farm

Crop class	Yield t/ha	ccs	Sugar t/ha
Plant	130	15	19.5
1st R	120	15	18.0
2nd R	110	14	14.7
3rd R	100	14	12.6

The operating costs for this situation are outlined below:

Land preparation: Two deep rippings, two discings and two rotary hoe passes for pre-planting ground preparation. In the ratoon crops there are only two passes with a scarifier. All operations are carried out using a Case 8930 tractor, which costs $42.82/hr to run as calculated by NSW agriculture..

Planting contractors: $345.80/ha.

Fertiliser: Five bags/hectare of mix at planting, then 7.5 bags/ha of urea after planting, then six bags/ha on ratoons.

Herbicides: 1.5 L/ha of Gramoxone at plant with planter, then 6 L/ha of Gesapax Combi, 0.5 L/ha of Diuron and 2 L/ha of Amitran, 0.5 L/ha of 2,4-D by air between plant and first harvest, and ratoons.

Insecticides: 24 kg/ha of suSCon® in the plant crop.

Irrigation: 12 ML per hectare at $38.60/ML in 10 irrigations.

Harvesting: Contractors are used, who charge $5.30/t to harvest.

These operating costs are summarised in Table 5.

TABLE 5
Summary of operating costs for burnt cane production

	Plant $/ha	1st ratoon $/ha	2nd ratoon $/ha	3rd ratoon $/ha
Planting	345.80	0	0	0
Fertiliser	40	100	100	100
Herbicide	82.53	76.58	76.58	76.58
Other pesticide	255	0	0	0
Irrigation	463.20	463.20	463.20	463.20
Harvesting	689	636	583	530
Tractor operations	346.24	124.28	124.28	124.28
Total variable costs $/ha	**2,221.77**	**1,400.06**	**1,347.06**	**1,294.06**

Assuming the farmer receives $30 per tonne and the yields shown above, this will result in gross margins as shown in Table 6.

TABLE 6
Gross margins for burnt cane production

	Operating costs $/ha	Income $/ha	Gross margin $/ha
1st Plant	2,221.77	3,900	1,678.23
1st Ratoon	1,400.06	3,600	2,199.94
2nd Ratoon	1,347.06	3,300	1,952.94
3rd Ratoon	1,294.06	3,000	1,705.94

2.3.1 Changing to GCTB

In the first crop cycle of practising GCTB, we assume the yields are reduced by around 10 tonnes per hectare due to a number of factors, including management experience, and then in the following three crop cycles, yields increase by 5% in each crop class (Table 7).

TABLE 7
Expected yields following a change to GCTB

Crop class	Yield t/ha	ccs	Sugar t/ha	Income $/ha
1st Plant	120	15	18	3,600
1st R	110	15	16.5	3,300
2nd R	100	14	14	3,000
3rd R	90	14	12.6	2,700
2nd Plant	126	15	18.9	3,780
1st R	115.5	15	17.33	3,465
2nd R	105	14	14.7	3,150
3rd R	94.5	14	13.23	2,835
3rd Plant	132.3	15	19.85	3,969
1st R	121	15	18.19	3,638.25
2nd R	110.25	14	15.44	3,307.5
3rd R	99	14	13.9	2,976.75

2.3.2 Capital costs of changing to GCTB

Firstly, there would be the initial outlay of money to redesign the farm layout, including shortening of rows. This would mean re-levelling of fields, installation of more pumps and pipes, as well as the purchase of a new fertiliser box with coulters rather than tines. Overall, this investment is estimated to be around $1,000 per hectare. The farmer will obtain a bank loan for the initial outlay of capital at an interest rate of 8% per annum.

The operating costs associated with a GCTB system are outlined below:

Land preparation (not including laser levelling): One deep ripping, two discings and one rotary hoe pass for pre-plant land preparation. No land workings in ratoons.

Planting: contractors at $345.80/ha.

Fertiliser: Five bags/hectare of Delta Crop King mix at planting, then 7.5 bags/ha of urea after planting, then 16 bags/ha of Delta Crop King mix on ratoons.

Herbicides: 1.5 L/ha of Gramoxone at plant with tractor, then 6 L/ha of Gesapax Combi, 0.5 L/ha of Diuron and 2 L/ha of Amitran by air between plant and first harvest.

Insecticides: 24 kg/ha of suSCon in the plant crop.

Irrigation: The amount of water applied is expected to be 12 ML in the first year, then fall to 11 ML in the second year, then 10 ML from the third year onwards. The number of irrigations is expected to fall to seven after the third year.

Harvesting: Contractors will be used, who will charge $6.30/t to harvest the crop green.

These operating costs for three crop cycles are summarised in Table 8.

TABLE 8
Summary of operating costs for GCTB in three crop cycles

	Plant	**1st ratoon**	**2nd ratoon**	**3rd ratoon**
Planting	345.8	0	0	0
Fertiliser	24	63.37	63.37	63.37
Herbicide	110	25	25	25
Other pesticide	255	0	0	0
Irrigation	463.2	424.6	386	386
Harvesting	756	693	630	567
Tractor operations	173.12	0	0	0
Total variable costs $/ha	**2,127.12**	**1,205.97**	**1,104.37**	**1,041.37**

	2nd Plant	**1st ratoon**	**2nd ratoon**	**3rd ratoon**
Planting	345.8	0	0	0
Fertiliser	24	63.37	63.37	63.37
Herbicide	110	25	25	25
Other pesticide	255	0	0	0
Irrigation	386	386	386	386
Harvesting	793.8	97.65	661.5	595.35
Total variable costs $/ha	**2,087.72**	**572.02**	**1,135.87**	**1,069.72**

	3rd Plant	1st ratoon	2nd ratoon	3rd ratoon
Planting	345.8	0	0	0
Fertiliser	24	63.37	63.37	63.37
Herbicide	110	25	25	25
Other pesticide	255	0	0	0
Irrigation	386	386	386	386
Harvesting	833.49	762.3	694.58	623.7
Tractor operations	173.12	0	0	0
Total variable costs $/ha	**2,127.41**	**1,236.67**	**1,168.945**	**1,098.07**

2.3.3 Financial revenue

In the past, the farmer received prices around $30 per tonne for burnt cane, so to compare the two cane production systems we will assume that the farmer will still get $30 per tonne for the GCTB cane. With the above forecasted yields, the farmer is expected to receive the income and gross margins shown in Table 9.

TABLE 9
Income and gross margin for GCTB production

Crop class	Yield t/ha	Income $/ha	GM $/ha
1st Plant	120	3,600	1,472.88
1st R	110	3,300	2,094.03
2nd R	100	3,000	1,895.63
3rd R	90	2,700	1,658.63
2nd Plant	126	3,780	1,692.28
1st R	115.5	3,465	2,892.98
2nd R	105	3,150	2,014.13
3rd R	94.5	2,835	1,765.28
3rd Plant	132.3	3,969	1,841.59
1st R	121	3,638.25	2,401.58
2nd R	110.25	3,307.5	2,138.55
3rd R	99	2,976.75	1,878.68

The differences in gross margins before and after the change to GCTB are shown in Table 10. Basically, it shows that the farmer will experience decreases in gross margins in the first crop cycle, and then increases in the following crop cycles.

TABLE 10
A comparison of gross margins before and after changing to GCTB

	GM before change $/ha	GM after change $/ha	Difference
1st Plant	1,678.23	1,472.88	-205.35
1st Ratoon	2,199.94	2,094.03	-105.91
2nd Ratoon	1,952.94	1,895.63	-57.31
3rd Ratoon	1,705.94	1,658.63	-47.31
2nd Plant	1,678.23	1,692.28	14.05
1st Ratoon	2,199.94	2,892.98	693.04
2nd Ratoon	1,952.94	2,014.13	61.19
3rd Ratoon	1,705.94	1,765.28	59.34
3rd Plant	1,678.23	1,841.59	163.36
1st Ratoon	2,199.94	2,401.58	201.64
2nd Ratoon	1,952.94	2,138.55	185.61
3rd Ratoon	1,705.94	1,878.68	172.74

3.0 COST-BENEFIT ANALYSIS FOR THE REGIONAL SECTOR

Currently in the Burdekin canegrowing district in north Queensland, around 5% of the area is harvested green. It is estimated that around 30% of the region has soils that are suitable to GCTB. A cost-benefit analysis can be used to demonstrate the difference in gross margins between 100% of the area using a burnt production system and a change to 70% using burning and 30% using GCTB.

This analysis focuses on the Burdekin region, and calculates the average changes in gross margins for the **entire** district as a result of 30% of the district changing to GCTB. A number of calculations are made in this analysis, including cane prices at low, medium and high sugar prices and ccs levels, total and average income, total and average costs, gross margin per hectare and per tonne.

3.1 Outcomes considered

This cost-benefit analysis has been conducted for a number of different outcomes resulting from a change from a 100% burnt cane production system to 30% GCTB system. Past research and statistics about GCTB show that it can perform differently in various situations. It is possible that one or more of the following circumstances could occur in a GCTB system:

- A loss in cane yield by 5%.
- An increase in cane yield by 5%.
- A gain in ccs of 1 unit.
- A loss in ccs of 1 unit.
- An increase in water use of 1 megalitre per hectare.
- A decrease in water use of 1 megalitre per hectare.
- No change from burnt.

The cost-benefit analysis has been conducted using various assumptions about the amount of change in cane yield, ccs and water use. Calculations have been made for each individual outcome as well as all possible combinations of outcomes.

3.2 Data sources

The average costs of production for GCTB systems and burnt systems were gathered from grower surveys conducted as a milestone requirement for BSS173: 'Quantifying the socio-economic impacts of harvesting residue retention systems'. The costs shown include inputs such as fertiliser, water, chemicals, machinery and labour, while income is calculated using the average yield for the 1999 season, which was 115 tonnes per hectare with an average ccs of 14.95. Cane prices are calculated using low, medium, and high sugar prices of $260, $300 and $340 per tonne, respectively. The sugar price for the 1999 season was an all time low price around $260 per tonne. The 2001 sugar price is expected to be approximately $340 per tonne.

3.3 100% of Burdekin district using burnt cane production systems

The cane price is $26.20 per tonne for cane with a ccs of 14.95 at the low sugar price, $30.15 per tonne at the medium sugar price and $34.09 per tonne at the high price. At these prices, average income for the Burdekin district ranges from $3,013.12 per hectare at the low sugar price to $3,919.78 per hectare at the high sugar price.

From the grower survey, the average cost of production in a burnt system is $1,640.12 per hectare; giving gross margins of $1,373 per hectare, $1,826.33 per hectare and $2,279.66 hectare at the low, medium and high sugar prices, respectively. The gross margin at the low sugar price is $11.94 per tonne, while the gross margin per tonne of cane is $15.88 per tonne and $19.82 per tonne at the medium and high sugar prices, respectively. These calculations are summarised in Table 11.

TABLE 11
Summary of prices, income and gross margins for 100% of the Burdekin district using burnt cane production systems

	Sugar price @ $260/t	Sugar price @ $300/t	Sugar price @ $340/t
Price	$26.20	$30.15	$34.09
Average income $/ha	$3,013.12	$3,466.45	$3,919.78
Gross margin $/ha	$1,373.00	$1,826.33	$2,279.66
Gross margin $/tonne	$11.94	$15.88	$19.82

3.4 Cost-benefit analysis for a change to GCTB in 30% of the Burdekin district

In this section the same calculations are made as for the burnt system, but using different assumptions. Here, we assume that 30% of the Burdekin changes to GCTB production without any major capital outlays to do so, and the remaining 70% continues to use burning methods. The GCTB area incurs a lower production cost due to reduced inputs required, as determined by the grower survey. Again, the analysis is carried out at three sugar prices, low ($260 per tonne), medium ($300 per tonne) and high ($340 per tonne).

3.5 Cost-benefit analysis at the low sugar price of $260 per tonne

If 30% of the Burdekin district was to convert to GCTB production, at low sugar prices, and with no change in yield, ccs or water use, the average district gross margin is $1,368.47 per hectare or $11.90 per tonne. This is equivalent to around $94.5 million gross margin for the total district. The gross margin in the GCTB area is $21.70/ha higher than in the burnt area. This difference is the same at all price levels because it is a proportional difference.

The first scenario assessed for a change to GCTB is that there will be an increase in cane yield of 5% in the GCTB area. With an increase in yield alone, the GCTB gross margin is $173 per hectare higher than the burnt cane production system. This gross margin is increased by even larger amounts if there is also an increase in ccs of 1 unit, and/or water use decreases by 1 megalitre. The highest increase in gross margin occurs when the GCTB area experiences increased yields, increased ccs and decreased water use. This difference in gross margins between GCTB and burnt systems is $474.50 per hectare.

On the other hand, if ccs is decreased by 1 unit, the gross margin in the GCTB area will be negative, regardless of water use. The difference in gross margin could be as much as $128 per hectare in favour of the burnt system.

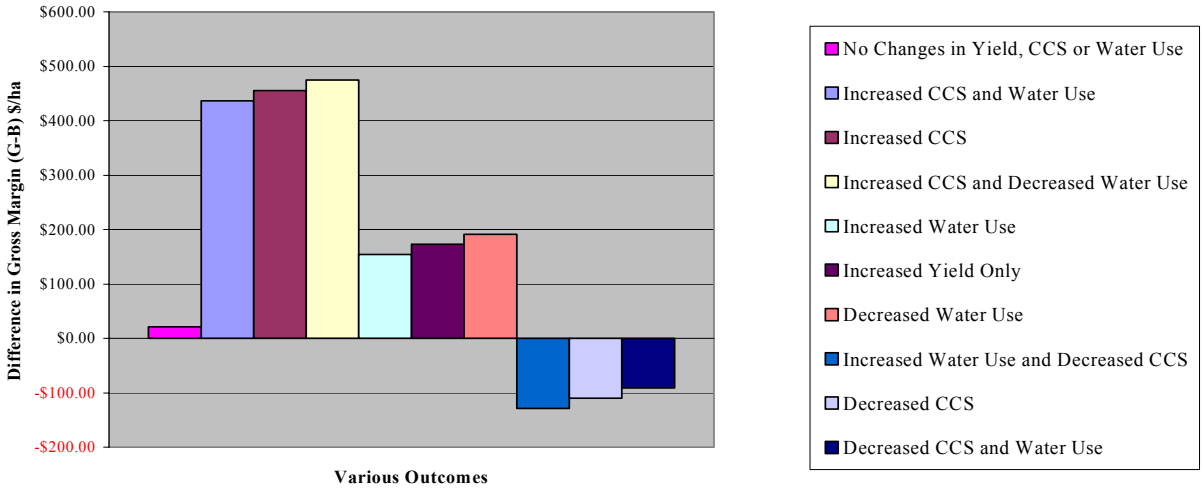
These results are illustrated in Figure 1, part (a).

Similar outcomes are shown in part (b) of Figure 1, where the analysis assumes there is no change in cane yield. However, ccs decreases result in much larger losses for the GCTB area, with gross margins being up to $400/ha less than the burnt systems.

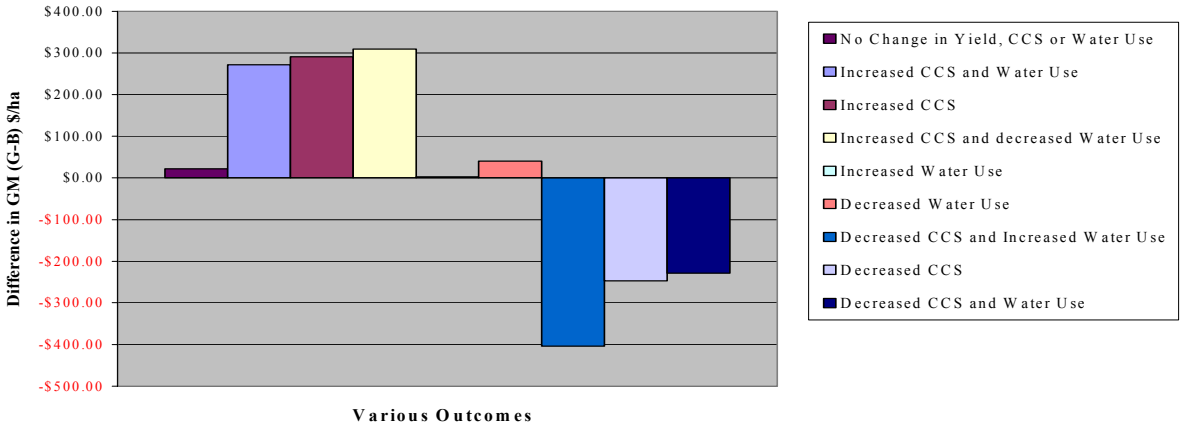
With decreased cane yields of 5% in the GCTB area, increased ccs and decreased water use, gross margins can be up to $150 per hectare higher than in the burnt area. However, with either decreased ccs or no change in ccs, gross margins in GCTB areas will be much lower than in burnt areas. As highlighted in part (c) of Figure 1, ccs decreases can reduce gross margins by over $400 per hectare lower than the burnt system.

Figure 1: Difference in gross margins between GCTB and burnt systems (G-B) at low sugar prices ($260 per tonne)

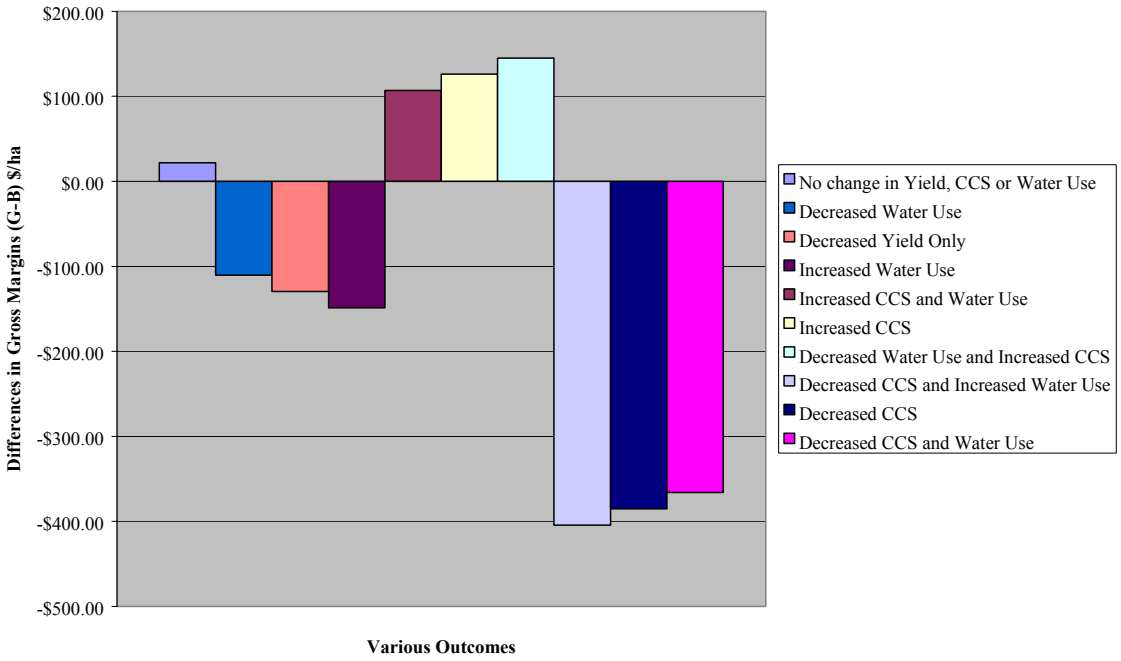
(a) 5% increase in cane yields in GCTB area



(b) No changes in cane yields in GCTB area



(c) 5% Decrease in cane yields in GCTB area



3.6 Cost-benefit analysis at the medium sugar price of $300 per tonne

If 30% of the Burdekin district was to convert to GCTB production, at medium sugar prices, and with no change in yield, ccs or water use, the average district gross margin is almost $126 million, $1,821.80 per hectare or $15.84 per tonne.

Again, the first scenario assessed for a change to GCTB at medium sugar prices is that there will be an increase in cane yield of 5% in the GCTB area. With this increase in yield, the GCTB gross margin is $195 per hectare higher than the burnt cane production system. This gross margin is increased by even larger amounts if there is also an increase in ccs of 1 unit, and/or water use decreases by 1 megalitre, giving gross margin increases of up to $540 per hectare.

However, if ccs is decreased by 1 unit, the gross margin in the GCTB area will be lower than the burnt area whether water use increases or not. This difference in gross margin could be as much as $150 per hectare.

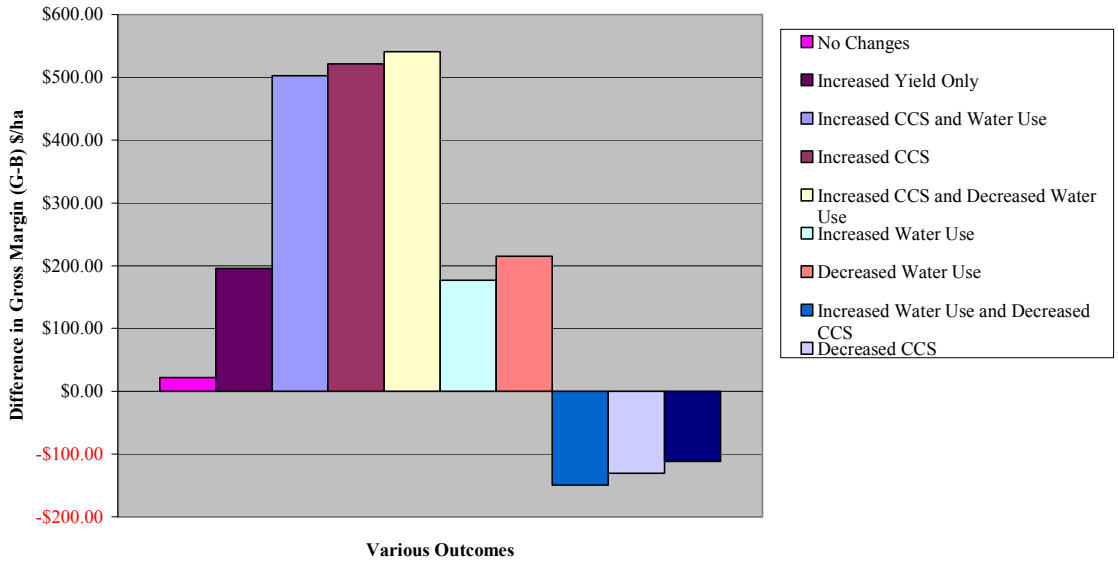
These results are illustrated in Figure 2, part (a).

In part (b) of Figure 2, where the analysis assumes there is no change in cane yield, ccs decreases result in losses for the GCTB area, with gross margins being over $300 per hectare less than the burnt systems.

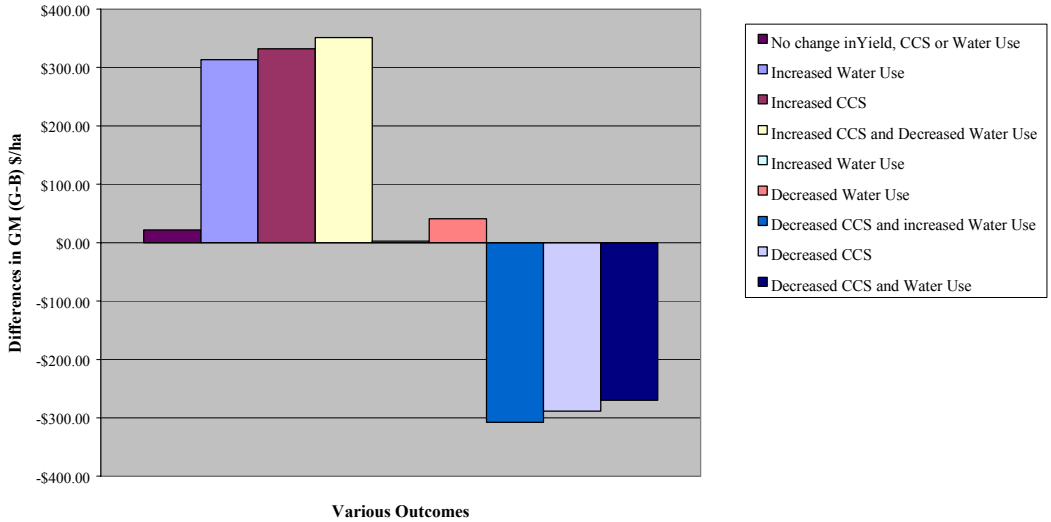
If cane yields are decreased by 5% in the GCTB area, as shown in part (c) of Figure 2, increased ccs and decreased water use, gross margins can be more than $160 per hectare higher than in the burnt area, while ccs decreases can reduce gross margins by up to $470 per hectare.

Figure 2: Difference in gross margins between GCTB and burnt systems (G-B) at medium sugar prices ($300 per tonne)

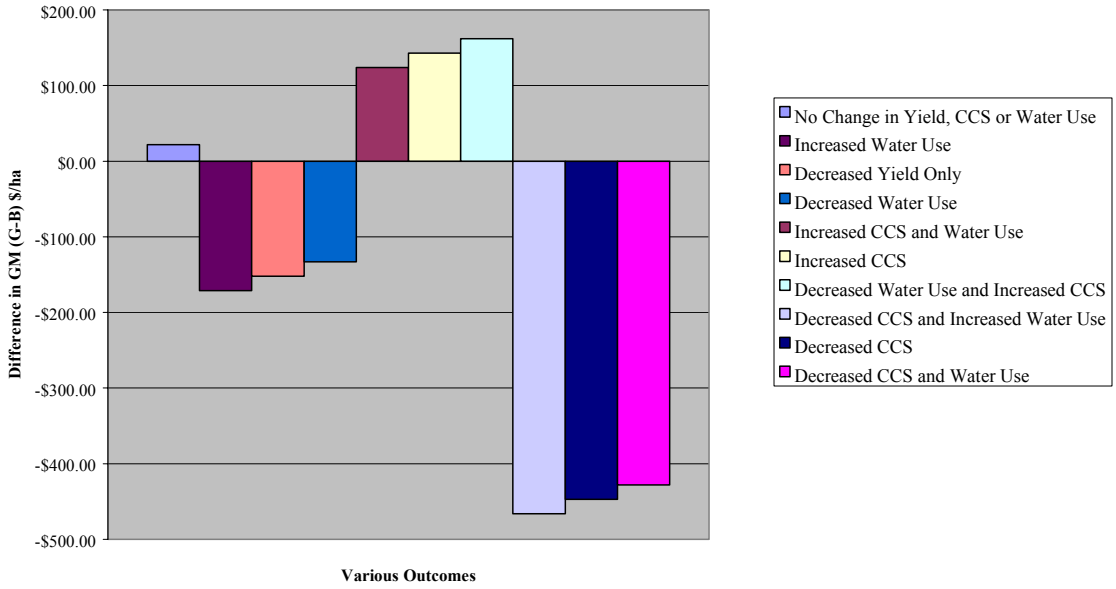
(a) 5% increase in cane yields in GCTB area



(b) No changes in cane yields in GCTB area



(c) 5% decrease in cane yields in GCTB area



3.7 Cost-benefit analysis at the high sugar price of $340 per tonne

The analysis has been carried out for a third time to assess a change for 30% of the district to GCTB under a high sugar price of $340 per tonne. With no change in yield, ccs or water use, the average district gross margin is $2,275.13 per hectare or $19.78 per tonne. This is a total district gross margin of $157 million.

Increased cane yields of 5% in the GCTB area increase the gross margin $218 per hectare higher than the burnt cane production system. This gross margin is increased more when there is also an increase in ccs of 1 unit, and/or water use decreases by 1 megalitre, giving gross margin increases over $600 per hectare for the GCTB area.

If ccs decreases by 1 unit, the gross margin in the GCTB area will be lower than the burnt area whether water use increases or not. This difference in gross margin could be up to $170 per hectare less than the burnt area's gross margin.

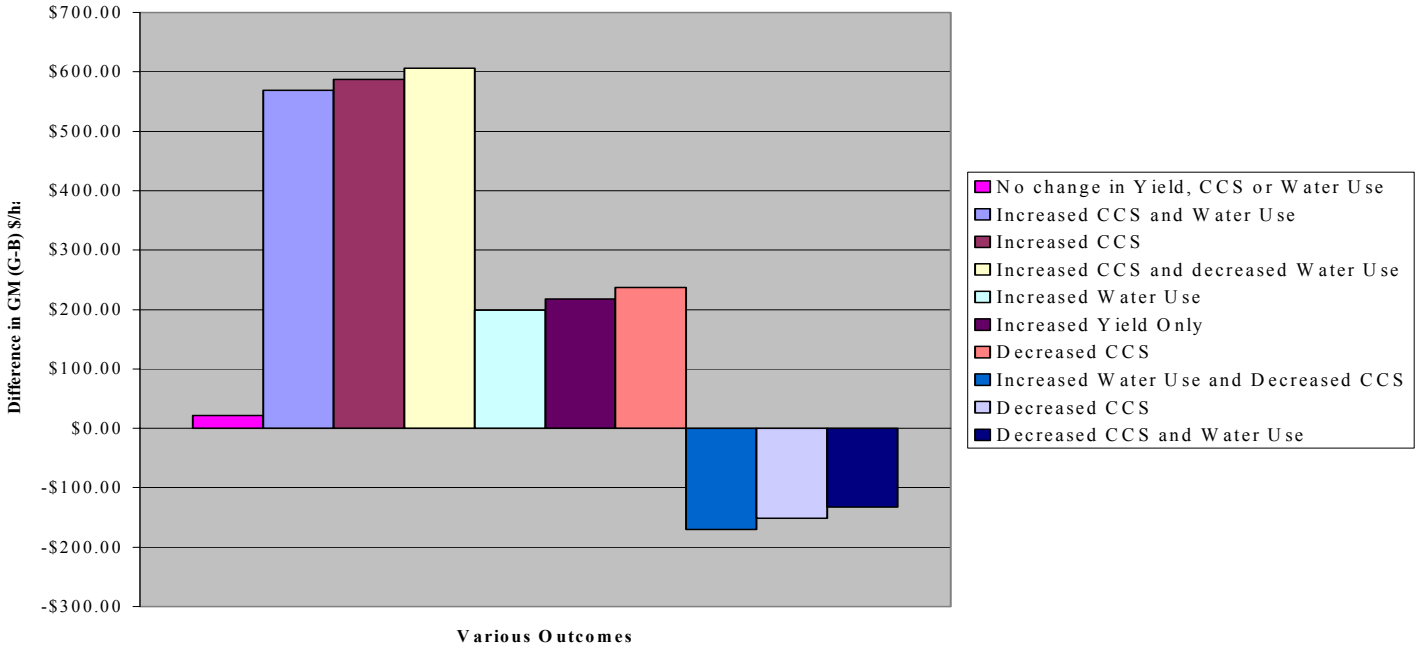
These results are illustrated in Figure 3, part (a).

Part (b) of Figure 3, which displays the differences in gross margins between GCTB and burnt areas when there is no change in cane yield, shows that ccs decreases result in losses for the GCTB area. Gross margins in the GCTB area are almost $350 per hectare less than in the burnt areas.

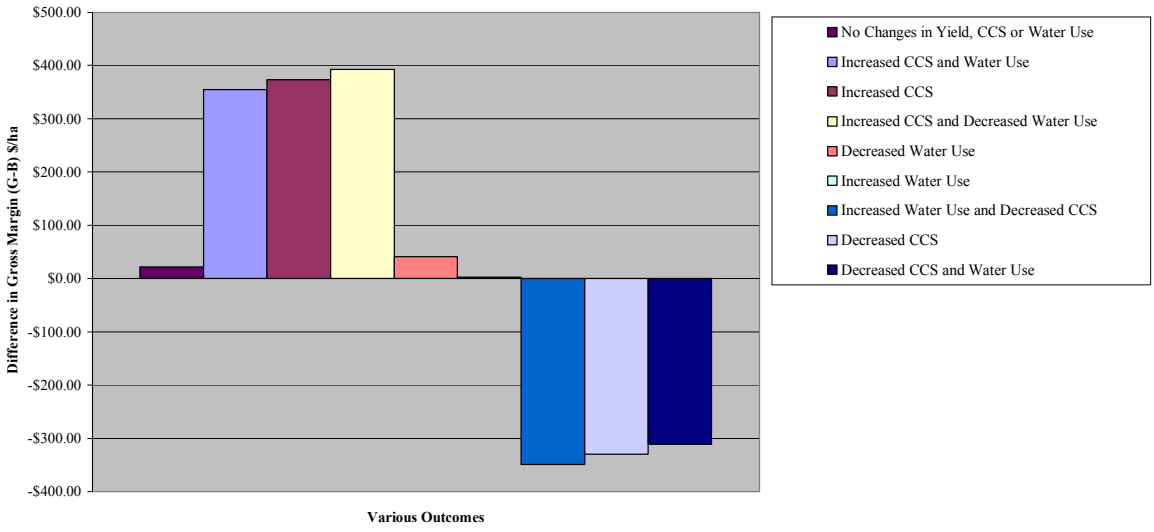
When cane yields are decreased by 5% in the GCTB area, as shown in part (c) of Figure 3, with increased ccs and decreased water use, gross margins can be around $180 per hectare higher than in the burnt area, while ccs decreases can reduce gross margins by up to $530 per hectare.

Figure 3: Difference in gross margins between GCTB and burnt systems (G-B) at high sugar prices ($340 per tonne)

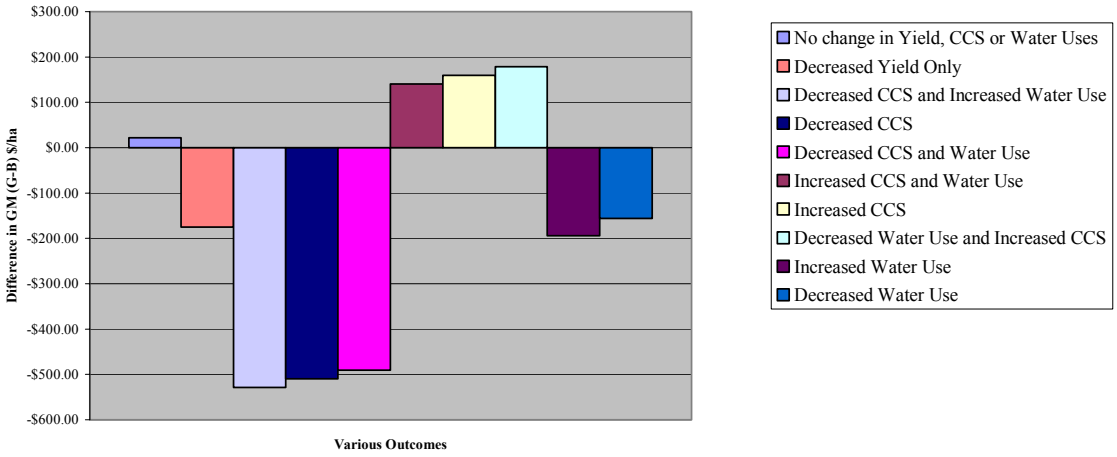
(a) 5% increase in cane yields in GCTB area



(b) No changes in cane yields in GCTB area



(c) 5% decrease in cane yields in GCTB area



3.8 Summary of outcomes at the three sugar prices

Table 12 summarises the various circumstances where GCTB will give better or worse outcomes for the total district if there is a change from a 100% burnt system to a system that is 70% burnt and 30% GCTB at each of the three sugar price levels. This section compares the gross margins of the 100% burnt system to various scenarios that could result with a change to the 70% burnt and 30% GCTB system.

In the Table 12, where the gross margin difference is positive, the 100% burnt system would be favourable, and vice versa. For example, after a change to the 70% burnt and 30% GCTB system in a period of low sugar prices, the district would experience on average increased gross margins of $125 per hectare, if cane yield and ccs is increased in the GCTB area.

On the other hand, if cane yield and ccs are decreased and water use is increased in the GCTB area, the district's gross margins will be an average of $132 per hectare lower than if the entire district was using a burnt system. In a year of high sugar prices, this loss in gross margin could be almost $170 per hectare.

These charts tell a similar story for all sugar price levels, that ccs is the main driver behind major changes in gross margins. If an increase in ccs occurs, the gross margin is increased by a greater proportion than if yields are increased or if water use is decreased. The sugar price reflects the amount by which gross margins are changed. For example, when yield and ccs are increased and water use is decreased, at low prices the GCTB area has a gross margin which is around $475 per hectare higher than the burnt area. At medium prices this figure is $540 per hectare while at high prices it is over $600 per hectare more than the burnt cane gross margin.

Yield changes alone have a moderate effect on gross margins, while water use is only a minor factor in regional gross margins and changes associated with it are only minimal. At low prices, a decrease in water use results in a GCTB gross margin that is $40 per hectare higher than the burnt cane gross margin, while an increase in yield gives a $172

per hectare higher gross margin, and an increased ccs gives a GCTB gross margin that is $455 per hectare higher than the burnt cane.

The effect of 30% of the Burdekin district changing to GCTB on the overall district average gross margins is demonstrated in Table 12. There are three sections in Table 12, each showing the increase or decrease in total district gross margins as a result of 30% of the district undertaking GCTB and experiencing various changes in yield, ccs or water use. In the table, when the gross margin difference is negative, the GCTB area has increased the overall district gross margins. If the gross margin difference is positive, the GCTB area has reduced the overall district gross margins.

At any sugar price, if there are decreased yields without an increase in ccs, the GCTB area is reducing the total district gross margins. However, with an increase in yields in the GCTB area at any sugar price level, if the ccs either stays the same or increases by one unit, the GCTB area increases the total district average gross margins. Also, a decrease in ccs in the GCTB area will always result in overall district gross margins being reduced, regardless of any changes in yield or water use.

TABLE 12
A summary of outcomes at various sugar prices

(a) Difference in district gross margins as a result of various outcomes at low sugar prices

Yield	ccs	Water use	Gross margin difference (B-G) $/ha
5% increase	1 unit increase	1 ML increase	-$119.34
		Same	-$125.04
		1 ML decrease	-$130.74
	Same	1 ML increase	-$34.58
		Same	-$40.28
		1 ML decrease	-$45.98
	1 unit decrease	1 ML increase	$50.19
		Same	$44.49
		1 ML decrease	$38.79
Same	1 unit increase	1 ML increase	-$70.50
		Same	-$76.20
		1 ML decrease	-$81.90
	Same	1 ML increase	$10.23
		Same	$4.53
		1 ML decrease	-$1.17
	1 unit decrease	1 ML increase	$131.73
		Same	$85.26
		1 ML decrease	$79.56

Yield	ccs	Water use	Gross margin difference (B-G) $/ha
5% decrease	1 unit increase	1 ML increase	-$21.66
		Same	-$27.36
		1 ML decrease	-$33.06
	Same	1 ML increase	$55.04
		Same	$49.34
		1 ML decrease	$43.64
	1 unit decrease	1 ML increase	$131.73
		Same	$126.03
		1 ML decrease	$120.33

(b) District gross margin changes as a result of various scenarios at medium sugar prices

Yield	ccs	Water use	Gross margin difference (B-G) $/ha
5% increase	1 unit increase	1 ML increase	-$139.18
		Same	-$1.17
		1 ML decrease	-$150.58
	Same	1 ML increase	-$41.38
		Same	-$47.08
		1 ML decrease	-$52.78
	1 unit decrease	1 ML increase	$56.43
		Same	$50.73
		1 ML decrease	$45.03
Same	1 unit increase	1 ML increase	-$82.92
		Same	-$88.62
		1 ML decrease	-$94.32
	Same	1 ML increase	$10.23
		Same	$4.53
		1 ML decrease	-$1.17
	1 unit decrease	1 ML increase	$103.38
		Same	$97.68
		1 ML decrease	$91.98
5% decrease	1 unit increase	1 ML increase	-$26.66
		Same	-$32.36
		1 ML decrease	-$38.06
	Same	1 ML increase	$61.84
		Same	$56.14
		1 ML decrease	$50.44
	1 unit decrease	1 ML increase	$150.33
		Same	$144.63
		1 ML decrease	$138.93

(c) District gross margin changes as a result of various scenarios at high sugar prices

Yield	ccs	Water use	Gross margin difference (B-G) $/ha
5% increase	1 unit increase	1 ML increase	-$159.02
		Same	-$164.72
		1 ML decrease	-$170.42
	Same	1 ML increase	-$48.18
		Same	-$53.88
		1 ML decrease	-$59.58
	1 unit decrease	1 ML increase	$62.67
		Same	$56.97
		1 ML decrease	$51.27
Same	1 unit increase	1 ML increase	-$95.34
		Same	-$101.04
		1 ML decrease	$104.40
	Same	1 ML increase	$10.23
		Same	$4.53
		1 ML decrease	-$1.17
	1 unit decrease	1 ML increase	$115.80
		Same	$110.10
		1 ML decrease	$104.40
5% decrease	1 unit increase	1 ML increase	-$31.66
		Same	-$37.36
		1 ML decrease	-$43.06
	Same	1 ML increase	$68.64
		Same	$62.94
		1 ML decrease	$57.24
	1 unit decrease	1 ML increase	$168.93
		Same	$163.23
		1 ML decrease	$157.53

4.0 SUMMARY

These analyses aim to give a basic background to the various issues associated with GCTB for farms and regional sectors. Individual circumstances, including debt loading, need to be taken into account for assessment for a particular block or farm.

The analysis has shown that there are both economic advantages and disadvantages of GCTB at both a farm and regional level. From the grower's perspective, if the farm is deemed to be highly suitable to GCTB, ie suitable soil type, slope, row length, the grower will incur reduced production costs if he/she converts from burnt cane production to GCTB production. The partial budget shows that a gain of around $320 per hectare is attainable for a farm suitable to GCTB.

The case study farm in this analysis shows the effect of a change to GCTB on a farm that is less suitable to GCTB, where considerable changes need to be made to the farm which require additional finance. The analysis showed that the change to GCTB may result in negative gross margins for the first crop cycle, but after this the gross margins are positive.

At a regional level, the analysis shows that ccs is the main factor behind benefits and costs to the overall district as a result of a change to GCTB by 30% of the district. If ccs is increased in that area, the total district gross margins will also be increased, while if ccs is reduced in that area, total district gross margins will be lowered.

5.0 REFERENCES

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