Profitability of changing to wider row spacing, permanent beds and minimum tillage – economic case study, Innisfail region

Grower: Joe Marano

Key findings

- New system increases farm gross margin by $10,500, or $27 per hectare, driven by savings in fuel, labour and repairs and maintenance resulting from the wider rows and reduced tillage.
- In addition, Joe's harvesting business, while separate from his farming business, is accruing further savings of $12 per hectare as a result of the wider row spacing.
- Investment analysis revealed that either the harvesting savings or the Reef Rescue grants that the grower received were necessary for the practice changes to be worthwhile from an economic perspective.

The aim of this case study is to evaluate the economic impact of management practice changes in the sugarcane industry supported through the Australian Government Reef Programme. The Reef Programme was delivered between 2008 and 2015 by Terrain and industry partners in the Wet Tropics region. The programme provided grants and specialist expertise to assist farmers with the adoption of improved management practices that lead to a reduction in pollutants entering the Great Barrier Reef lagoon, in particular nutrients, sediments and pesticides. Along with the expected environmental benefits from improved management practices, developing a greater understanding of the implications to farm profitability is crucial for the future sustainability of the sugarcane industry.

Farm characteristics

Joe Marano owns and leases almost 400 hectares of sugarcane land near Innisfail, as well as running a contracting business that provides harvesting and planting services to other growers in the region. He is in the process of converting his farm to wider row spacing with GPS guidance, and will trial introducing a minimum till system with permanent beds once the first blocks have gone a full crop cycle on the wider rows.

Joe's farm consists of predominantly sandy soils. His cane typically goes to fourth or fifth ratoon, and he plants a legume crop in his fallow blocks around 65% of the time.

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Management practice changes

Wider row spacing: Joe began the process of widening his cane rows from 1.63m to 1.83m in 2014. The process will take around seven years in total, as each block transitions to the wider spacing after fallow.

Moving to wider rows is primarily a means of reducing compaction caused by harvesting equipment passing too close to the cane row. Matching row spacing to the wheel spacing of harvesting and haul-out equipment, combined with the addition of GPS guidance, significantly reduces the amount of soil compaction in the row, potentially leading to improved cane yields.[1] In addition, wider rows reduce machinery operation costs, as many implements need to cover less distance to work the same area, saving labour and FORM[2] costs.

Permanent beds and minimum tillage: Once each block has gone a full crop cycle on the wider row spacing, Joe will trial replacing his current tillage operations with a single pass of a bed renovator. Joe's current tillage practice in fallow is to do three passes with offset discs and a single pass with a ripper. In the new system Joe will plant legumes into the existing beds, then just prior to planting he will do a pass with a bed renovator, which reforms the existing beds and creates a fine soil tilth ready for planting. The new tillage system will reduce labour and FORM costs, and should result in improved soil health and structure.

Both Joe's harvester and the tractor that he will use to pull the bed renovator have been fitted with GPS guidance, which will assist in keeping the harvester and tractor wheel tracks from drifting close to the cane rows, further reducing the level of soil compaction.

Table 1: farming system changes

Management practice	Conventional	New
Row spacing	1.63 metre	1.83 metre
Fallow and pre-plant tillage	3 passes with offset discs 1 pass with ripper	1 pass with bedformer

Methodology

The economic evaluation was undertaken using the Farm Economic Analysis Tool (FEAT). The FEAT model was developed by Queensland DAF and was designed to assist cane farming enterprises in planning and decision making. The objective of this study is to compare the gross margin[3] of the conventional and the new farm management practices. The difference between the gross margins determines whether there is an economic benefit or cost associated with the change. In the analysis, yield and CCS by crop class are held constant, based on Joe's typical production results, to enable a comparison of the cost implications of the two systems. Fixed costs are also held constant as they are not expected to be affected by the new farming system.

[1] Braunack, M. V. (2001) Final report – SRDC project BSS106: Assessing the linkages between machine traffic, soil conditions and productivity. Bureau of Sugar Experiment Stations.

[2] fuel, oil, repairs and maintenance

[3] The gross margin is equal to gross revenue minus variable costs, which include chemical, fertiliser, machinery and harvesting costs.

The annualised equivalent benefit (AEB)[4] is calculated to determine if the increase in gross margin is sufficient to offset the initial investment.

Sensitivity and break-even analyses were also completed to assess the effect of fuel price, labour rate and farm size on the AEB of the management practice change.

Key parameters

- Sugar price: $430 per tonne IPS[5]
- Labour: $30 per hour
- Fuel: $1.00 (net of GST and diesel rebate)
- Discount rate: 7%
- Investment horizon: 10 years
- Total capital cost: $40,800 (grower's share: $20,800, Reef Rescue grants: $20,000)

Details of farming operations, machinery costs and production data were obtained through discussions with the grower, and fertiliser and pesticide prices were sourced from local rural suppliers.

Results

Gross margin analysis

As the width of many of Joe's farming implements are determined by his row spacing, including his legume planter, fertiliser boxes and spray booms, widening his rows means each of these implements has to cover less distance to work his blocks. This results in lower costs due to fewer labour hours and lower FORM costs. Table 2 shows the per hectare gross margins by crop class of the conventional and new row spacings.

[4] Annualised Equivalent Benefit (AEB) is a way of evaluating whether an investment is worthwhile from an economic perspective. The AEB is a transformation of the investment amount and the economic benefits it generates into a single annual cash flow. If the AEB is positive, the investment is performing better than the specified rate of return (the discount rate) and is thus considered worthwhile.

[5] $430 per tonne is the 5 year average (2010 14) of QSL's seasonal and harvest pools.

Table 2: Gross margins, conventional (1.63m) and new (1.83m) row spacings

Crop class	Gross margin ($/ha) 1.63m rows	Gross margin ($/ha) 1.83m rows	Difference ($/ha)
Plant	$914	$921	$6.74
1st ratoon	$1052	$1058	$6.44
2nd ratoon	$881	$888	$6.44
3rd ratoon	$768	$774	$6.44
4th+ ratoon	$597	$604	$6.44
Fallow	-$971	-$966	$4.43
Farm average	**$548**	**$554**	**$6.20**

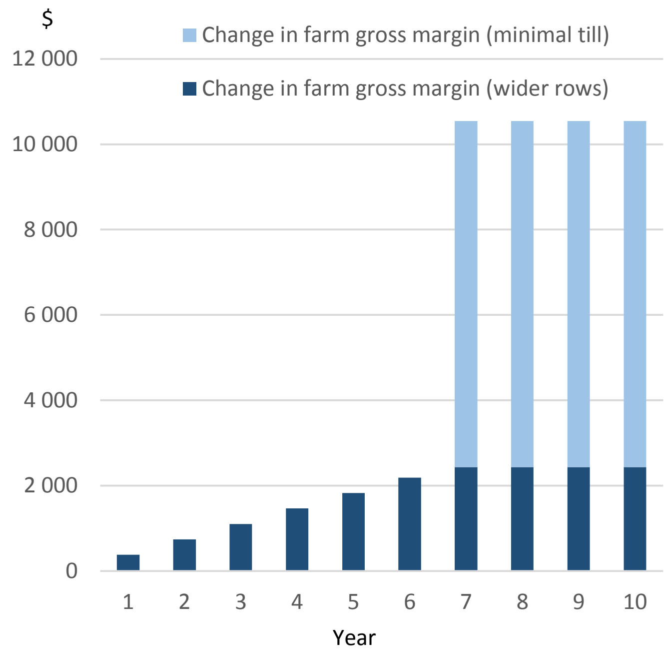
Additional savings will result from the shift to minimum tillage. Table 3 shows the FORM and labour costs per hectare of the conventional and new tillage operations.

Table 3: Tillage cost per hectare, conventional and new systems

Operation	Number of passes	Total cost ($/ha)
Conventional		
Offset discs	3	$113
Ripper	1	$94
New		
Bed renovator	1	$63
Difference		**$144**

Joe will implement the practice of wider rows and minimum tillage progressively across his farm as each block moves into fallow. Figure 1 shows the estimated impact on farm gross margin for each year of the transition to the new system. As can be seen in the chart, the change in farm gross margin resulting from the wider rows (shown in dark blue) gradually increases from year one to year seven. The biggest impact comes from the shift to minimum till (shown in light blue), which begins in year seven, at which point the full cost savings of $10,500 ($27 per hectare) are realised. However, it should be noted that potential soil improvements that may result from either the wider rows or the minimum tillage could occur over a longer timeframe.

Figure 1: Progressive change in farm gross margin



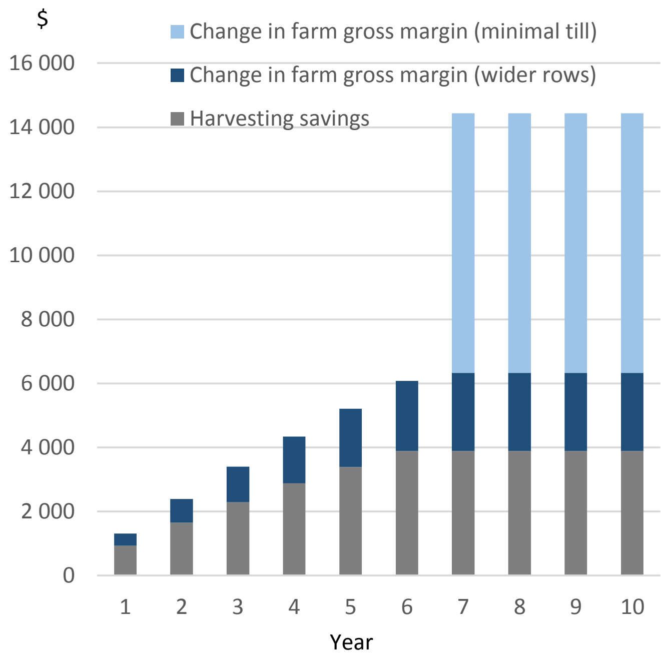
A significant economic benefit resulting from the new system is the savings made from harvesting. Like other machinery operations, the wider rows reduce harvesting costs by decreasing the distance the harvester needs to travel, resulting in lower labour[6] and FORM costs. Normally these benefits would not accrue to growers,[7] as they are typically charged a flat rate per tonne for harvesting irrespective of their specific farm characteristics such as row width or soil type. While Joe's harvesting business is a separate entity, and he charges his cane farming business his standard flat rate, the lower harvesting costs that result from the wider rows nevertheless would constitute an additional incentive for Joe to change to the new farming system.

An analysis of Joe's harvesting costs suggests that he would save about $0.19 per tonne, which amounts to $12 per hectare at his average yield per hectare. Figure 2 presents the progressive benefits of the new system including the savings from harvesting. As the chart shows, the savings from harvesting (shown in grey) increase from $933 in the first year to $3,900 once the full transition has occurred. At this time harvesting savings account for 27% of the total cost savings of the new system.

[6] In this case study, as Joe pays his harvester and haulout drivers by the tonne, and yield has been held constant for the purpose of this analysis, his harvesting labour costs do not change as a result of the shift to wider rows. Instead, the labour savings will accrue to the harvester and haulout drivers in the form of a higher hourly rate, and are therefore excluded from the analysis.

[7] It should be noted that this analysis assumes that the harvesting contractor charges a flat rate per tonne of cane inclusive of fuel. For growers who pay for their own fuel, a portion of the harvesting savings resulting from converting to wider rows would accrue to the grower instead of the harvesting contractor.

Figure 2: Progressive change in farm gross margin and harvesting savings



Investment analysis

As part of the new farming system, Joe purchased the bed renovator and installed GPS guidance on one of his tractors. Joe received Reef Rescue grants for both pieces of equipment, amounting to roughly half of the total investment amount. The details are presented in table 4.

Table 4: Investment details

Item	Grower's contribution	Reef Rescue grants	Total
Bed renovator	$13,550	$12,750	$26,300
GPS	$7,250	$7,250	$14,500
Total	**$20,800**	**$20,000**	**$40,800**

An investment analysis was conducted to determine whether the benefits that result from the farming system change are enough to justify the initial capital outlay. The parameters used in the analysis are presented in table 5.

Table 5: Investment analysis parameters

Parameter	Value
Farm size (ha)	393
Capital cost (total)	$40,800
Capital cost (Joe's contribution)	$20,800
Discount rate	7%
Investment horizon	10 years

The benefits of the new system have been compared to both the total investment cost ($40,800), as well as Joe's contribution ($20,800), to see what impact the Reef Rescue grants had on the profitability of the investment from Joe's perspective. In addition, the impact that the reduction in harvesting costs has on the profitability of the investment is also examined. The annualised equivalent benefit (AEB), discounted payback period and break-even capital of four scenarios are presented in table 6.

Table 6: Investment analysis results

Scenario	AEB ($/ha)	Discounted payback period	Break-even capital
Total investment (no harvesting saving)	-$4	13 years	$29,565
Joe's share of investment (no harvesting saving)	$3	9 years	
Total investment (harvesting saving)	$3	9 years	$49,748
Joe's share of investment (harvesting saving)	$10	7 years	

As the table shows, without including the harvesting savings in the analysis, the total investment amount of $40,800 has a negative AEB of -$4 per hectare per year over a ten year investment horizon, with a payback period of 13 years. However from Joe's perspective, the Reef Rescue grants made the investment worthwhile. If only his share of the investment ($20,800) is included in the analysis, the AEB is $3 per hectare and the payback period is 9 years. A break-even capital analysis suggests that a total of $29,565 could have been spent before the investment became unprofitable.

When the harvesting savings are included in the analysis, the total investment has a positive AEB of $3 per hectare and will be paid back in 9 years, while the AEB of Joe's share of the investment is $10 per hectare, with the investment being paid off in 7 years. Including the harvesting savings in the analysis results in a break-even capital amount of $49,748.

It should be noted that the purchase of the GPS and bed renovator occurred before the transition to wider rows began, however the benefit resulting from the bed renovator doesn't begin until year 7 of the transition. If the purchase of the bed renovator had occurred just prior to it being used, then the purchase amount would have been subject to the discount rate and the investment would look more attractive. To look at it another way, by purchasing the bed renovator early, Joe has foregone the interest he could have earned from the purchase amount during the years prior to using the bed renovator.

If the investment analysis is done assuming the bed renovator was purchased in year 6, the AEB of the total investment (not including the harvesting savings) is only slightly negative, at -$0.89 per hectare per year, with a payback period of 11 years.

Sensitivity analysis

The previous analysis was made based on a number of fixed assumptions such as the price of fuel and labour. As these can both have a significant impact on the profitability of the system change, the following analysis examines the degree to which the AEB changes in response to changes in these variables.

Figure 3 shows the AEB of Joe's share of the investment (not including harvesting savings) at a range of diesel prices (net of GST and diesel rebate). The chart shows that the AEB is relatively insensitive to changes in the price of fuel, with the AEB increasing from $3.18 to $3.72 per hectare with a doubling of the diesel price (from $1 to $2). Note that the AEB increases as fuel price increases, as part of the cost saving from the new system results from reduced fuel usage associated with the wider rows and minimal tillage.

Figure 3: Sensitivity of AEB to changes in fuel price

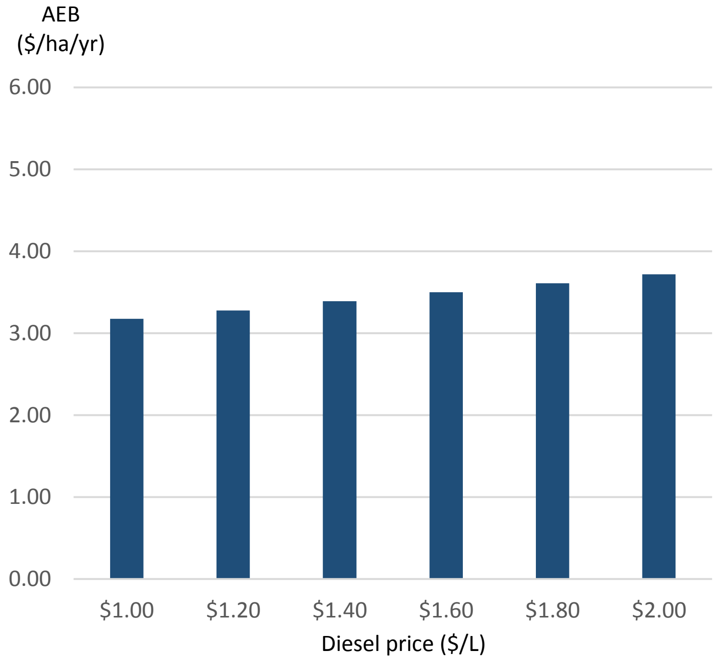
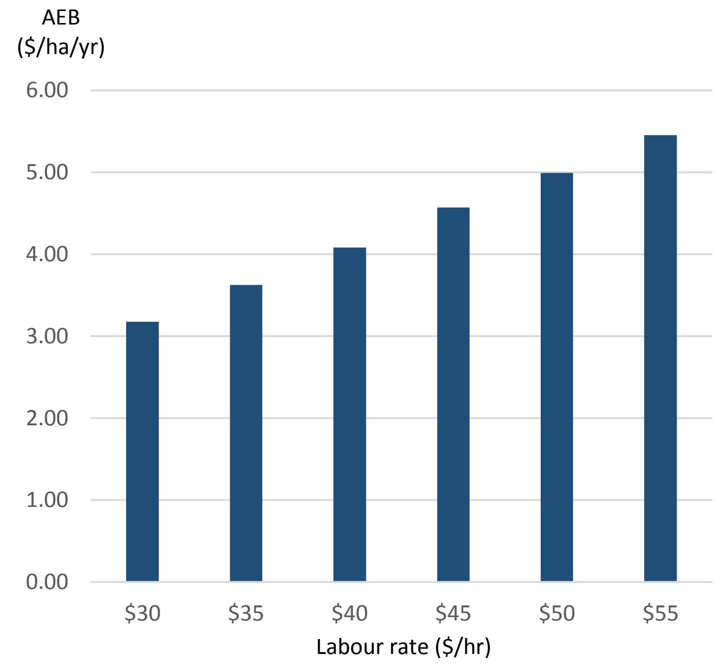


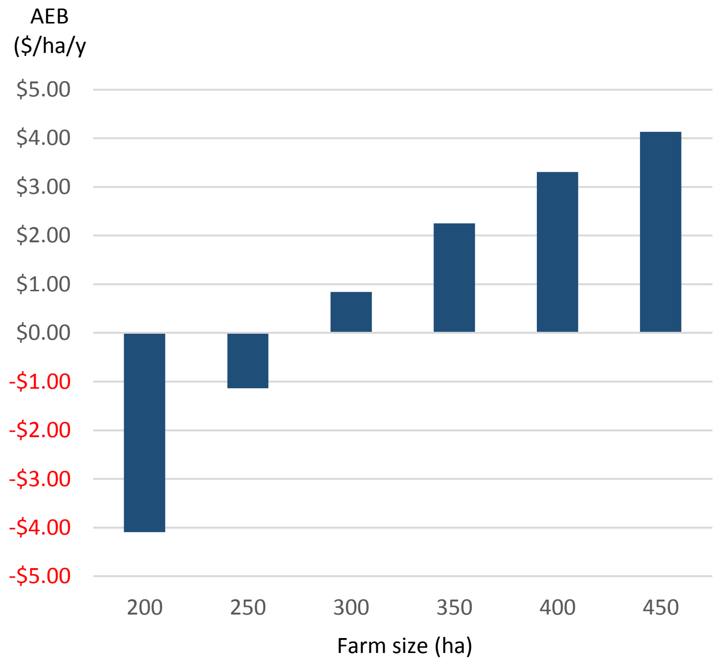
Figure 4 presents a similar analysis in relation to changes in the hourly labour rate. As can be seen in the chart, the AEB is more sensitive to changes in the price of labour, increasing from $3.18 to $5.45 per hectare as the labour rate increases from $30 per hour to $55 per hour.

Figure 4: Sensitivity of AEB to changes in hourly labour rate



Finally, farm size can have a significant impact on the profitability of machinery investments, as investment costs per hectare reduce as farm size increases. Figure 5 shows the AEB of Joe's share of the investment (not including harvesting savings) at a range of different farm sizes. The investment breaks even (with an AEB of zero) at 276 hectares. For farms larger than this, the investment is worthwhile, however for smaller farms the investment would not perform as well as the required rate of return of 7%. It should be noted that this analysis has assumed the farming system change has had no impact on production, whereas the management practice improvements could potentially lead to higher yields and/or CCS due to improvements in soil health.

Figure 5: Sensitivity of AEB to farm size



Conclusion

Joe Marano is in the process of converting his farm to wider rows, with permanent beds and minimal tillage. The management practice changes are expected to improve his farm's profitability, with an increase in farm gross margin of $10,500, or $27 per hectare once the new system is fully established. The conversion to wider rows also generated significant harvesting savings, which was beneficial to the grower as he does his own harvesting.

The new system required the purchase of a bed renovator and a GPS system, which was partially funded with Reef Rescue grants. A number of scenarios were tested to assess the profitability of the investment. The total investment amount, not including the savings from harvesting, was found to have a negative AEB of -$4 per hectare per year. Including the Reef Rescue grants resulted in a positive AEB of $3 per hectare per year. When the savings from harvesting were included, the AEB of the total investment amount was $3 per hectare per year, while the AEB of the investment net of the grants was $10 per hectare per year. The AEB was found to be relatively sensitive to changes in the labour rate, as well as farm size.

This case study is specific to an individual grower and is not representative of all situations. When evaluating a farming system change, it is important to have a detailed plan and an accurate assessment of benefits and costs involved for your own situation.

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Citation

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