GPS levelling trial – economic case study, Mossman region

Grower: Brett Coulthard

Brett Coulthard farms 423 hectares near Mossman, and is conducting a GPS levelling[1] trial to see if he can improve drainage and ultimately cane yield on his farm. GPS levelling is used to smooth out the high and low points in a block, providing a more even slope that improves surface drainage and reduces the risk of water pooling after a rain event. Poor drainage can lead to prolonged water logging, which can significantly reduce cane yield through the loss of nitrogen from denitrification, increased risk of disease and the stunting of root growth. Research suggests that sugarcane crops can lose 0.5 tonnes of cane per hectare for every day they remain waterlogged.[2] In this trial, GPS levelling is being compared with the grower's conventional practice of no levelling, to determine whether there is a sufficient yield benefit to offset the levelling cost.

Key findings

- GPS levelling increased fallow costs by $245 per hectare compared to the grower's conventional practice of no levelling.
- An average increase in yield of 2.2 tonnes per hectare over the crop cycle would be required to offset the cost of levelling.

Trial description

Brett is conducting the trial on a seven hectare block on his Killaloe farm near Mossman. The trial was established in September 2014, with half of the block GPS levelled, and the other half left untreated as a control. Plant cane from the trial block was harvested in August 2015.

Levelling initially involves surveying the block with a GPS-fitted tractor to map the block's contours. The data is then transferred to a mapping program where a smoothed map is generated, which guides the subsequent levelling work. The surveying and mapping is provided by Mossman Agricultural Services (MAS) to growers in Mossman as part of their productivity board levy.

Methodology

This case study investigates the levelling costs (grader [laser scoop] hire, labour and tractor operating expenses) involved with levelling and completes a break-even yield analysis to identify the yield improvement necessary to recover these costs.

The Farm Economic Analysis Tool (FEAT) was used to model Brett's typical growing expenses such as fertiliser application costs, pesticides and other machinery operations. 2015 production data from the trial block is used to compare the performance of the two

[1] GPS levelling differs from laser levelling in that it allows for complex field designs consisting of multiple planes or curves. This is an advantage in blocks with steeper, uneven gradients, as a field design can be created that provides adequate drainage without having to move as much soil, which can significantly reduce the cost of levelling and minimise the amount of soil disturbance.

[2] Davis, M. (2014) Managing poor drainage and waterlogging to improve sugarcane yields. *CaneConnection*, 3, 2.

treatments. In addition, the treatment costs are compared against constant production data to determine the break-even yield required to make the GPS levelling worthwhile economically.

Other parameters used in the analysis include: a sugar price of $430 per tonne;[3] a labour price of $30 per hour; and a fuel price of $1 per litre (net of the diesel rebate and GST). Fertiliser and pesticide prices were sourced from local suppliers.

Results

As the surveying and mapping work is provided by MAS to Mossman growers as part of their productivity board levy, the levelling costs consist of grader hire costs, labour costs and tractor running costs (FORM [fuel, oil, repairs and maintenance]).

In this trial the grader was provided by MAS free of charge, however their normal hire cost of $55 per hour has been used for the purpose of this analysis. Levelling the trial block took around 8.5 hours, and the total cost of grading, (including grader hire, labour and FORM) was estimated at $245 per hectare.

Figure 1 presents the breakdown of the grader costs per hectare. The hire cost of $131 per hectare represented the majority of the total cost, followed by labour ($71 per hectare) and tractor FORM ($42 per hectare).

Figure 1: Breakdown of grader operating costs

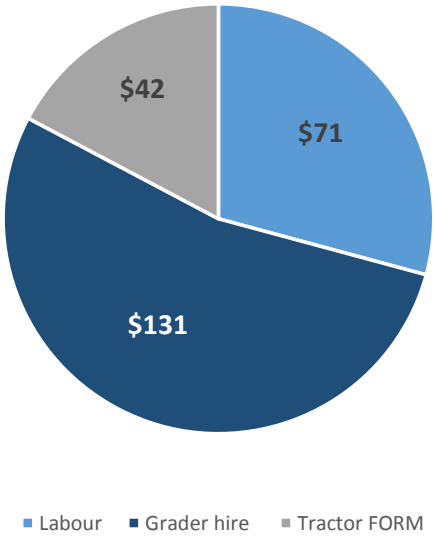


Table 1 compares fallow gross margin[4] per hectare for the levelled and non-levelled sections.

Table 1: Fallow gross margin per hectare

Treatment	Gross margin ($/ha)
Non-levelled	-$990
Levelled	-$1,235
Difference	***-$245***

Table 2 shows the 2015 production results and revenue for the trial block. Contrary to expectations, the levelled treatment had a lower yield, and therefore lower gross margin, than the non-levelled treatment. However, as the trial was not replicated, it cannot be determined whether the difference in yield was a result of the treatments or caused by other factors.

[3] $430 per tonne is the 5 year average (2010-14) of QSL's seasonal and harvest pools.

[4] Gross margin equals revenue minus variable costs, which include chemical, fertiliser, machinery and harvesting costs.

Table 2: 2015 trial results - plant cane yield, CCS and gross margin

Treatment	Yield (t/ha)	CCS	Gross margin ($/ha)
Non-levelled	99.1	14.5	$2,229
Levelled	92.0	14.5	$2,011

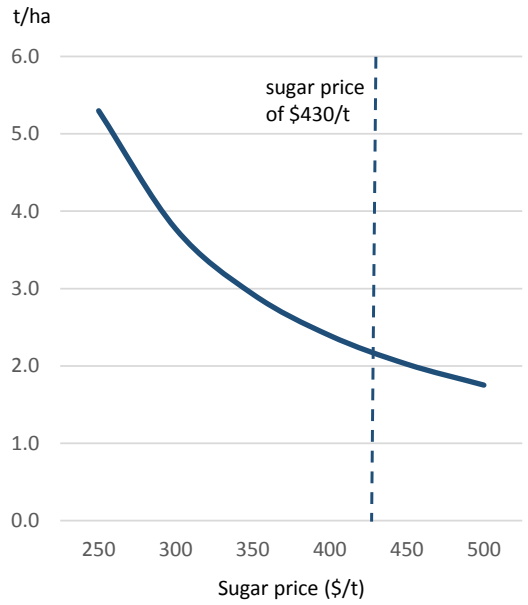
A break-even analysis was also conducted to examine the yield increase required to make GPS levelling worthwhile, assuming it was applied to all fallow blocks on Brett's farm, and levelling was repeated each crop cycle.

The analysis indicates that GPS levelling would need to result in an average increase in yield of 2.2 tonnes of cane per hectare, or 3.2 per cent, over the crop cycle in order to offset the increase in costs.

Sensitivity analysis

The preceding break-even analysis assumed a sugar price of $430 per tonne. Figure 2 examines the sensitivity of the break-even yield to changes in the price of sugar. The chart shows that as the price of sugar rises, a smaller average yield increase is required for the GPS levelling to break even. For example, an increase in the price of sugar from $430 to $500 would result in a break-even yield increase of only 1.8 tonnes per hectare. The changing slope of the line indicates that the break-even yield increase is more sensitive at lower sugar prices, and vice-versa.

Figure 2: Sensitivity of break-even yield to sugar price

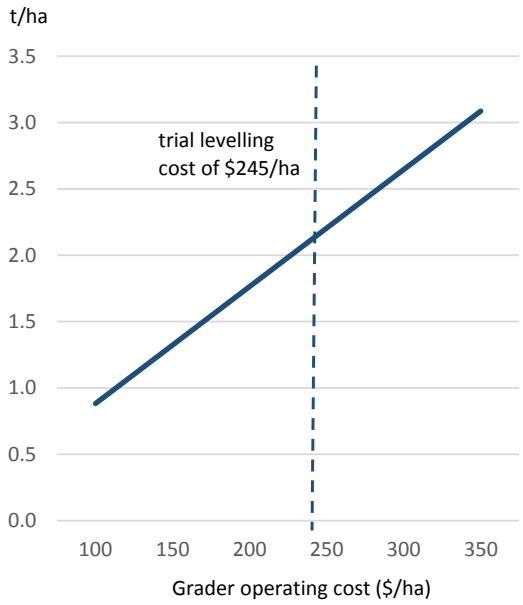


Another factor that could change is the work rate of the grader, which is a critical determinant of the grader operating cost. In this trial, the block took around 8.5 hours to grade, which implies a work rate of 0.42 hectares per hour. The agronomist noted that the trial block was relatively easy to level, as it already had a fairly even fall. For blocks requiring more extensive levelling work, the work rate may be lower, resulting in a higher cost per hectare. For example, if the work rate fell to 0.3 hectares per hour, the operating cost of the grader would increase to $340 per hectare.

Alternatively, levelling costs for a particular block may fall in subsequent crop cycles, as each block may only need some touch up work once initial grading has been completed.

Figure 3 examines the break-even yield increase at a range of grader operation costs. As the chart shows, if the average cost of the grader increased to $350 per hectare (consistent with a work rate of 0.29 hectares per hour), the yield increase required to break even would rise to 3.1 tonnes of cane per hectare.

Figure 3: Sensitivity of break-even yield to grader operating cost



Conclusion

This study examined the cost effectiveness of applying GPS levelling to fallow blocks on a sugarcane farm near Mossman.

Results indicate that levelling increases fallow costs by $245 per hectare, and an average increase in yield of 2.2 tonnes per hectare over the crop cycle would be required to offset the cost of levelling.

Sensitivity analysis shows that the break-even yield is relatively sensitive to both the sugar price and levelling costs.

Acknowledgments

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