

The impact of Smartcane BMPs on business and the environment in the Wet Tropics

Case Study 2: Doug Crees

This case study is the second in a series that evaluates the economic and environmental impact of Smartcane Best Management Practice (BMP) adoption by a number of sugarcane growers in the Wet Tropics of north Queensland. Economic, biophysical and farm management data before and after BMP adoption was supplied by the grower, and the Farm Economic Analysis Tool (FEAT)¹ and CaneLCA Eco-efficiency Calculator (CaneLCA)² were used to determine the impact of these changes on business performance and the environment. The findings of these case studies are specific to the individual businesses evaluated and are not intended to represent the impact of Smartcane adoption more broadly.

Key findings of the Doug Crees case study

The transition to BMP, which began in 2004, has resulted in:

- Annual improvement in farm operating return of \$109/ha (\$16,542/yr total)
- 9kg less pesticide active ingredients and 650kg less nitrogen lost to waterways annually
- Annual fossil fuel use reduced by 18 per cent (or 14 tonnes of fuel over the cane life cycle)
- Greenhouse gas emissions reduced by 19 per cent annually (equivalent to taking 40 cars off the road each year).

About the farm

Doug Crees farms 167 hectares of sugar cane in Mossman, far north Queensland.

Doug plants his own cane and uses a contractor for harvesting. Doug grows a legume fallow in rotation to sugarcane.

Over the past twelve years, Doug has implemented a range of best management practices on his farm to improve profitability and reduce his environmental impact.

Image 1: Doug Crees



What changes were made?

The main changes to Doug's farming system are summarised in Table 1.

To improve soil health, Doug widened his row spacing and reduced tillage. Doug changed his row spacing from 1.52m to 1.68m using GPS guidance. In Doug's experience, 1.68m row spacing has allowed better alignment to the wheel tracks on his tractors without the earthworks needed to move wider equipment around his farm. Changing row spacing is a long term commitment and it took Doug seven years to make these changes across his entire farm.

¹ FEAT is a Microsoft Excel® based tool that models sugarcane farm production from an economic perspective, allowing users to record and analyse revenues and costs associated with their sugarcane production systems. <https://www.daf.qld.gov.au/plants/field-crops-and-pastures/sugar/farm-economic-analysis-tool>.

² CaneLCA is a Microsoft Excel® based tool that calculates 'eco-efficiency' indicators for sugarcane growing based on the life cycle assessment (LCA) method. It streamlines the complex LCA process to make it more accessible to researchers, agricultural advisors, policy makers and farmers. <https://eshop.uniquest.com.au/canelca/>

To improve nutrient management, Doug adopted the Six-Easy-Steps guidelines. Nitrogen rates recommended by Six-Easy-Steps were 115kg/ha less nitrogen in plant cane and 27kg/ha less nitrogen in ratoons than Doug's original practices.

In fallow, Doug reduced his tillage operations by using a direct drill legume planter and replaced his cowpea cover crop with soybeans. Additional changes made by Doug include; ceasing diuron and atrazine application in plant cane and minor chemical store modifications.

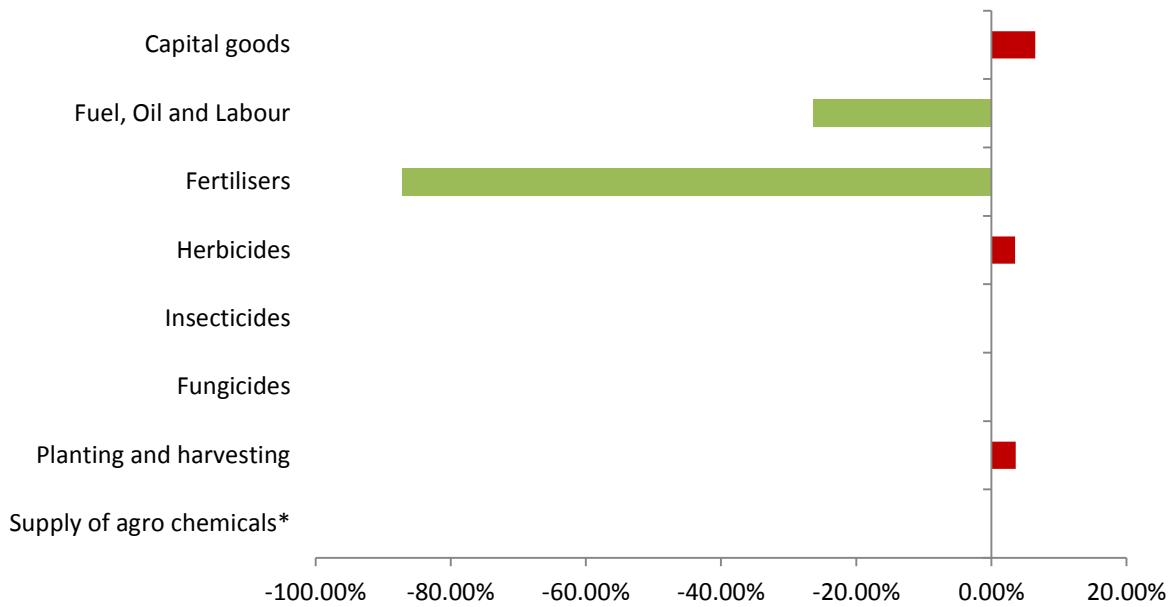
Table 1: Main changes to the new farming system

	Before	After
Weed, Pest and Disease Management	<ul style="list-style-type: none"> 3kg/ha Velpar K4 (468g/kg diuron and 132g/kg hexazinone) in plant cane 1L/ha Gesaprim (900g/kg atrazine) in plant cane 	<ul style="list-style-type: none"> No diuron in plant cane No atrazine in plant cane Balance (750g/kg isoxaflutole) in plant cane
Soil Health	<ul style="list-style-type: none"> Heavy tillage (discing, ripping and rotary hoe) 1.52m row spacing Cow pea fallow crop 	<ul style="list-style-type: none"> Reduced tillage (zonal ripping, no rotary hoe) 1.68m row spacing GPS guidance Soy fallow crop using direct drill
Nutrient Management	<ul style="list-style-type: none"> Grower determined nutrient rate 	<ul style="list-style-type: none"> Six-Easy-Steps nutrient rate in plant cane and ratoons

What does this mean for the business?

Economic analysis indicates that Doug's operating return has increased by \$109/ha/yr (\$16,542/yr total) under the new BMP farming system. This is the result of lower operating costs after BMP adoption. The biggest contributors to change in operating costs were; fertiliser costs (-87 per cent, -\$95/ha); fuel, oil and labour (-26 per cent, -\$29/ha); and capital goods (+6 per cent, \$7/ha) (Figure 1).

Figure 1: Contribution to change in farm operating costs (%)



*Cost to supply agro-chemicals is embodied in fertilisers /herbicide /insecticide /fungicide cost.

In terms of cost savings from BMP adoption, reduction in fertiliser use has had a significant impact. Through adoption of the Six-Easy-Steps nutrient program, Doug now spends \$95/ha less on fertiliser.

Reduced tillage has also made a large contribution to cost savings. Doug now spend \$29/ha less on fuel, oil and labour. Wider row spacing, which reduces tractor hours through the reduction of the total number of rows and therefore distance travelled, has also contributed to cost savings.

Overall, cost savings have more than offset cost increases. In this instance Doug has incurred a small cost increase in fallow, owing to the per hectare cost of soybeans being more than the per hectare cost of cowpea (per hectare cost being a product of the plant rate and seed cost) (Figure 1, planting and harvesting cost, \$4/ha). There has also been a small increase in herbicide costs (\$4/ha) resulting from the transition to pesticides with lower toxicity.

Capital goods (Figure 1) refer to the cost of repairs, maintenance and depreciation of machinery and equipment. After BMP adoption repairs and maintenance costs decreased as a result of reduced tractor hours. However, depreciation increased due to new equipment purchased. Consequently, Doug has incurred a small increase in capital goods costs.

How much did it cost to make the change?

To move to a controlled traffic minimal till system with 1.68m single row spacing, Doug purchased a GPS unit, converted his ripper to a zonal ripper and made modifications to his mechanical weeder. Doug borrowed a direct drill legume planter at no cost.

The total cost of implementation was \$186/ha or \$28,300.

Was the investment profitable?

Results of an investment analysis show that BMP adoption was a worthwhile investment. It would take two years to repay the \$28,300 invested. Over a ten year investment horizon, Doug's investment has added an additional \$100ha/yr to the bottom line (when the initial investment is taken into account) (Table 2). This analysis is based on the assumption that yield is maintained after BMP adoption, which is Doug's experience.

Table 2: Total cost change, capital investment and value of investment

Cost of Implementation (\$/ha)	\$186
Discounted Payback Period	2 years
Annual Benefit (\$/ha/yr)	\$100
Internal Rate of Return	66%
Investment Capacity (\$/ha)	\$886

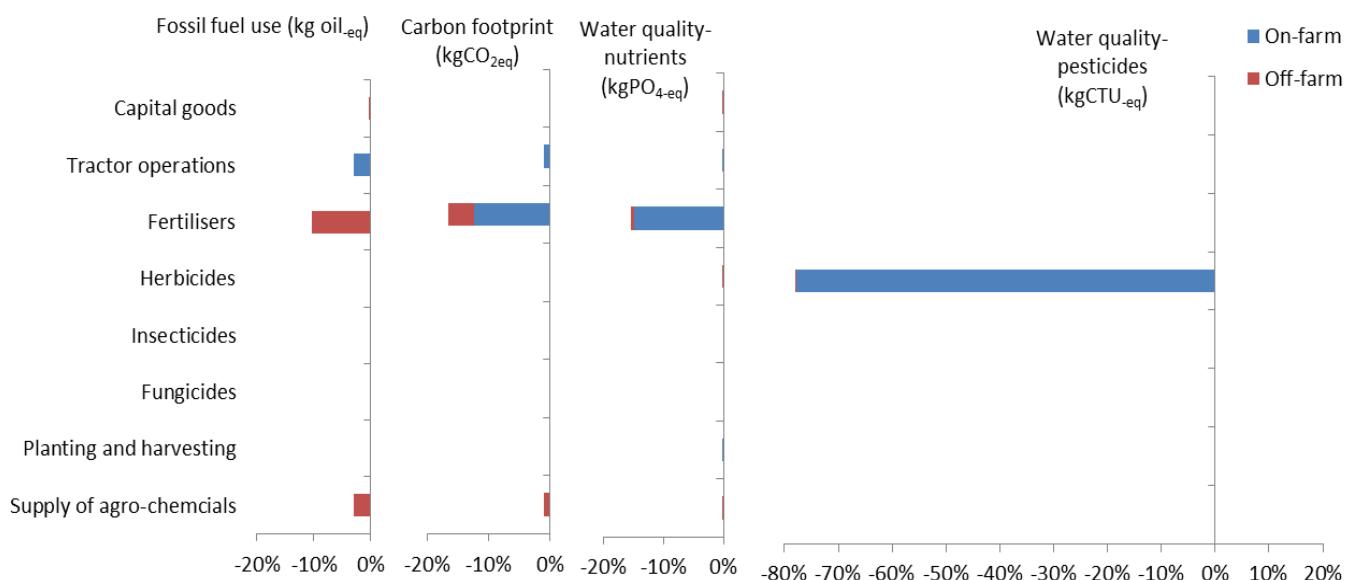
Doug could have invested up to \$134,654 (\$886/ha), or more than four times his actual investment, before the cost savings made by adopting BMP would be insufficient to provide the required (7 per cent) return on investment (Table 2, Investment capacity).

What does this mean for the environment?

The estimated environmental impacts of Doug's farming system before and after BMP adoption are shown in Figure 2.

After BMP adoption, annual fossil-fuel use was reduced by 18 per cent overall. This means avoiding around 14 tonnes of fossil fuel use per year over the whole life cycle of the farming operation³. More than half of this occurs off-farm, due to less fertiliser being produced at the factory and supplied to the farm. Avoided urea use is the biggest energy-saver because its production is energy intensive, but there are also some savings from reduced potassium fertiliser use. The remainder is due to the on-farm reductions in fuel use for tractor operations as a result of reduced tillage and wider row spacing.

³ Fossil fuel use over the whole life cycle of the farming operation includes not just on-farm diesel consumption but also off-farm use of fossil fuels in the production of fertilisers, pesticides, lime, electricity.

Figure 2: Increase / decrease in environmental impacts after adoption of BMP (per ha)⁴

The carbon footprint (greenhouse gas emissions) of cane production is reduced by around 19 per cent overall after BMP adoption. This means avoiding around 123 tonnes of carbon dioxide per year across the whole farming operation, the equivalent of taking 40 cars off the road for a year. Most of the carbon footprint reduction (75 per cent) is due to less on-farm emissions of nitrous oxide⁵ (a strong greenhouse gas) due to the reduced nitrogen application rates. The rest (25 per cent) are due to the avoidance of off-farm production and supply of fertilisers (mostly urea), as well as less tractor use from reduced tillage and wider row spacing.

The potential for water eutrophication from nutrient losses to the environment was estimated to reduce by around 17 per cent. This means the avoidance of around 650kg of eutrophying substances lost to waterways per year. This is all due to a reduced potential for nitrogen loss to surface water runoff and groundwater infiltration, because less nitrogen has been applied.

The potential for aquatic eco-toxicity impacts from losses of pesticides to waterways was estimated to reduce by 78 per cent overall. This resulted from an avoided loss of around 9kg of pesticide active ingredients to water, as well as a change to active ingredients with less toxicity.

What about risk?

When adopting any management practice change there is always a risk that things may not go as planned (e.g. yield loss, financial risk). The adoption of management practices that have been scientifically validated, such as BMP, means that an adverse impact on production is unlikely.

⁴ A negative value is a decrease in environmental impact, and a positive value is an increase in impacts.

kg oil_{eq} = kilograms of oil equivalent, the reference substance for measuring fossil-fuel resource depletion

kg CO₂-eq = kilograms of carbon dioxide equivalent, the reference substance for measuring greenhouse gases

kg PO₄-eq = kilograms of phosphate equivalent, the reference substance for measuring eutrophication of water due to releases of nutrients (N, P) and sugar

kg CTU_{-eq} = kilogram of equivalent critical toxicity units, a measure of eco-toxicity in freshwater due to releases of pesticides

⁵ The assessment assumes a generic nitrous oxide (N₂O) emission factor of 1.99% of applied N lost as nitrous oxide N, which is based on the latest Australian greenhouse gas inventory methodology. The global warming potential is 298 kg CO₂-eq/kgN₂O.

Results of a production risk analysis show that yield across plant and ratoon cane would need to decline by more than 7 per cent before investing in BMP adoption is unprofitable (Figure 3).

From an environmental perspective, for there to be no net gains in environmental impacts (per tonne cane produced), yields across plant and ratoon canes would need to decline by 15 per cent for nutrient-related water quality impacts and 25 per cent for both fossil fuel use and carbon footprint. For pesticide-related water quality impacts, yield decrease would have to be considerable for there to be no net gain (Figure 4).

What's the bottom line?

This case study has evaluated the business and environmental impact of Smartcane BMP adoption for a farm in the Wet Tropics.

Results of the economic analysis indicate that BMP adoption has resulted in cost savings for Doug, largely as a result of reduced fertiliser application. The amount Doug now spends on fuel and labour has also reduced.

Doug invested in a GPS and made some minor machinery modifications to implement BMP. This has proved to be a worthwhile investment.

The most significant environmental benefit for Doug Crees' farm is the reduced potential for water quality impacts from a transition to pesticide with lower toxicity and a reduction in the amount of N fertiliser applied. There are also fossil-fuel conservation and greenhouse gas mitigation gains from a combination of reduced tillage and reduced urea demand.

Each farming business is unique in its circumstances and therefore the parameters and assumptions used in this case study reflect Doug Crees' situation only. Consideration of individual circumstances must be made before applying this case study to another situation.

This case study forms a component of SRA Project 2014/15 (Measuring the profitability and environmental implications when growers transition to Best Management Practices). For further information contact the Townsville DAF office on (07) 3330 4560

Figure 3: Annual benefit of investment (\$/ha/yr) sensitivity to yield

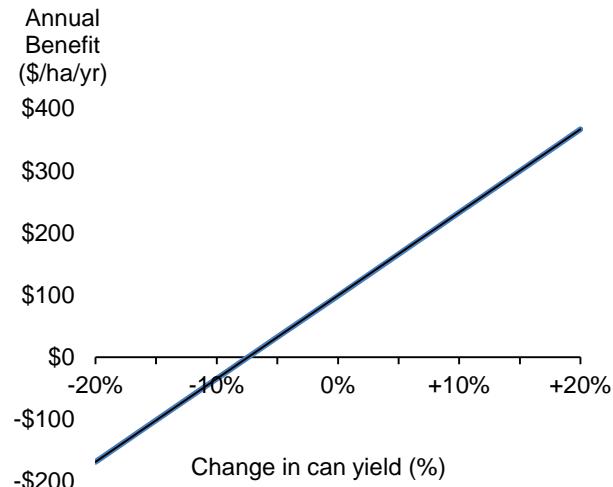


Figure 4: Environmental impact (impact/t cane) sensitivity to yield

