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

Case Study 6: David Singh

This case study is the sixth in a series that evaluates the economic and environmental impact of 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 were supplied by the grower. The Farm Economic Analysis Tool (FEAT)[1] and CaneLCA Eco-efficiency Calculator (CaneLCA)[2] were used to determine the impact of the BMP 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 BMP adoption more broadly.[3]

Key findings of the David Singh case study

The transition to BMP, which began prior to 2000, has resulted in:

- An annual improvement in farm operating return of $107/ha/yr ($81,244 total)
- 370 kg less pesticide active ingredients (52 per cent decrease) and 434 kg less eutrophying substances (nitrogen and phosphorous) potentially being lost to waterways annually.
- Annual fossil fuel use reduced by 10 per cent (or 35 tonnes of oil over the cane life cycle)
- Greenhouse gas emissions reduced by 7 per cent annually (equivalent to taking 56 cars off the road each year).

About the farm

David Singh farms 760 hectares of sugar cane in Carruchan (Kennedy), North Queensland. David does his own planting and uses contractors for harvesting. He grows a legume fallow on half of his fallow area in rotation with sugarcane. David has implemented a range of best management practices on his farm to improve profitability and reduce his environmental impact.

Image 1: David Singh

What changes were made?

The main changes to David's farming system are summarised in Table 1. To reduce compaction and improve soil health, David widened his row spacing from 1.58m to 1.8m (this is close to the 1.83m wheel tracks on his contractor's harvester) and fitted five tractors with GPS guidance. David has moved from conventional to zonal ripping in preformed beds and has halved the area of land rotary hoed. To improve nutrient management, David

[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/*

[3] Various management practice changes have been made progressively by David since 2000 and prior to 2000 (well before the Smartcane BMP program was initiated). Given the progressive nature of the changes and limited accessibility of data in some instances, certain aspects of this case study have been simplified and modelled over a 10 year period (base year: 2007).

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varies fertiliser rates and lime rates between blocks.[4] His applied fertiliser rates have decreased since following Six Easy Steps guidelines. Additional changes made by David include reducing the use of some chemicals whilst maintaining weed control and using a variable rate spray controller (which has improved the accuracy and efficiency of his spray rate). David has improved drainage by laser levelling, undertaking earthworks, and installing underground pipes and spoon drains.

David is an early adopter of new sugar cane varieties and is an active participant in the Tully Sugar Limited led New Variety management program which aims to promote BMP in variety adoption and management.

Table 1: Main changes to the new farming system

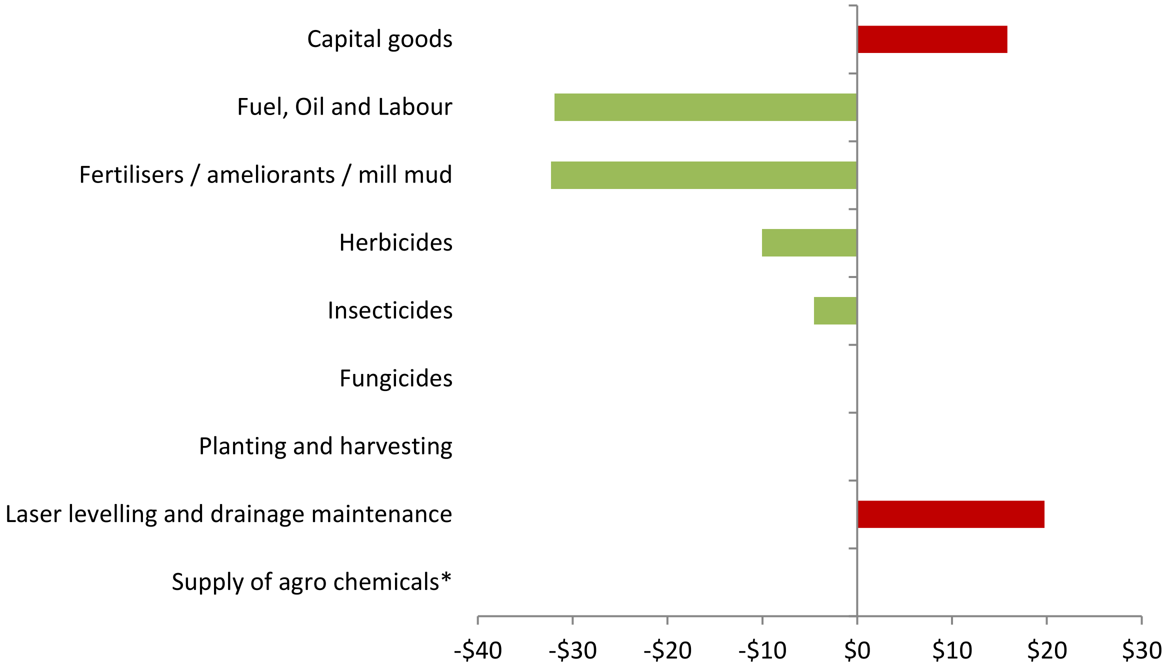
	Before	After
Soil Health	• 1.58m row spacing • No GPS guidance for machinery operations • Conventional planting • Heavy tillage / machinery operations (discing, ripping, strategic rotary hoe 20% of blocks, grubbing, marking out)	• 1.8m row spacing • GPS guidance for machinery operations (auto steer ensures controlled traffic on 1.8m rows) • Bed forming and conventional planting • Reduced tillage/machinery operations (reduced discing, zonal ripping, strategic rotary hoe 10% of blocks, bed forming)
Nutrient Management	• Grower determined nutrient rate • Applying same fertiliser rate across all blocks • Applying same lime rate in all (fallow) blocks	• Following Six Easy Steps guidelines to reduce inorganic fertiliser rates • Varying fertiliser rate between blocks • Varying lime rate between (fallow) blocks
Weed, Pest and Disease Management	• Standard spraying/calibration	• Variable rate spray controller • Reduced use of some chemicals in plant cane and ratoons.
Drainage	• Drainage issues (waterlogging, machinery ruts and bogging)	• Improved drainage (by laser levelling, undertaking earthworks, installing underground pipes and spoon drains)

What does this mean for the business?

Economic analysis indicates that David's operating return has increased by $107/ha/yr ($81,244 total) after making a number of BMP changes. This is the result of lower operating costs after BMP adoption. The biggest contributors to the change in operating costs included: fertiliser and ameliorant costs (-$32/ha); fuel, oil and labour costs (-$32/ha); capital goods costs (+$16/ha); herbicides (-$10/ha); and insecticides (-$5/ha) (Figure 1).

[4] Rates depend on soil tests and are varied between (not "within") blocks.

Figure 1: Contribution to change in farm operating costs ($/ha)



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

After varying his lime (ameliorant) rate between blocks, David now applies lime to 10% less area and his application rate has been reduced by 0.5t/ha. A reduction in fertiliser application rates in David's plant cane has resulted in further cost savings. David has continued using a legume crop for half of his fallow area, but after adoption of Six Easy Steps guidelines, has now adjusted his nutrient application rates to account for nitrogen from the legume crop.

Reduced tillage has made a large contribution to cost savings (reducing fuel, oil and labour costs). 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. In David's experience, GPS guidance also reduces tractor hours.

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. David has also incurred an increase in costs related to maintaining drainage and occasionally laser levelling ($20/ha).

How much did it cost to make the changes?

To move to a controlled traffic reduced tillage system with 1.8m single row spacing, David purchased five GPS units, modified the wheel spacing on his machinery, purchased a zonal ripper and purchased a bed former. A variable rate spray controller was purchased and fitted onto the existing spray equipment. Also, he has progressively laser levelled his farm and completed earthworks to improve drainage.

The total cost of implementation was $735,016 (or $967/ha). The costs for laser levelling and earthworks occurred progressively in each fallow block until full implementation.

Was the investment profitable?

Results of an investment analysis show that BMP adoption was a worthwhile investment. It would take 10 years to repay the $735,016 invested.[5]

Over a ten year investment horizon, David's investment has added an additional $57/ha/yr to the bottom line (when the initial investment, required return of 7 per cent and time to transition to the new system is taken into account) (Table 2).

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

Cost of Implementation ($/ha)	$967
Discounted Payback Period	10 years
Annual Benefit ($/ha/yr)	$57
Internal Rate of Return	13.7%
Investment Capacity ($/ha)	$1,370

This analysis is based on the assumption that yield is maintained after BMP adoption. In David's experience, yields have improved after making the BMP changes. He is of the view that, in particular, the improved drainage on his farm has helped reduce waterlogging and, together with controlled traffic changes, has improved yields.[6]

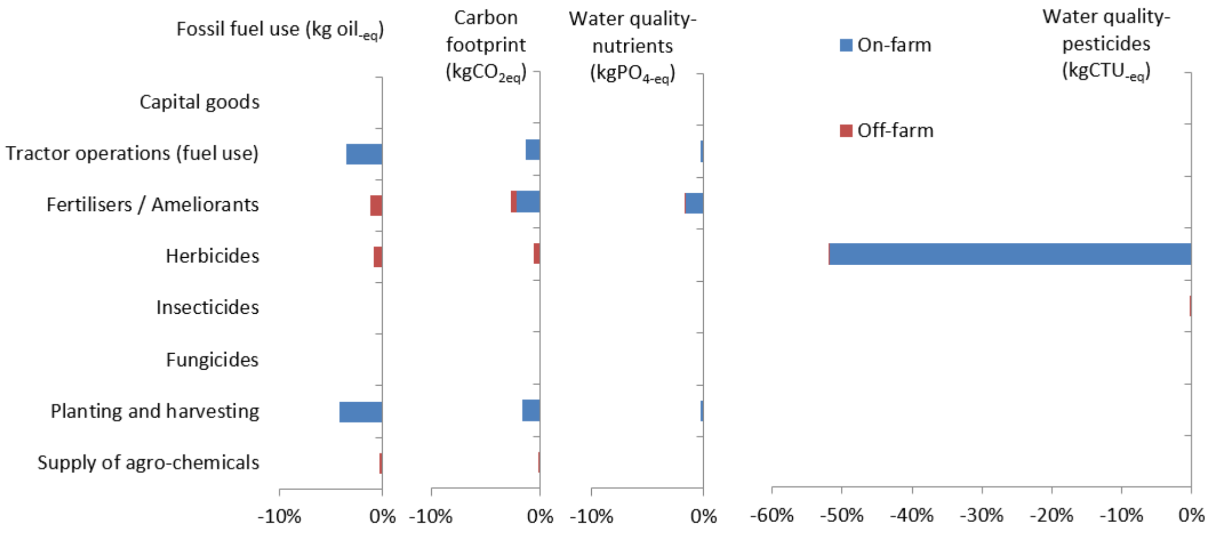
David could have invested up to $1,041,142 ($1,370/ha), or $306,126 ($403/ha) more than his actual investment, before the cost savings made by adopting various BMPs would be insufficient to provide the required (7 per cent) return on investment.

What does this mean for the environment?

The estimated change in environmental impacts for David's farming system before and after BMP adoption is shown in Figure 2.

After BMP adoption, annual fossil-fuel use over the life cycle of cane growing (i.e. on-farm plus off-farm) was reduced by 10 per cent overall. This means avoiding around 35 tonnes of oil equivalent per

Figure 2: Increase / decrease in environmental impacts after BMP changes (per ha)



[5] David expects that if he were to sell his farm, costs of initial laser levelling and drainage earthworks implemented over a 10 year period would be recovered in improved farm value and, therefore, these changes are treated in the analysis as capital improvements.

[6] It is emphasised that this is the personal view of David Singh only. The findings of these case studies are specific to the individual businesses evaluated and are not intended to represent the impact of BMP adoption more broadly. As noted previously, various aspects of this case study have been simplified and modelled. For example, David considers that some machinery upgrades (excluded from this analysis) have also assisted him in applying herbicides during certain "windows of opportunity" when the weather is appropriate and have, in turn, improved yields. Whilst David now grows up to six ratoons on his farm, only four ratoons are modelled to be conservative. It is noted that, whilst extended ratoons (that maintain high yields) may improve profitability, a detailed consideration of any such yield improvements is beyond the scope of this analysis.

year.[7] On-farm fuel use for tractor operations and harvesting was reduced as a result of wider row spacing and reduced tillage. There were also some off-farm reductions in energy use, due to less fertilisers and pesticides being produced at the factory and supplied to the farm.

The carbon footprint, which is the greenhouse gas (GHG) emissions of cane production, was reduced by around 7 per cent overall after BMP adoption. This means that around 174 tonnes of carbon dioxide per year are now avoided over the life cycle of the farming operation, the equivalent of taking 56 cars off the road each year. The sources of reductions in GHG emissions are similar to those described for fossil fuel use. There was also a reduction, however, in on-farm emissions of nitrous oxide[8] (N2O, a strong GHG), due to the reduction in N fertiliser application rates.

The potential for water quality impacts from nutrients losses to water, via surface water runoff and groundwater infiltration, was estimated to reduce by around 2 per cent. This means the avoidance of around 435 kg of eutrophying substances (nitrogen and phosphorus) potentially being lost to water per year. This is again because less nitrogen is now being applied.

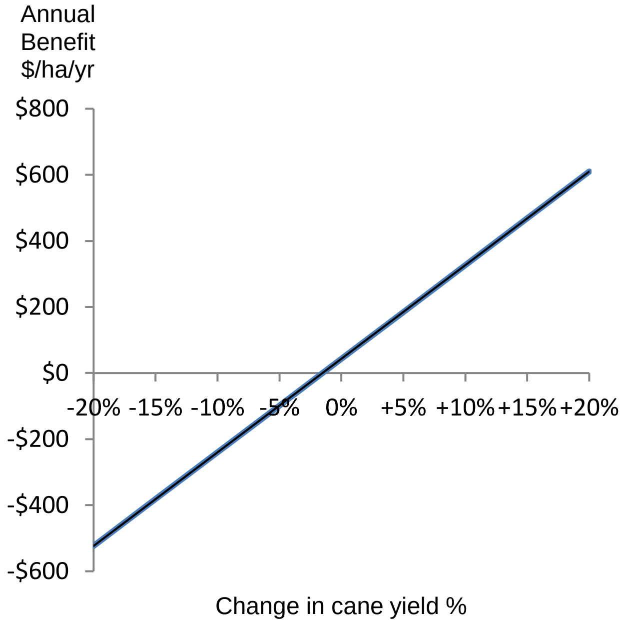
The potential for water quality impacts from losses of pesticides to water was estimated to decrease by about 52 per cent, and is the most significant environmental improvement. The quantities of pesticide active ingredients (AI) applied decreased, resulting in about 370 kg less pesticide AI being lost to water per year. The reduction in toxicity was also due to changes in the types of herbicide AI used, particularly the avoided use of Pendimethalin, and reduced use of Diuron, Hexazinone and Paraquat.

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.

Results of a production risk analysis show that yield across plant and ratoon cane would need to decline by 2% per cent before investing in BMP adoption is unprofitable (Figure 3). Conversely, a small improvement in cane yield would result in substantial economic benefits.

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



From an environmental perspective, the environmental improvements can also be quite sensitive to cane yield. For there to be no net reduction in environmental impacts (per tonne cane produced), yields across plant and ratoon cane would need to decline by only 2 per cent for nutrient-related water quality impacts, 15 per cent for fossil fuel use and 7 per cent for carbon footprint.

Because the improvements in pesticide-related water quality impacts are so high, there is no risk of them being compromised by yield changes (Figure 4).

[7] 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.

[8] The assessment assumes a generic nitrous oxide (N_2O) 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 $CO_{2\text{-}e}$/kgN_2O.

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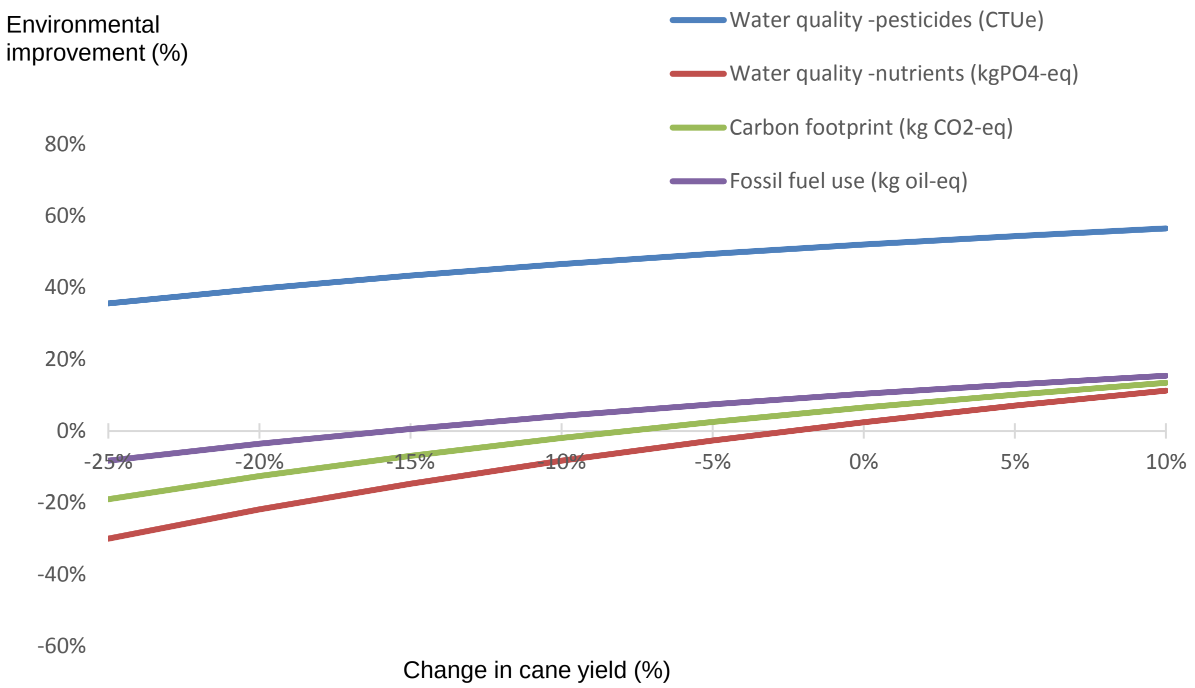
Figure 4: Environmental impact sensitivity to yield



What's the bottom line?

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

Results of the economic analysis indicate that the changes have resulted in cost savings for David, largely as a result of reduced fuel, oil and labour costs, and reduced fertiliser and ameliorant costs. The amount David now spends on herbicides and insecticides has also reduced. David has made a substantial investment in new technology and improved drainage and this has shown to be a worthwhile investment. David has also observed benefits in his farm production since making the changes on his farm.

"Before improving drainage and shifting to controlled traffic I had issues with machinery ruts and bogging and often couldn't get machinery operations done on time. Now, I get better yields and extra ratoons due to being able to do operations on time when they are needed and having better soil health from reduced compaction" – David Singh

The BMP changes have resulted in reductions in the risk of water quality impacts, especially in relation to reduced toxicity due to reduced herbicide application. The reduced risk of eutrophication due to reduced N application is less. There has also been the added bonus of reduced fossil fuel use and greenhouse gas emissions due to less fertiliser production and use, and less machinery use.

Each farming business is unique in its circumstances and therefore the parameters and assumptions used in this case study reflect David Singh's 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

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