WET TROPICS SUGARCANE FRAMEWORK

An economic report card for sugarcane management practice changes critical to water quality

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Practice	Profitability metrics	Risk Analysis	Quality of Evidence
PRACTICES RELATING TO NITROGEN, LEGUMES, HERBICIDES AND WHOLE OF FARM CHANGE. **Practice type:** 'Six Easy Steps' Nitrogen Rate Management → Page 3 Legume Fallow Management → Page 4 Herbicide Management → Page 5 Dual Herbicide Sprayer → Page 6 Whole of Farm transition from C-class to B-class → Page 7 Variable Rate Treatment within blocks → Page 8 Reference list → Page 9 ABCD classes are classified using the P2R Framework.	PROFITABILITY METRICS USED TO ASSESS PRACTICE CHANGE. **Gross Margin (GM)** → Calculated by subtracting variable growing costs from gross revenue over any given period, measured in $/ha. Gross margins do not take into account any capital investment similarly to calculating Farm Operating Return (FOR) and Return on Assets (ROA), which is closely related to Industry Rates of Return, see link. **Farm Operating Return (FOR)** → FOR accounts for fixed costs in a steady state analysis and is one of the overarching outputs of FEAT (economic spreadsheet model). **Investment analysis** → Investment analysis takes capital investment into account and can calculate several measures such as: NPV, AEB, BCR, DPP, IRR and Breakeven analysis (below). **Net Present Value (NPV)** → NPV is the sum of present values of costs and revenue over a period of time (typically 5 or 10 years). The present value is how much a future amount of money is currently worth. **Annualised Equivalent Benefit (AEB)** → AEB is a transformation of an investment's NPV over its lifetime to an annualised measure of benefit or cost and is used to compare mutually exclusive projects with different implementation lengths.	THE MAIN RISK ANALYSES USED ARE SENSITIVITY ANALYSIS AND MONTE CARLO SIMULATION ANALYSIS. **Sensitivity analysis** → Sensitivity in changes of variables, such as yield and sugar price, to economic measures of the performance of an investment. **Monte Carlo simulation analysis** → This technique is used to understand the impacts of risk and uncertainty in a project and uses random samples to evaluate models. PiRisk is a program used by some of the studies which uses this technique. **Yield variability** → Risk is associated with yield. Yield is measured in three different ways: tonnes of cane per hectare (tc/ha), tonnes of sugar per hectare (ts/ha) and Commercial Cane Sugar (CCS). Whether or not yield changes when a practice is implemented is an agronomic question not an economic one. However, the focus will be on the impact on profitability that there would be if there was a hypothetical change in yield. For example, a farmer invests in capital, which is assumed to increase yield, resulting in an increase in profitability if the return on increased yield is greater than the cost of capital over a defined period.	THE RISK SURROUNDING THE QUALITY OF PRACTICE CHANGE EVIDENCE. **Publication ages** → 2004 to 2015 and only relevant for changes in technology. **Trial types** → Most of the replicated and randomised trials are strip trials, small plot trials and there are also pot trials. Other trials are not replicated and cannot be analysed using statistical analysis including demonstration sites and those that cannot be easily replicated (static irrigation systems and whole-of-farm management system changes). Other data used includes yield estimates generated from APSIM (bio-physical model) and economic measures generated from FEAT (economic spreadsheet model). **Soil types** → Multiple, basic description, specific soil name.

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Rating for practices: **POSITIVE ECONOMIC OUTCOME**  **MIXED RESULTS**  **EVIDENCE DOESN'T SUPPORT CHANGE** 	**Benefit-Cost Ratio (BCR)** → BCR is an indicator that attempts to summarise the overall value for money of a project. BCR > 1 indicates positive net benefits, BCR < 1 indicates negative net benefits. **Discounted Payback period (DPP)** → DPP is the time it takes to pay back capital costs, by adding positive discounted cash flow coming from the profits of the project. **Internal rate of return (IRR)/Discount rate** → The discount rate at which the NPV equals zero ranges from 6-7% in these studies. **Breakeven analysis** → Breakeven analysis can test a range of variables including capital outlay, yield and price.		**Locations** → Wet Tropics Natural Resource Management (NRM) region, Great Barrier Reef (GBR) catchments, Burdekin region and Mackay region. **Statistical analyses** → Statistical measures such as: Standard Error (SE), Least Significant Difference (LSD) and Coefficient of Variation (CV). Also Analysis of Variance (ANOVA) and Regression analysis. **Economic measures** → Gross Margin, Net Present Value, Benefit Cost ratio, Internal Rate of Return, Discount rate, Annualised Equivalent Benefit, Payback Period, Maximum initial investment and Capital cost. **Testing risk parameters** → Testing the impact to NPV (or GM) from the risk of changes in the parameters used in the analysis, such as: prices, yields, capital outlays, CCS and discount rate.

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
'Six Easy Steps' Nitrogen Rate Management This is regarded as a B-class practice and is compared to the C-class practice of Grower Developed (GD) rate. ABCD classes are classified using the P2R Framework. **POSITIVE ECONOMIC OUTCOME** 	**It is well known that the marginal benefit of N decreases with higher application rates** and the studies show little evidence of a positive relationship between profitability and the amount of N applied above the 6ES guidelines. **For a large majority of studies, the 'Six Easy Steps' nutrient management strategy was the most profitable.** 	**The economic outcome is sensitive to changes in the price of sugar and fertiliser.** At higher sugar prices or lower harvest costs, the relative profitability of the higher N rate treatments tend to improve. Alternatively, higher fertiliser prices will decrease the relative profitability of the higher N rate treatments. Most studies indicate that there is no capital cost and the largest risk is yield loss. **The magnitude of economic benefit and risk will depend on the N amount that the grower is currently using over the 6ES standards.** 	**Publication year:** From 2009-2015. 2009 Schroeder a, 2009 Schroeder b 2010 Schroeder, 2012 Skocaj 2013 Savina, 2014 Thompson 2015 Van Grieken **Trial Type:** Replicated strip trial: two ratoons (4), three ratoons, plant and three ratoons, plant and four ratoons. Whole of Farm FEAT with APSIM. **Soil Type:** Multiple soil types. **Location:** Various locations in Wet Tropics NRM region. **Statistical analysis:** No (4), Standard Error, Least Significant Difference and Coefficient of Variation. **Economic measures:** Gross Margin, Net Present Value and Annualised Equivalent Benefit. **Risk parameters tested:** None (6), Yield. **Studies do not have enough statistical analyses, economic measures or risk parameters.** 

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
Legume Fallow Management This is regarded as a B-class practice and is compared to the C-class practice of bare fallow. ABCD classes are classified using the P2R Framework. **POSITIVE ECONOMIC OUTCOME** 	All studies indicate that **Gross Margin could be increased with a change to a legume fallow.** 	Most studies indicate that return on capital was highly sensitive to changes in yield, which was mostly maintained when changing to a legume fallow. **Therefore there is low risk.** 	**Publication year:** From 2004 to 2015. 2004 Garside 2007 Poggio, Morris, Reid and DiBella 2007 Poggio, Hanks 2015 Van Grieken **Trial Type:** Large scale experiments, FEAT Whole of Farm (2), FEAT Whole of Farm with APSIM. **Soil Type:** Jarra, Toobanna, Herbert clays and course red sandy loams, Loam. **Location:** Gordonvale, Ingham, Herbert (2), Wet Tropics NRM region. **Statistical analysis:** No (4). **Economic measures:** Gross Margin, Capital Cost, Net Present Value and Annualised Equivalent Benefit. **Risk parameters tested:** No (4). **Studies do not have enough statistical analyses, economic measures or risk parameters.** 

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
Herbicide Management This is regarded as a B-class practice and is compared to the C-class practice for herbicide management. ABCD classes are classified using the P2R Framework. **POSITIVE ECONOMIC OUTCOME** 	2014 Poggio indicate that **B-Class Herbicide practices have increased cost savings from less herbicide use**, which could give a higher Gross Margin than C-class practices. 	The study indicates that B-class Herbicide practices are highly sensitive to changes in yield, with the assumption that new practices have no effect on yield. **Therefore there is low to medium risk.** 	**Publication year:** 2014. 2014 Poggio **Trial Type:** FEAT Whole of Farm with APSIM. **Soil Type:** Tully heavy alluvial on flood plain and light soils on slopes. **Location:** Tully. **Statistical analysis:** Coefficient of Variation. **Economic measures:** Gross Margin, Discount rate, Capital cost, Annualised Equivalent Benefit, Payback Period and Maximum initial investment. **Risk parameters tested:** Yield. **Studies do not have enough statistical analyses, economic measures or risk parameters.** 

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
Dual Herbicide Sprayer This is regarded as an A-class practice and is compared to the C-class practice of using a standard Irvin Boom. ABCD classes are classified using the P2R Framework. **POSITIVE ECONOMIC OUTCOME** 	2013 Thompson indicate that **A-Class Herbicide practices have increased cost savings from substituting the use of residual herbicides for glyphosate**, which could give a higher Gross Margin than C-class practices. 	The study indicates that A-class Herbicide practices are highly sensitive to changes in yield, with the assumption that new practices have no effect on yield. However, a slight reduction to the average ratoon cane yield (of only 0.10%) will cause the DHS investment to be un-acceptable from an economic perspective. **Therefore there is medium risk.** 	**Publication year:** 2013. 2013 Thompson **Trial Type:** FEAT Whole of Farm **Soil Type:** Herbert soil type **Location:** Herbert **Statistical analysis:** No **Economic measures:** Gross Margin, Net Present Value, Benefit Cost Ratio, Internal Rate of Return, Discount rate, Capital cost, Payback Period and Maximum initial investment. **Risk parameters tested:** Yield. **Studies do not have enough statistical analyses, economic measures or risk parameters.** 

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
Whole of Farm transition from C-class to B-class ABCD classes are classified using the P2R Framework. **POSITIVE ECONOMIC OUTCOME** 	All studies indicate that **Gross Margin could be increased, NPV is high and positive and capital cost will be paid back in several years, with a change to a B-class practices.** 	All studies indicate that yield can be maintained, Gross Margin has a higher probability to be positive and there is a high internal rate of return associated with a change to a B-class practices. **Low to medium risk.** 	**Publication year:** From 2010 to 2015. 2010 Van Grieken, 2010 Van Grieken, Star, 2010 Poggio, 2010 Van Grieken, Webster, 2014 Collier, 2015 Thompson 2015 Van Grieken **Trial Type:** Breakeven analysis, FEAT Whole of Farm with APSIM (4), FEAT cost benefit analysis (fallow, plant, 1st ratoon), Single replicated treatments (fallow, plant, 1st and 2nd ratoon). **Soil Type:** Sandy loam, Med-heavy clay, Heavy clay, Alluvial plain, Loam. **Location:** Wet Tropics NRM Region, Herbert, Lower Herbert (5km west Ingham). **Statistical analysis:** No (5), PiRisk (2). **Economic measures:** Internal Rate of Return, Payback Period, Maximum Initial Investment, Discount rate, Capital Cost, Net Present Value and Annualised Equivalent Benefit. **Risk parameters tested:** No (3), Net Present Value/Discount rate, Gross Margin (2), Gross Margin/Yield. **Studies do not have enough statistical analysis.** 

Practice	Profitability metrics	Risk Analysis	Quality of Evidence
Variable Rate Treatment (VRT) within blocks This is regarded as an A-class practice and is compared to the B-class practice of a 'Six Easy Steps' rate across the whole block. ABCD classes are classified using the P2R Framework. **MIXED RESULTS** 	The study indicates that **Gross Margin might be increased by changing from using a 'Six Easy Steps' Rate across the whole block (B-class) to using a Variable Rate Treatment within blocks (A-class)**, if yield/CCS is maintained and savings in growing costs outweigh extra capital cost. In addition, when using a Variable Rate Treatment within blocks (A-class), investment does not provide an acceptable return. Please note that A-class is aspirational and may not be compatible with current farming practices. 	The study indicates that the Variable Rate within blocks (Treatment four) investment return is highly sensitive to maintaining yield. **Therefore there is Medium to high risk.** 	**Publication year:** 2015. 2015 Project Catalyst, Reinaudo Family **Trial Type:** Three replicated strips of four different fertiliser treatments with plant cane and first ratoon. **Soil Type:** Multiple Ingham soils. **Location:** Ingham, Lannercost and Bambaroo. **Statistical analysis:** Least Significant Difference. **Economic measures:** Gross Margin, Annualised Equivalent Benefit, Payback Period, Maximum Initial Investment. **Risk parameters tested:** Capital outlay. Trial work indicates that there is potential to use VRT without significantly impacting yields. However, **there needs to be more studies and economic analyses completed.** 

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