Department of **Employment, Economic Development and Innovation**

Paddock to Reef Monitoring & Evaluation

Economic analysis of ABCD cane management practices for the Burdekin River Irrigation Area

June 2010

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1 Background

1.1 ABCD Framework

The economic analysis is based on the A, B, C and D management practice framework for water quality improvement developed in 2007/2008 by the respective natural resource management region. This document focuses on the economic implications of these management practices in the Burdekin River Irrigation Area (BRIA). A review of the management practices is currently being undertaken to clarify some issues and incorporate new knowledge since the earlier version of the framework. However, this updated version is not yet complete and so the Paddock to Reef project has used the most current available version of the framework for the modelling and economics.

The ABCD framework used in this economic work is based on the ABCD framework as at 2007-2008. Therefore, some of the mechanical operations, chemical use and fertiliser use may not necessarily link up with what growers may think should be in each management class today. The project utilised expert agronomist advice to prepare an initial draft of the operations that could/would be practiced by growers in each management class, and then these were validated and modified with a group of growers to obtain a consensus. The final list of machinery operations, chemical application and fertiliser applications used for the modelling and economic analysis are detailed in the CSIRO MTSRF project 3.7.5.

It must be acknowledged that the machinery operations, chemical applications and fertiliser applications modelled in this project are only one of a myriad of possible scenarios that could equally suit each management class. It is recommended that each individual grower undertake their own research and economic analysis before implementing a change in management practice on their own faming business. From a policy perspective, it is important to note that the results in this report are not prescriptive of every landholder. Some landholders will have higher/lower costs of transitioning to improved practices, and some landholders will end up with higher/lower gross margins that those provided here even if similar operations are practiced.

1.2 APSIM

As part of the CSIRO project specification, sugarcane crop production data for the Burdekin River Irrigation Area was provided by the APSIM model. The information obtained from the APSIM crop modelling programme included:

- Sugarcane yields; and
- Soybean grain yield (this only applies to A class management practice where a Soybean fallow crop was harvested for grain).

Fertiliser application rates detailed in MTSRF project 3.7.5 are not fully supported by growers for the A and B class management categories. For A class management, this project has used the Nitrogen Replacement Theory developed by CSIRO. This method of calculating fertiliser application rates is not yet accepted by industry and has not yet been proven to be either scientifically or economically sound, although further scientific work is on-going. For B class management, fertiliser application rates are based on the 6 Easy Steps programme which is widely accepted by industry. For modelling and economic purposes a specific fertiliser application rate had to be chosen, whereas in reality the application rate is determined using 6 Easy Steps after relevant soil tests. The rate of nitrogen to apply following a legume crop in fallow is also subject to further research and may be influenced by various biophysical, environmental and management factors. A sensitivity analysis was undertaken for plant cane nitrogen rates in A and B class management practices to determine the overall influence on net present value (NPV) results. The

sensitivity analysis indicated that there is no impact on the overall NPV decision rule results when applying additional nitrogen (≤150kg/ha) to plant cane following a legume fallow.

1.3 Economic Analysis

The economic analysis focuses on the implications of changing from D to C, C to B and B to A class management practices. It is recognised that these management practices have certain limitations and in many cases the grouping of practices may not be reflective of the real situation. This aim of this report is to provide a guide to the economic impact that may be expected when undertaking a particular change in farming practices and will ultimately lead to more informed decisions being made by key industry stakeholders.

Because of the complexity involved in the economic calculations, a combination of the FEAT, PiRisk and a custom made spreadsheet was used for the economic analysis. Figures calculated in the FEAT program were transferred to the custom made spreadsheet to develop a discounted cash flow analysis. The marginal cash flow differences for each farming system were simulated over a 5-year and 10-year planning horizon to determine the NPV of changing across different management practices.

PiRisk is a risk analysis tool that can be added into an Excel Workbook and includes macros and distributions that give spreadsheets the ability to conduct stochastic simulations to evaluate risk. The process of risk analysis allows us to test uncertain parameters in an economic analysis and determine the potential risk associated with a change in value. In this economic analysis, a risk analysis was completed for sugarcane price, sugarcane yield and soybean price to determine its impact on farm gross margin for each management practice class.

2 Economic Analysis Parameters

- 240 hectare farm: representing a typical farm size for the region.
- Net sugar price: $349.30. This is the 5 year average price from 2005 to 2009.
- CCS: 14.94. This is the 5 year average CCS for the Burdekin Sugar Mills.
- Sugarcane yields and soybean grain yields determined by APSIM
- APSIM HAT soil type.
- The water applied is held constant across all management classes.
- Contractors used for harvesting, planting and some spraying operations.
- Contract harvest cost: $6.00/tonne for D and C class management practice, $6.30/tonne for B class management practice with GPS guidance and $6.80/tonne with GPS guidance and green cane harvesting for A class management practice.
- Contract planting cost: $370/ha without GPS guidance for D and C class management, $395/ha with GPS guidance for B and A class management.
- Contract spraying cost: $30/ha.
- Fuel price without GST and after rebate: $0.85/L.
- Labour cost: $30/hour.
- Soil tests are $130 each and leaf test are $50 each.
- Figures are exclusive of GST where applicable.
- Burnt cane harvesting is used in all D, C and B class management practices. Green cane trash blanketing is used in A class management practice.
- Crop cycle consists of fallow, plant and three ratoon cane crops. Each part of the crop cycle has an equal proportion of land area.
- Bare fallow used in D and C class management practice.
- Soybean fallow crop grown for green manure in B class management practice and soybean crop grown for grain harvest in A class management practice.
- Maintenance lasering is carried out on half of the fallow area each year in all management classes.
- Gypsum is applied in the fallow area in all management practices.
- All chemical and fertiliser prices are based on April 2010 figures.
- Grower changes from narrow rows (1.5m) to wider rows (1.8m) in the process of implementing controlled traffic as the move is made from C class to B class management practice.
- Detailed machinery operations, fertiliser application rates and chemical application rates are contained in the MTSRF project 3.7.5 document.
- The information presented on A class management practices is based on practices under research, scientifically sound but commercial viability not yet proven and caution must be taken with the interpretation of the actual numbers presented.
- Transaction costs are not included in this analysis. Examples of transaction costs include the time spent purchasing and learning about the new equipment purchased.
- The economic analysis is a steady state analysis for a representative property operating exclusively in each management class. In reality, most farms would operate across a few management classes, and there would varying periods of transition. This analysis assumes that the transition to a new management practice occurs in the first year.

Each farming business is unique in its circumstances and therefore the parameters and assumptions used in this economic analysis do not reflect each individual situation. Consideration of individual circumstances must be made in order to make an informed investment decision.

3 Gross Margins

The main objective of this section is to identify the gross margin of fallow, plant and ratoon cane crops (Table 1). The economic analysis focuses on two types of fallow management, bare fallow and soybean fallow crop. Legume crops (eg. soybeans) can either be grown as a green manure or harvested grain crop in the Burdekin region due to the availability of water for irrigation and suitable environmental conditions. The ABCD framework specifies a bare fallow in C and D class management practice, soybean green manure crop in B class management practice and soybean harvested grain crop in A class management practice. Labour has been treated as a variable cost ($30/hr) in the gross margin analysis to allow for a more accurate comparison between management practices. It should be noted that as cultivation decreases when transitioning from D to A class management practices, the additional labour savings contribute to the higher gross margin.

Table 1 shows a trend of increasing farm gross margin per hectare as management practices change from D class through to A class management. This trend is largely associated with savings in tillage, fertiliser, weed control and labour costs in the plant and ratoon cane crops. A substantial increase in farm gross margin is indicated in the change from D through to C class management practices. The fallow gross margin is negative for B, C and D management practices due no revenue being generated. A positive fallow gross margin is displayed in A class management practice due to the soybean crop being harvested for the sale of grain. As anticipated, the gross margin for plant cane crops is lower than ratoon cane crops because of the higher input costs associated with plant cane operations (eg. tillage and planting).

Table 1. Gross Margins

Scenario Name	Plant Cane GM/ha	Ratoon 1 GM/ha	Ratoon 2 GM/ha	Ratoon 3 GM/ha	Bare Fallow GM/ha	Soybean Fallow GM/ha	Soybean Grain Crop Fallow GM/ha	Farm GM/ha
A Class	$1,242	$2,113	$2,342	$2,267	NA	NA	$208	$1,634
B Class	$1,722	$2,095	$2,319	$2,246	NA	-$929	NA	$1,491
C Class	$1,324	$1,800	$2,040	$2,006	-$767	NA	NA	$1,281
D Class	$620	$1,409	$1,650	$1,619	-$761	NA	NA	$907

4 Characteristics of Management Class Change

Table 2 shows the potential practice changes that a grower may undertake in the transition from one management class to another management class. It has also been assumed that the grower changes from narrow rows (1.5m) to wider rows (1.8-2.0m) in the process of implementing controlled traffic as the move is made from C class to B class. The changes listed will vary for every individual business depending on their soil type, farm size, machinery, access to contractors, and individual circumstances.

Table 2. Potential practice changes

D class to C class
Reduction in the number of soil preparation passes pre cane planting
Reduction in the number of cultivations post cane planting
Reduction in cultivation in ratoon cane
Reduction in fertiliser application rates
More flexible chemical strategy across the farm (eg. use of spray out in fallow and herbicides in plant cane)
Slightly better record keeping
Decrease in farm labour requirements
C class to B class
GPS used for cane planting and harvesting equipment
Controlled traffic at 1.8m row spacing
Further reduction in tillage passes pre and post cane planting
No tillage in ratoon cane
Soil tests undertaken in each fallow block before planting
Fertiliser application rates based on soil tests
Use of soybean legume crop in fallow area, legumes grown on raised beds
Increased chemical use – but targeted to each blocks requirements
Use of more accurate spray nozzles – matched to job
Development of a soil management plan
Development of computer skills
Much better record keeping
Use of climate and weather forecasts
Decrease in farm labour requirements
B class to A class
All major machinery controlled by GPS guidance
Green Cane Trash Blanketing (GCTB)
Controlled traffic at 1.8m row spacing
Zero tillage post cane planting
Trash rake used in ratoons for GCTB
EM mapping of farm
Soil test taken in each fallow block and selected leaf tests undertaken
Use of soybean legume crop in fallow area, legumes grown on raised beds and harvested for grain
Knockdown chemicals used more and residual chemicals used less
Zonal spraying with a hooded sprayer
Continued development of computer skills
Decrease in farm labour requirements

5 Capital Costs

The capital costs incurred by a grower transitioning from one management class to another will vary substantially and largely depend on individual circumstances. The capital costs that have been included in this economic analysis are shown in Table 3.

Table 3. Capital Costs

Capital Item	**Cost ($)**
D Class to C Class	
Bed former	35000
Total	35000
C Class to B Class	
Stool splitter fertiliser box	50000
Sprayer modifications	10000
Harvester modifications	12500
Farm tractor modifications	1500
Total	74000
B Class to A Class	
GPS on farm tractor	40000
Shielded sprayer	28000
Trash rake (GCTB)	18000
Total	86000

In addition to the capital costs in Table 3, there are some annual costs associated with changing management class. These annual costs are associated with the nutrient management programme used in A and B class management practices. Annual costs include:

- Soil tests: 2 soil tests per annum for B class management and 4 soil tests per annum for A class management
- Leaf tests: 2 leaf tests per annum for A class management

6 Investment Analysis

An investment analysis was undertaken using the net present value (NPV) technique to determine if the investment in capital is worthwhile and creating value for the farming business. The investment analysis framework implicitly accounts for the opportunity cost of the extra capital investment involved. Given the economic parameters used in the analysis, an investment should be accepted if the net present value is positive and rejected if it is negative. A discount rate of 7% has been used to convert the future cash flows of the cane business to their present values (value in today's dollar terms).

Table 4 below shows the net present values associated with changing from one class to another class over both a 5 year and 10 year investment period. The NPV's are greater for the 10 year investment period due to the fact that the large capital costs are incurred at the beginning of the investment, but the smaller improvements in cash flow are received annually. Thus the longer the investment time period, the more years of increased cash flow to offset the initial capital investment.

Table 4. Net Present Values

Change in management practice class	Net Capital Investment	NPV (10 year analysis)	NPV (5 year analysis)
D to C	$35,000	$594,256	$332,345
C to B	$74,000	$279,846	$132,567
B to A	$86,000	$156,474	$55,551

Changing from D to C requires $35,000 additional capital outlay and earns a positive NPV of $332,345 (5 years) and $594,258 (10 years). The results indicate that a change in management practice from D to C is worthwhile from an economic perspective.

Changing from C to B requires an additional capital outlay of $74,000 and displays a positive NPV of $132,567 over a 5 year investment horizon. The 10 year investment horizon revealed a positive NPV of $279,846. The results indicate that changing from C to B class management practices is a worthwhile investment for the farming business.

Changing from B to A requires an increase in capital investment of $86,000 and is likely to produce a positive NPV of $55,551 (5years) and $156,474 (10 years). The results indicate that a change from B to A class management practice is a worthwhile proposition from an economic perspective.

7 Risk Analysis

Risk analysis has been undertaken due to the uncertainty that surrounds future cash flows. These future cash flows can vary due to the variability in prices received and yields obtained from both the sugarcane and fallow crops.

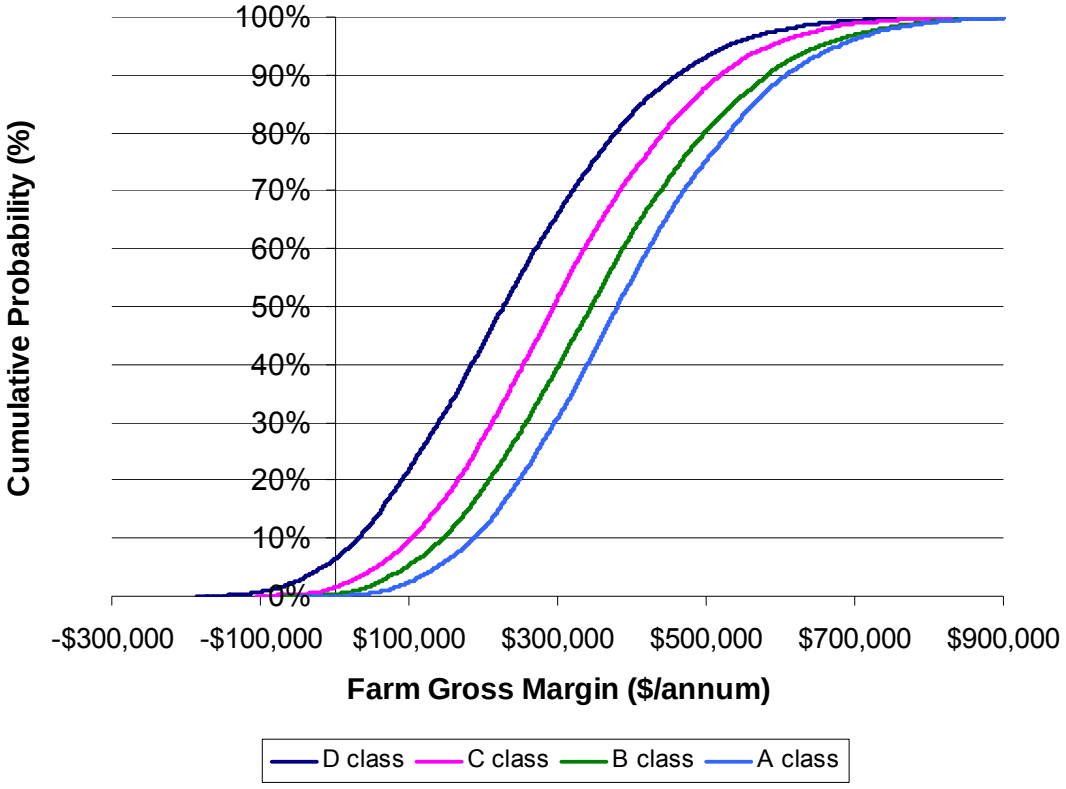
PiRisk was used to introduce stochastic properties (variability) into the analysis by specifying probabilistic distributions for the variables that are considered most important. The outcomes for the risk analysis are arranged as cumulative probability distribution curves. The risk analysis focuses on variability in sugarcane price, sugarcane yields and soybean price.

In the last 10 years, the sugar price has varied between $230 and $450 per tonne, while the average of the last 5 years is $349.30 which is the base sugar price used for the analysis. For the risk analysis, the minimum price has been set at $230/tonne and the maximum price at $450/tonne. The base case cane yields for the plant and ratoon crops were obtained from the APSIM crop model that uses approximately 100 years of weather information for a particular site and the relevant soil type to calculate expected yields.

The average soybean price has been assumed at $450/tonne in the base case. For each variable, the probabilities and values have been set so that the expected value of the distribution is approximately the same as the value generated by APSIM.

PiRisk was used to conduct 10,000 simulations of the farm gross margin with random values being chosen from the probability distributions for prices and yields of both sugarcane and soybeans. The farm gross margin for each of the simulations is plotted on the cumulative probability graph in Figure 1.

Figure 1. Distribution of farm gross margin



The PiRisk analysis indicates that the progression towards A class management practice will improve the probability of achieving a higher farm gross margin. This suggests that farms using improved management practices will have a higher farm gross margin, all else being equal, in any given year. The graph emphasises the superiority of A and B class management practices over the other options, however this does not take into account fixed costs or capital investment required to make the transition. Therefore, the interpretation of this graph should be carried out in conjunction with the NPV figures outlined in section 6 of this report.

8 Conclusions

This economic analysis is based on APSIM modelled cane and soybean yields, the assumptions discussed in Section 2 and the costs associated with transitioning discussed in Section 4. The results indicate that the transition from D to C, C to B and B to A is a worthwhile proposition from an economic perspective for both the 5 year and 10 year investment period. The change from D to C class management practice provided the highest NPV result.

The risk analysis showed that in any specific year, a grower will receive a higher farm gross margin when operating with an improved class of management practices. The results indicated an increase in farm gross margin when progressing through the management practice classes from D to A. This suggests that A, B and C class management practices will be stronger financially than those persevering with D class practices.

This economic analysis has shown that there are expected economic benefits when moving from D to C and C to B and B to A class management practices. The benefits will vary for each individual grower and will depend on their starting point and individual circumstances. Although the results indicate a positive NPV when moving from B to A class management practices, the outcome of this transition will strongly depend on the ability to successfully implement these commercially unproven practices. As previously noted, the costs and benefits associated with a transition will be different for each individual grower and therefore each circumstance needs to be carefully considered before making a change in management practice.