DECREASING BANK DENSITY AND WIDTH INCREASES LANDCARE PROFITABILITY

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Abstract

A case study approach was used to analyse the profitability of “trees on banks” landcare strategies located in the Upper Blackwood Catchment. The three sites: ‘The Meadows’, ‘Ucarro’ and ‘Acadia’ are located in the shires of Broomehill, Katanning and Wickepin respectively. Landholders at these sites have employed a trees on banks landcare strategy in an effort to alleviate waterlogging, reduce erosion, provide shelter, control rising water tables and/or salinity problems.

The profitability of the landcare strategies implemented at each site were assessed using a Benefit Cost Analysis (BCA). For this analysis, implementation costs, estimates of the production benefit realized due to implementation of the landcare strategy, the likely decline in arable area and the gross margin if no landcare was undertaken, were derived for each site after consultation with the landholders.

The most profitable landcare strategy was “The Meadows” strategy (BCR = 1.41). This was due to the density of banks and the cost of implementation per 100 ha being the lowest of the three sites. Ucarro and Acadia have benefit cost ratio’s of 0.89 and 0.08 respectively

From these analyses, the profitability of trees on banks farming systems is shown to be highly dependent on the interactions between several variables. These variables include: the density and cost of the strategy per 100 ha, the area of land taken up by the landcare strategy, the gross margin decline under a ‘no landcare’ strategy and the production benefit derived from implementing the landcare strategy. These results suggest that position in the landscape and the severity of waterlogging, erosion and salinity will influence the profitability and adoption of high water use farming systems in the Upper Blackwood Catchment.

Introduction

Three sites are located in the Upper Blackwood Catchment. These sites are part of a long-term research study assessing the water use of the trees on banks strategies. The profitability of these landcare strategies has been determined as part of the project. All sites have implemented a trees on banks (TOB) strategy to address problems such as waterlogging, soil erosion, salinity and wind exposure.

The aim of this analysis was to assess the profitability of each trees on banks strategy and determine the main factors that drive trees on banks profitability. It was assumed through the implementation of these strategies the land management problems were alleviated and the decline in arable land was halted. The profitability of the different trees on banks landcare strategies were determined for different land degradation conditions for the application of these strategies to other parts of the catchment.

THE METHOD

Trial Sites

The three sites strategies vary in terms of the density of banks, bank types, and implementation costs. Table 1 summarises the comparative information about the trial sites.

Table 1: Information about the three trial sites.

	The Meadows	Acadia	Ucarro
Landcare Strategy	Trees on Banks	Trees on Banks (incl. Oil Mallees)	Trees on Banks
Shire Location	Broomehill	Wickepin	Katanning
Type of Banks	Grade banks	Dozer banks	Excavator banks
Total Area of trial site	80 ha	166 ha	96 ha
Trees on Banks Density per 100 ha	2.6km	4.9km	5.6km
Cost of strategy per 100 ha	$9241	$24412	$26497
Area taken up by the landcare strategy	3.8%	12.2%	10.6%
Purpose of implementation	Waterlogging Wind breaks Biodiversity	Erosion Waterlogging Oil mallees	Erosion Waterlogging Wind breaks

Table 1 highlights the major differences between the three trial sites. The Meadows strategy has the lowest density of banks, takes up the least area and cost the least to implement. The differences in the implementation costs are mainly due to the different types of banks constructed. Acadia and Ucarro implemented bull dozer or excavator banks, where as grade banks were constructed at the Meadows site at a lower cost. At all three trial sites fencing costs represented between 50% and 60% of the total implementation costs.

Benefit Cost Analysis

Benefit-Cost Analysis (BCA) is an investment technique used to rank and assess different landcare projects.

The BCA's contained in this section were conducted over a 20-year period using a discount factor of 7%. A standard gross margin of $121/ha was used for all three trial sites in order to generate yearly cash flows. The net present value of the cash flows were calculated for both "landcare" and "no landcare" scenarios. If the difference between these two scenarios is positive, it indicates a profitable landcare strategy. The difference between the "landcare" and 'no landcare" scenarios is then divided by the net present value of the cost of the "landcare" strategy in order to generate a Benefit Cost Ratio (BCR). If the BCR is greater than 1, it indicates that the project is profitable and the landcare strategy will return an amount that is greater than the cost of implementation. However if the BCR is less than 1, it indicates that the landcare strategy will not breakeven and requires the generation of non-market benefits in order to breakeven.

Variables

In order to conduct a benefit cost analysis on the trial sites, it is necessary to generate three key variables. These variables are the area lost to land degradation if no landcare work was undertaken, the gross margin decline if no landcare work was undertaken and the gross margin production benefit generated by the landcare work. These variables were derived in consultation with each landowner and have some error as no objective measurements were made. Table 2 summarizes the variable used.

Table 2: Variables used in the Benefit Cost Analysis

	The Meadows	Acadia	Ucarro
Decline in arable land if **no** landcare was undertaken	-0.2ha/year 4 ha at the end of 20 years	-0.4ha/year 8 ha at the end of 20 years	-0.25ha/year 5 ha at the end of 20 years
Rotational gross margin decline if **no** Landcare was undertaken (percent decline per year)	-1% $121/ha to $99/ha after 20 years	-0.5% $121/ha to $109/ha after 20 years	-2% $121/ha to $81/ha after 20 years
Rotational Gross Margin Production benefit due to the Landcare strategy (percent increase realized in first year)	5% $121/ha to $127/ha	10% $121/ha to $133/ha	10% $121/ha to $133/ha

RESULTS

Using the information in Table 1 and the variables in Table 2 it is possible to calculate the benefit cost ratios for the three trial sites. These are shown in table 3 below.

Table 3: Calculated Benefit Cost Ratios for the three trial sites

	The Meadows	Acadia	Ucarro
Benefit Cost Ratio (BCR)	1.41	0.08	0.89
Production benefit required to breakeven i.e. BCR=1	Not applicable as BCR>0	33.8% $121/ha to $162/ha	12.7% $121/ha to $136/ha
Extra Annual benefit per hectare required to breakeven i.e. BCR=1	Not applicable as BCR>0	$21.24/ha/y	$2.78/ha/y

All three trial sites have positive BCR's, indicating that these landcare projects generated a cash flow greater than the "no landcare scenario". However, only one of the projects, The Meadows, generated sufficient extra benefit to cover the costs involved in implementing the landcare strategy. The Meadows strategy has a BCR of 1.41, which indicates that over the 20-year period of analysis this project returns an extra 41 cents for every dollar invested. The Acadia strategy needs to generate an extra $21.24/ha/year while the Ucarro strategy only has to generate an extra $2.78/ha/year in order to breakeven.

The extra benefit required to breakeven can be generated by benefits that are not included in this analysis. Both landowners indicated that the benefits they experienced were greater than the extra benefit required to breakeven. Some examples of benefits not included in the analysis are:

- Crop management improvements e.g. the ability to sow and spray crops at optimal times
- Reduction in grain losses due to shedding
- Long term soil structure improvements
- Erosion has been reduced to zero preventing the loss of soil and nutrients
- Bio-diversity benefits
- Improvements in the value of land
- Sheep management

Sensitivity of Variables

Trees on Banks Density

Trees on bank density is related to the gradient of the landscape, with higher densities required on steep landscapes as well as waterlogging prone sites. Increasing TOB density has the influence of decreasing the BCR and landcare profitability at the three trial sites as shown in Figure 1. This is due to the combination of extra cost incurred during implementation and the increase in the area taken up by the TOB.

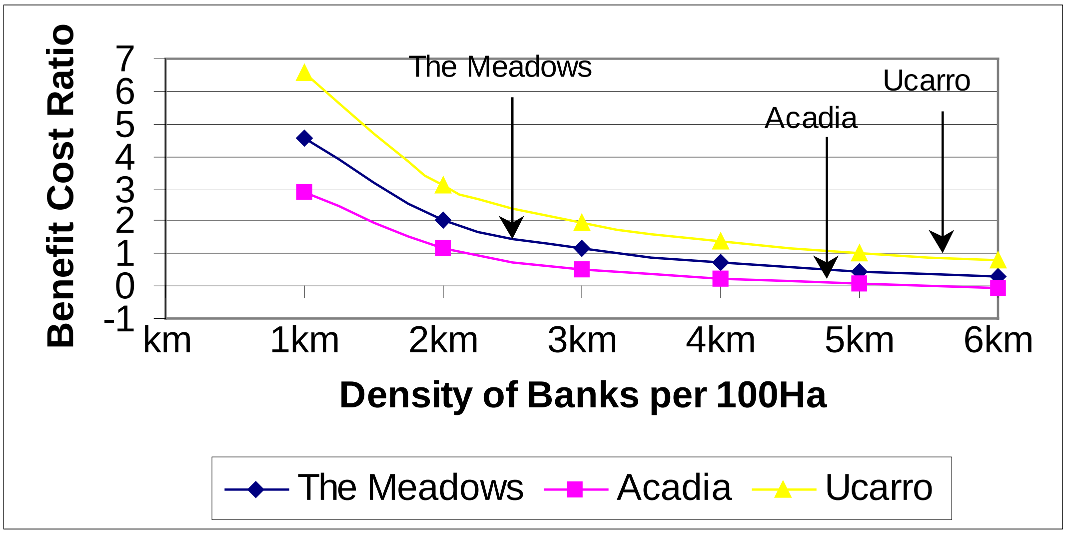

Figure 1: Hypothetical Profitability of Landcare Strategies at Different Trees on Bank Densities (Arrows indicate the density of trees on banks implemented at each site).

Width of Trees on Banks

The width of TOB refers to the area taken out of production by the trees on banks strategy. The Acadia strategy has a TOB width of 25 metres and takes up an average of 12.2% of the total area. While the Ucarro strategy has a TOB width of up to 20 metres and takes up an average of 10.6% of the total area. The Meadows strategy has a TOB width ranging between 10 and 15 metres and the lowest area (3.8% of total area) taken out of production. Increasing TOB width has the effect of reducing landcare profitability primarily due to the increase in the area of land taken out of production. As more land is taken out of production by the landcare strategy, the remaining land needs to be able to generate sufficient cash flow in order to cover the lost income from the area now taken up by the landcare strategy. Decreasing the width of the TOB also has a flow on effect of lowering implementation costs. This is because either the bank is not installed (i.e. trees only) or the width of the tree belt is reduced. Figure 2 suggests that the Ucarro strategy have a greater chance of breaking even if TOB were implemented at a width of 5 metres.

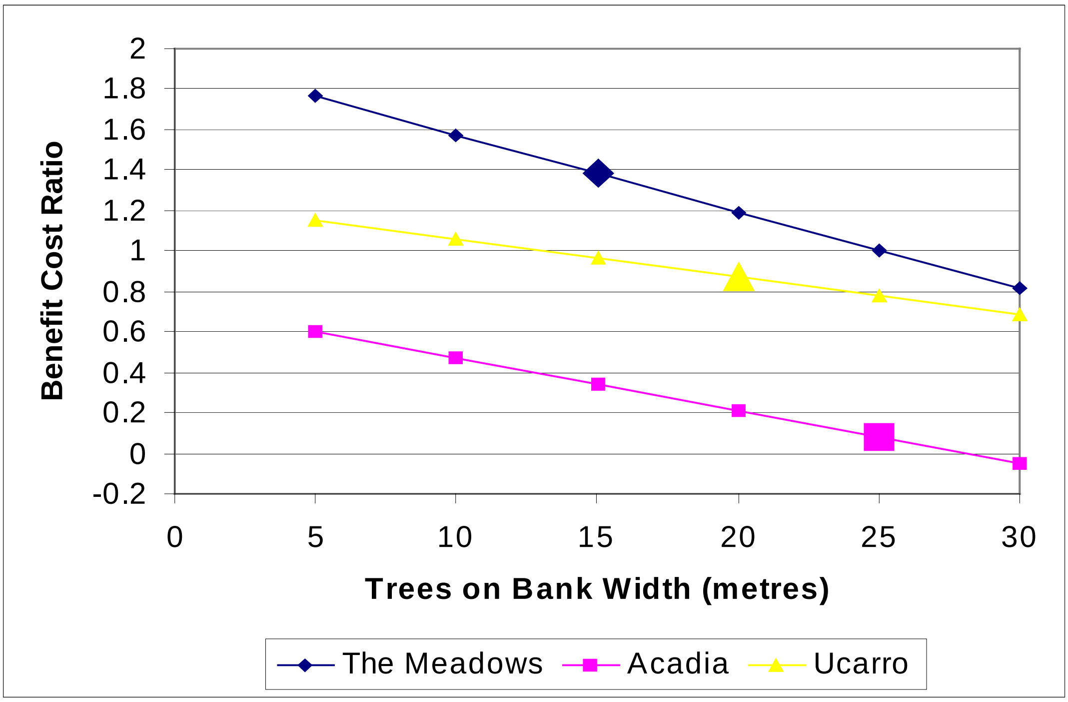

Figure 2: Hypothetical Profitability of Landcare Strategies at different Trees on Banks Widths (Large symbols indicate the BCR calculated for each trial site)

Production benefit

Production benefits relate to the increase in gross margin received by the landholder due to the landholder undertaking the landcare work. The production benefits generated by the landcare strategy can be either market based such as improved yields or non-market based such as aesthetics or biodiversity. Market based production benefits could include an increase in cash inflow in the form of yield/quality improvements or savings in cash outflows in the form of reduced fuel bills. These production benefits mainly come in the form of increases in yield, due to reductions in waterlogging (Cox and Negus, 1984). Well designed, surveyed and constructed drains could be expected to increase crop yields during a waterlogging year by about 1 tonne per ha on an average of 50 metres downslope of the drain (Cox and Negus, 1984). In 1981 grain yield losses of 89 per cent for severely waterlogged areas and 56 per cent for moderately affected areas were measured in the Narrogin and Cuballing Shires (Cox and Negus, 1984). The assessment of production benefits generated by landcare works is often difficult because farming systems that were previously impossible are able to be practiced after drainage (Gardner, 1990).

A constant yearly production benefit measured as an increase in the gross margin is used in this analysis. The production benefit is recognised in the first year of implementation. This is an acknowledged simplification of a real world situation in which the production benefit is likely to vary considerably from year to year depending on the severity of waterlogging. It is also assumed that the TOB width and density are sufficient to generate the same production benefits that are associated with banks on their own.

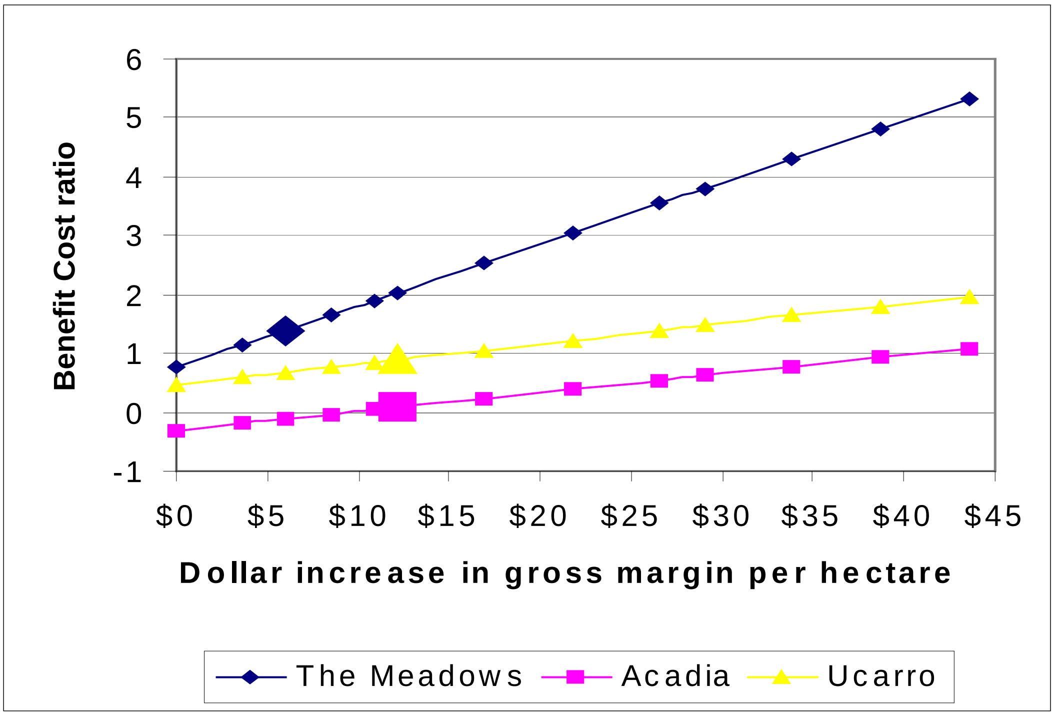

Figure 3: Hypothetical Profitability of Landcare strategies at different Production benefits (Large symbols indicate the BCR calculated for each trial site).

Figure 3 shows that as production benefit increases, the profitability of the landcare strategies increases. This is due to the landholders ability to generate more cashflow from the "landcare" scenario than the "no landcare" scenario. Figure 3 shows that the Meadows strategy is far more responsive to increases in production benefits than either Acadia or Ucarro. This is due to the lower cost of implementation of the Meadow strategy. The lower cost of implementation allows costs to be recouped quicker and profits to be generated at a much lower production benefit than the other two strategies. Although a production benefit of $12 was used in the analysis for the Acadia and Ucarro strategies, both landowners indicated that the actual production benefits they received were sufficient for their projects to breakeven.

Decline in Gross margin under the no landcare scenario

The decline in gross margin under the "no landcare" scenario is used to simulate production decline if no landcare work is undertaken. It is recognized that in some situations, the productivity of land can not be maintained unless some landcare work is undertaken. A constant percentage decline in gross margin over the 20 years was used in this analysis. This gross margin decline is averaged over the whole area even though the production decline is likely to be localized to specific areas. The Ucarro strategy has a percentage decline in gross margin of –2%/year, which results in the gross margin falling from $121/ha/year to $80/ha/year over the 20 years. A percentage decline of –1%/year is used for the Meadows strategy which results in the gross margin declining from $121/ha/year to $99/ha/year over 20 years. The percentage decline in gross margin used for Acadia was –0.5%/year, which results in a decline in gross margin from $121/ha/year to $109/ha/year over the 20 year period.

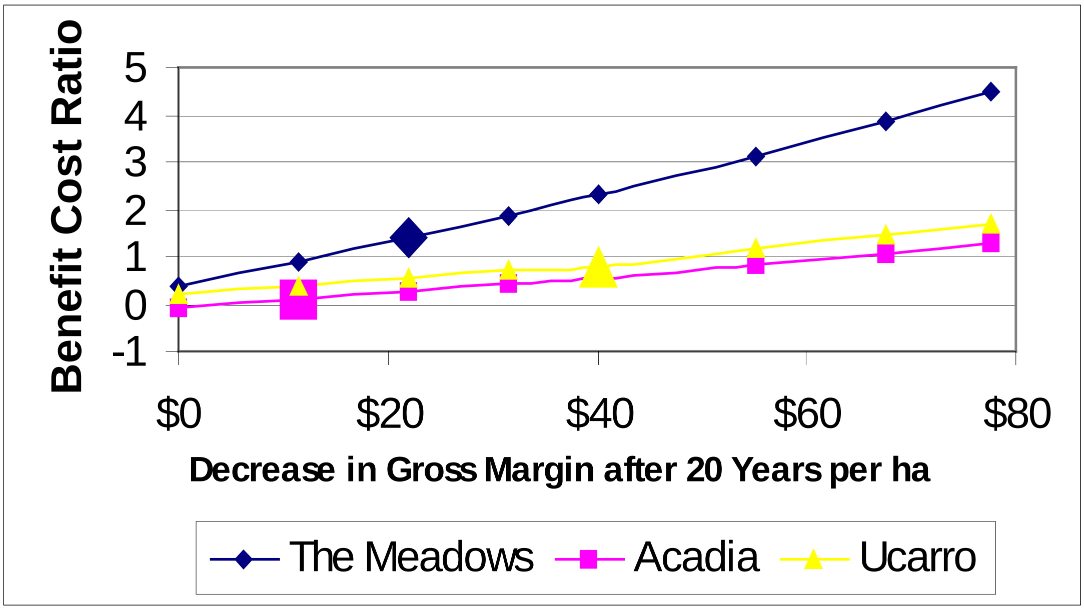

Figure 4: Hypothetical Profitability of Landcare Strategies at different net decreases in gross margins after 20 years. (Large symbols indicate the BCR calculated for each trial site)

Figure 4 shows that as the rate of gross margin decline (or the net decrease in gross margin after 20 years) increases, the profitability of all three landcare strategy's improves. This is due to the net present value of cash flows generated from the "no landcare" scenarios decreasing as the rate of gross margin decline increases. A high rate of gross margin decline under a "no landcare" scenario increase the opportunity for the "landcare" scenario to generate greater benefits than the "no landcare" scenario.

The Meadows strategy appears to be more sensitive to changes in gross margin decline than both the Arcadia and Ucarro strategies. This is mainly due to the lower cost of implementation. As the rate of gross margin decline increases, the difference between the net present value of cash flows generated by the landcare and no landcare scenario become greater. The lower cost of implementation can be divided into this difference a greater number of times, resulting in a higher benefit cost ratio.

Decline in arable land under the no landcare scenario

The decline in arable land is used to simulate the situation where land would become unproductive if no landcare was undertaken e.g. the encroachment of salinity or loss of land due to erosion. A constant rate of decline in hectares per year is used to simulate the decline in arable land. The Meadows strategy uses a rate of decline of 0.2 ha/year, this results in a total of 4 ha becoming unarable after 20 years. Alternatively this can be seen as a 50% drop in production over 8 ha. The Ucarro and Acadia strategies have rates of decline of 0.25 ha/year (5 ha after 20 years) and 0.4 ha/year (8 ha after 20 years) respectively. It is assumed within the analysis that all this land is prevented from becoming unarable if landcare work is undertaken.

Increasing the rate of decline of arable land under the no landcare scenario improves the profitability of the landcare strategies as shown in Figure 5. The profitability increases because the net present value of cashflows generated by the no landcare scenario is reduced. This make it possible for the "landcare" scenario to generate cashflows which are greater than the "no landcare" scenario. The Meadows strategy appears to be the most sensitive to increases in the rate of decline of arable land. This is because the Meadows trial site area is the smallest of the three trial sites. So, as the rate of decline increases, it represents a greater percentage of land and therefore a higher proportion of cashflow than in the other two trial sites. The lower implementation costs of the Meadows strategy also allows the cost to be divided into the generated benefits more times resulting in a high benefit cost ratio.

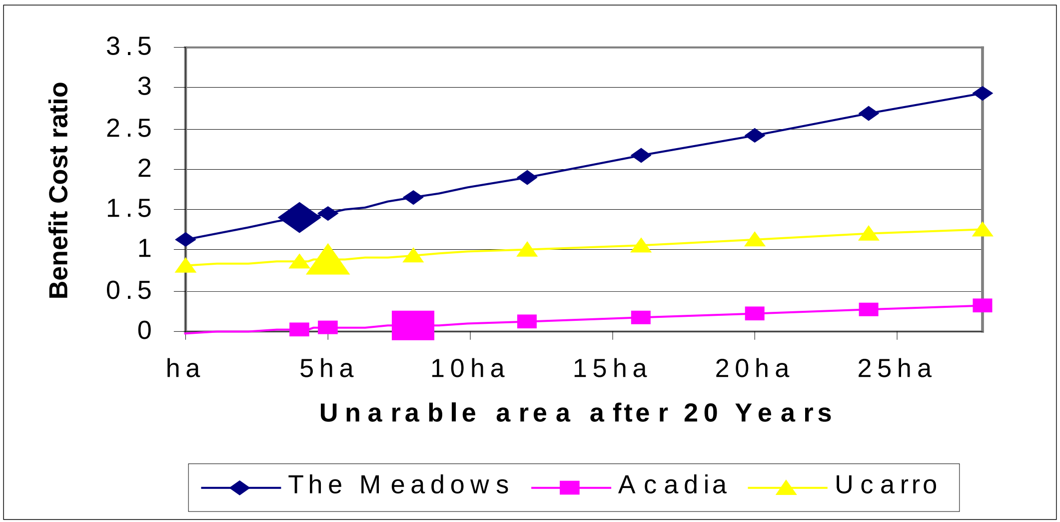

Figure 5: Hypothetical Profitability of landcare strategies at different net decrease in arable land. (Large symbols indicate the BCR calculated for each trial site)

Comparison of strategies using standard variables

The benefit cost ratios were generated using different variables that are specific for each trial site. In order to make a standard comparison between the three trial sites, benefit cost ratios were calculated using the variables outlined in Table 4 below and applying the strategies to a standard area of 100 ha.

Table 4: Variables used to make standard comparisons between trial sites

	Zero	Low	Moderate	Severe
Area decline if **no** landcare was undertaken at the end of 20 years	0	4ha	8ha	16ha
Rotational gross margin decline if **no** Landcare was undertaken (percent decline per year)	0%	-0.5%	-1%	-2%
Rotational Gross Margin Production benefit due to the Landcare strategy	5%	8%	10%	15%

The calculated standard benefit cost ratios are presented in Table 5. The Acadia and Ucarro strategies are only able to generate a profit when severe land degradation conditions are being experienced. The Meadows strategy generates a profit under low, moderate and severe land degradation conditions. It is important to note that the calculated benefit cost ratios assume that the landcare strategy is sufficient to solve the land degradation situation. If the landcare strategy is not sufficient to solve the problem, the benefit cost ratios will be lower than the ones presented in Table 5.

Table 5: Benefit cost ratios calculated for the different strategy's using standard variables

Benefit Cost Ratio	Zero	Low	Moderate	Severe
Meadows Strategy	0.13	1.31	2.30	4.27
Arcadia Strategy	-0.36	0.08	0.44	1.16
Ucarro Strategy	-0.09	0.31	0.65	1.32

Conclusions

The profitability of "trees on banks" landcare strategies is highly dependent on the interaction between several variables. These variables include: the density and cost of the strategy per 100ha, the area of land taken up by the landcare strategy, the gross margin decline under a 'no landcare' strategy and the production benefit derived from implementing the landcare strategy. The profitability is also influenced by the site's specific land degradation characteristics; principally the decline in gross margin and the decline in arable land under the "no landcare" scenario. However the profitability of "trees on banks" landcare strategies can be enhanced by:

- Implementation of trees on banks at the lowest density necessary to ameliorate the problem.
- Implementation of trees on banks which takes minimal land out of production i.e. lower width
- Lowering the cost of implementation of trees on banks, principally fenceline costs.
- Reduce the cost of bank construction with the use of grade banks if suitable for the particular site.

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