Northern United Forestry Group

Economic Evaluation of the Revegetation of Saline Land at Kamarooka

Final Report

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1 Introduction

1.1 Purpose

RMCG was engaged by the Northern United Forestry Group (NUFG) to undertake an economic evaluation of their saline land revegetation project at Kamarooka in the Northern Plains Region of Central Victoria.

This project aims to provide farmers in the district with an improved understanding of the costs and benefits associated with revegetating salt affected land. This information will be used to inform decisions based around investing in sustainable grazing systems.

1.2 Project background

In 2004, with funding from the National Landcare Program, the NUFG established a demonstration site on approximately 40 hectares of salt-affected land on the Hay family farm at Kamarooka to trial saline agricultural production and salt tolerant ecosystems.

Thousands of trees, saltbush and native grasses have been planted and in just over two years a salt wasteland has been transformed and some grazing potential of the site returned.

NUFG argues that there is a strong case for a sheep grazing system that:

- Includes more diverse and profitable products, while contributing to natural resource management outcomes, such as the control of dryland salinity.
- Enhances the feed base where the predominant annual species show distinct temporal gaps in production and quality.
- Includes shrubs that provide beneficial secondary compounds that alter rumen microbial activity, improve animal health and production, reduce greenhouse gas emissions, and reduce the reliance on chemicals to control gastrointestinal parasites.
- Uses integrated processing of fodder shrubs to support animal production in combination with production of wood-based commodities.
- Includes a mix of plant species that have nutritive value and palatability, can function and persist, and contain secondary compounds that alter rumen microbial activity (e.g. to decrease methane, nitrogen loss, lactic acidosis, or bloat) or reduce parasitic worm counts.

1.2.1 Study site

The study site is approximately 42 ha consisting of 24 ha of forestry plantation (18,000 trees) and 18 ha of saltbush. Livestock are able to graze both the saltbush and pasture in the forest understorey. Stage one of the project commenced in 2004 with the planting of 16 ha of trees and 18 ha of saltbush. Stage two followed in 2005 with the establishment of 8 ha of forestry.

Grazing commenced with a small-scale trial in January 2006, however it was not until year three when both the saltbush and trees were well established that prolonged grazing of the site began.

1.3 Scope

The major element of this consultancy is to:

- undertake a basic discounted cash flow analysis of the study site to determine economic viability of the revegetation and grazing system.

1.3.1 Costs

Costs to be used in the evaluation were determined from actual records held by Mal Brown (NUFG Kamarooka Project Manager). Costs include:

- preparation of saltland for revegetation (ripping, gypsum applications);
- revegetation costs for trees, pasture and saltbush;
- infrastructure (i.e. fencing);
- watering and feed costs; and
- in-kind planting and construction labour costs.

Some costs were sourced from relevant literature in the field including:

- maintenance costs; and
- supplementary feed costs.

Costs not included were:

- all costs associated with other parts of the farming enterprise;
- project management and trial related labour costs.

1.3.2 Benefits

Benefits are based on valuing sheep grazing days. This is considered a suitable 'production' measurement as Andy Hay utilises the saltland pasture to supply extra feed into the feed gap during November to April. A proxy value of the equivalent feed costs saved has been determined based on the cost of feeding a sheep a maintenance diet of hay and grain. In determining this cost results from grazing trials conducted at the study site in November 2006 were used.

Other benefits that were estimated using anecdotal evidence are:

- reclaimed crop land from revegetating saltland;
- firewood returns from agroforestry; and
- stock shelter benefits.

Benefits not included were:

- whole farm implications from additional feed;

- values associated with environmental and social outcomes;
- changes in land value.

1.4 The Hay Farm

Andy Hay's family has farmed at Kamarooka since 1886. The farm comprises 1200 ha and carries 2 400 sheep. There is 400 ha of crop, 480 ha of lucerne with the remaining 320 ha comprising annual and saltland pastures. Each year the ewes on the Hay farm lamb in April and May. The Hays sell between 900 and 1000 lambs into the market each year. A selection of 45 kg lambs is sold in October. The remaining lambs are shorn and continue to graze until May the following year when they are sold into the market at an average of 55 kg. The sheep are well cared for with good quality feed (including lucerne pasture) and have access to water at all times. Since establishing the saltland pastures Andy[1] has been able to increase his stocking rate by 10% over the grazing component of the property.

Lucerne is increasingly seen as an important component of the Hay's grazing system. It has proven to be a successful grazing alternative to annual pasture due to the feed it provides over summer and its ability to make use of summer rainfall. The summer period is a time when traditional annual based pastures provide little nutrition. Lucerne is normally grown as a phase crop in rotation with cereals where it provides valuable fertilization benefits through its ability to fix nitrogen in the soil.

Andy rotationally grazes mobs of sheep throughout the year between lucerne, annual pasture, saltbush and crop stubble.

[1] While Andy Hay is managing the land set aside for the NUFG project the land is owned by his three sons.

2 Methodology

The purpose of this section is to outline the methodology and assumptions used in the discounted cash flow model of the study site. The broad purpose of the model is to determine the economic viability of the revegetation and grazing system imposed on the 42 ha salt affected site and to provide accurate economic information for landholders who are interested in saltland pastures. This will help landholders make informed decisions and to identify the major limitations to the successful adoption of revegetating saline land.

2.1 Discounted cash flow analysis of study site

Discounted cash flow analysis shows investment cash flow and projected earnings cash flow of a project. A discounted cash flow analysis generates financial data on three main indicators of the economic viability of a project. These are the project's Net Present Value (NPV), the Payback Period (PBP) and Benefit Cost Ratio (BCR).

Study site information was collected during a field visit and used along with relevant literature in an analysis framework with the following features:

- discounted annual cash flow;
- partial analysis which only considers the study site area of the farm;
- a 25-year analysis period;
- costs and returns are discounted at a 9% annual rate which is comparable to the cost of borrowing money and/or the productivity of competing investments.

The following explanations of the analysis will assist understanding of the results:

- taxation implications of the investment by the host farmer were not considered;
- impacts on land values were not considered;
- the demonstration/research nature of the study site at Kamarooka meant that costs per ha were generally in excess of commercial costings.

2.2 Costs

2.2.1 Revegetation and infrastructure costs

Preparation

Costs associated with site preparation were provided by the NUFG. These costs included:

- seed;
- saltbush seedlings;
- tube stock;
- trees;
- gypsum (including transport);
- pig manure; and

- fencing (including gates, end assemblies and star posts).

2.2.2 Water

Sheep that graze saltbush consume up to 11 litres of water per animal per day (NUFG has measured up to 9 litres of water per animal per day at Kamarooka). It is therefore very important that stock have access to a clean reliable water source. During the trial significant costs ($10,000) were associated with carting summer water supplies on a daily basis. A large proportion of this cost was is in-kind labour. The discounted cash flow model assumes a stand alone water supply is installed at a cost of $1000. The assumptions are:

- water supply is connected to the Kamarooka water scheme, which runs directly past the southern boundary of the revegetated site;
- a small amount of 1-inch poly pipe along with a water trough capable of servicing 200 sheep is accounted for in the costs;
- estimated capital costs are $750 for materials;
- an installation cost of $250 is assumed.

2.2.3 Supplementary feed and labour

Supplementary feed

Saltbush alone cannot maintain animals. It is necessary to balance the high protein saltbush diet with a form of roughage such as baled barley straw or hay.

Andy Hay provides stock with extra supplementary feed in the form of two half tonne bales of roughage per month. At $200 per bale this equates to 3 cents per sheep grazing day and is taken into account when determining the value of the saltbush as a feed.

Labour

Labour costs for establishing the site have been accounted for in the discounted cash flow analysis however labour relating to the grazing trial conducted on the site have been omitted. These include the cost of weighing lambs along with project management costs.

2.2.4 Maintenance costs

Saltbush

Few ongoing maintenance costs associated with the saltbush component of the revegetated site. Experience from WA suggests that weed control and fertiliser applications might only be an occasional or rare event. No saltbush maintenance costs have been included in the analysis.

Forestry

Following consultation with the NUFG, annual maintenance costs for thinning the forestry plantation were included for years 5 and 10 with firewood being harvested in year 15. It is anticipated that sawlogs will be harvested at year 25. Costs are based on the following thinning schedule:

- Year 5 – 200 stems are removed per ha
- Year 10 – 200 stems are removed per ha.

Maintenance costs of $200 per ha are based on contractor rates and the time it takes to fell and poison trees.

In year 15, 200 stems are removed per ha and sold as firewood. This acts as a thinning and maintenance operation as well as resulting in no specific cost allocated to maintenance in year 15.

Of the original trees at planting, 200 per ha remain for sawlogs in year 25.

2.3 Benefits

A grazing trial was undertaken on the 28 ha revegetated site during the 2006-07 summer. Lambs gained 50 grams live weight per day or an average of 5kg over the trial period. This trial proved that the revegetated saline land had an economic value.

Returns in this analysis are based on valuing grazing days rather than live weight gains. This is because the current management practice employed by Andy Hay utilises the saltland pasture to supply extra feed into the feed gap during November to April.

2.3.1 Grazing days

Andy currently stocks 200 lambs on the saltbush for a period of 6 months prior to finishing these stock on lucerne pasture. Stock are fed 2 half-tonne bales of roughage per month whilst grazing on saltbush. The lambs enter the saltbush at 6 months of age from the end of October until the end of April.

In 2008 stage 2 of the revegetation project, which consists of native trees and pastures, is expected to come online providing an additional 8 ha grazing capacity. It is estimated that an additional 50 lambs will be grazed bringing the total stocking rate to 250 lambs over a 6 month period.

The alternative to this grazing method would be to place stock on annual pastures elsewhere on the property where they are likely to lose condition and require significant supplementary feed. Grazing these stock on the saltbush also reduces the grazing pressure on the lucerne.

The cost of feeding a maintenance ration is a useful surrogate value to determine short-term grazing benefits. Using current grain and hay prices, the feed required to equate with a sheep-grazing day equals approximately 13 cents. The weekly energy requirements for maintenance and minimum dietary protein concentrations (assuming some useful grazing is available) is presented in Table 1 and has been used in determining this value.

Table 1 Maintenance ration for lambs assuming some grazing is available (Adapted from DPI (2006)[2])

	Energy requirement (MJ per week)	Minimum crude protein (% DM)	Feed	Ration (Kg per hd per week)
Weaned lambs >15 kg live weight	20	7	Wheat Oaten Hay	1.2 kg/hd/wk 3 kg/hd/wk

- Oaten Hay $200 per tonne: 600 kg per week: $120 per week[3].
- Grain $250 per tonne (feed grain): 240 kg per week: $60 per week.

Sheep are also fed roughage at a cost of 3 cents per grazing day. The equivalent feed cost used in the analysis therefore represents $0.10 per sheep grazing day.

Total $0.10 per sheep grazing day

Note: A full sensitivity analysis of differing equivalent feed costs is shown in Table 5.

Grazing trial

Sheep body weight results from the grazing trial provide a useful reference and way of reconciling the above result. The live weight gain from the lucerne trial site represented 50 grams a day. At a value of $2.50 per kg this is equivalent to $0.125 per day.

It is important to have a carefully managed grazing system to maximize feed benefits. Left unmanaged, salt bush has the potential to become overgrown and unpalatable to stock during good seasons when feed is plentiful. Careful grazing management during these times will ensure feed quality is maintained for when it is needed most.

2.3.2 Shelter

The shade/shelter benefit has been estimated with reference to Lockwood et al (2000) who state that a 20 percent premium to the livestock gross margin results from shelter. Immediately following shearing in September Andy Hay allocates a 9 ha section of revegetated land for 250 ewes to graze for 3 weeks. Stock do not put on weight but are well protected after shearing. This reduces the number of mortalities.

As the Stage 2 forestry plot becomes available along with the 7 ha in the south eastern corner of the Stage 1 area, Andy Hay will be able to double the amount of ewes he grazes in the plantations to 500 ewes for 3 weeks

[2] DPI (2006). Drought Feeding and Management of Sheep. MLA and AWI.
[3] Note: If an oaten hay/roughage price of $250 per tonne is assumed then the feed required to equate with a sheep grazing day equals 15 cents rather than 13 cents. The roughage cost also rises from 3 to 4 cents per grazing day. This results in a slightly higher equivalent feed cost of 11 cents.

The benefits are calculated by multiplying the grazing area (with shelter) by the 20 percent premium from the livestock/grazing gross margin per ha, which equates to approximately $15/ha.

In 2008 an additional 8 ha will become available as a shelter for ewes immediately after shearing to make a total of 17 ha.

2.3.3 Reclaimed Crop returns

Andy sowed 12 hectares of previously salt affected land to a barley crop for the first time this year. It is envisaged that around 2 ha/year of adjoining land (previously salt affected) will be returned to arable production as a result of the revegetation project.

A conservative allowance of 1 ha per year has been made in the analysis for degraded land to be returned to cropping. The value associated with this land will depend on what is grown, how it is managed and the climatic conditions during the growing season. A value of $150 per ha has been assumed which is an average cropping gross margin per ha for the region.

2.3.4 Additional revenue source – Firewood and sawlogs

The 24 ha forestry plantation is managed as a firewood and sawlog plantation with the following assumptions:

- maintenance (thinning) occurs in years 5 and 10 by contractors charging $200/ha;
- the firewood plantation matures at year 15 with a yield of 25 tonnes per ha (200 stems). The calculations for firewood have been determined assuming mean annual increment (MAI) of 5 cubic metres/hectare/year based on bole volume only and not accounting for branches that may be cut for firewood;
- firewood returns are based on a contractor paying $25 per tonne for access to the plantation. Contractors are not likely to pay much more than this as firewood collecting is very labour intensive and a suitable margin is needed when current prices are $100/tonne in Bendigo.
- The total revenue from firewood represents a total of $15,000 in 2018 or $625 per ha.
- Sawlog revenue is also expected in year 25 from the remaining 200 trees per ha in the plantation. Individual trees are expected to yield 0.625 cubic metres of sawlog. This equates to 125 cubic metres of sawlog per ha. Sawlog returns are based on a contractor paying $50 per cubic metre for access to the plantation. This has been determined by assuming that contractors would demand at least a 100% mark-up on the original value of the logs they have access to taking into account labour and machinery costs associated with lopping and logging the trees. Based on a current market price of $100 per cubic metre for sawlogs The Hays could expect to receive approximately $6,250 per ha for sawlogs with a market value of $12,500 per ha.

Mulch from thinnings

Recent research by DPI's forestry team in Bendigo indicates that production and sale of mulch from maintenance (thinning) operations may prove profitable. Normally thinning is a costly exercise, however if thinnings can be turned into mulch, the market value of mulch

could be up to $25 cubic metre. This revenue source has not been included in the analysis due to the early nature of DPI's research.

2.4 Risks

The allocation of incentive funds through a Landcare grant provided a strong incentive to attract the NUFG and the Hays into the project. It was a major factor in assisting them to avoid the risk of using their own funds in an experimental venture. The experience has been positive however it is important to note that seasonal conditions during establishment and site selection are likely to impact on whether a revegetated site is successful or not. The Kamarooka site received favourable rainfall following planting which enabled it to establish successfully.

2.4.1 Waterlogging

The threat of waterlogging has been identified as a potential risk to the project. Since establishment, the project site has not endured an above average rainfall season. There is a risk that water logging from heavy rain, may have serious implications for both the saltbush and the forestry plantation due to the layout of the project site. This is considered a greater risk than below average rainfall or drought years as the site has performed well during the past few years.

2.4.2 Water source

A clean reliable water source is critical for stock grazing on saltbush. Providing access to a good supply of fresh water can significantly reduce the profitability of a saltland grazing system through large establishment costs. One way of preventing the need for expensive additional infrastructure is to utilise existing water supplies when selecting a site. The saltbush paddock on the site runs adjacent to the Kamarooka water supply pipeline.

3 Results and General Discussion

3.1 Saltland pasture and timber site

The results simulate a stand-alone investment comparing possible future returns with how much is invested in the initial investment. A Net Present Value (NPV) is determined which provides a means of estimating the profitability of long term investments. NPV is defined as the difference between the present value of future revenues and the present value of future costs at a chosen discount rate.

Choosing an appropriate discount rate is crucial to the NPV calculation. Normally investors only commit funds to projects that return above a chosen discount rate. A discount rate of 9% has been chosen for this analysis and sensitivity conducted around this figure on page 12.

Cumulative cash flow is determined by adding the net operating surplus (annual site return minus annual site costs) to the previous years cash flow and is presented along with yearly site costs and returns in Figure 2.

Figure 2: Costs and returns

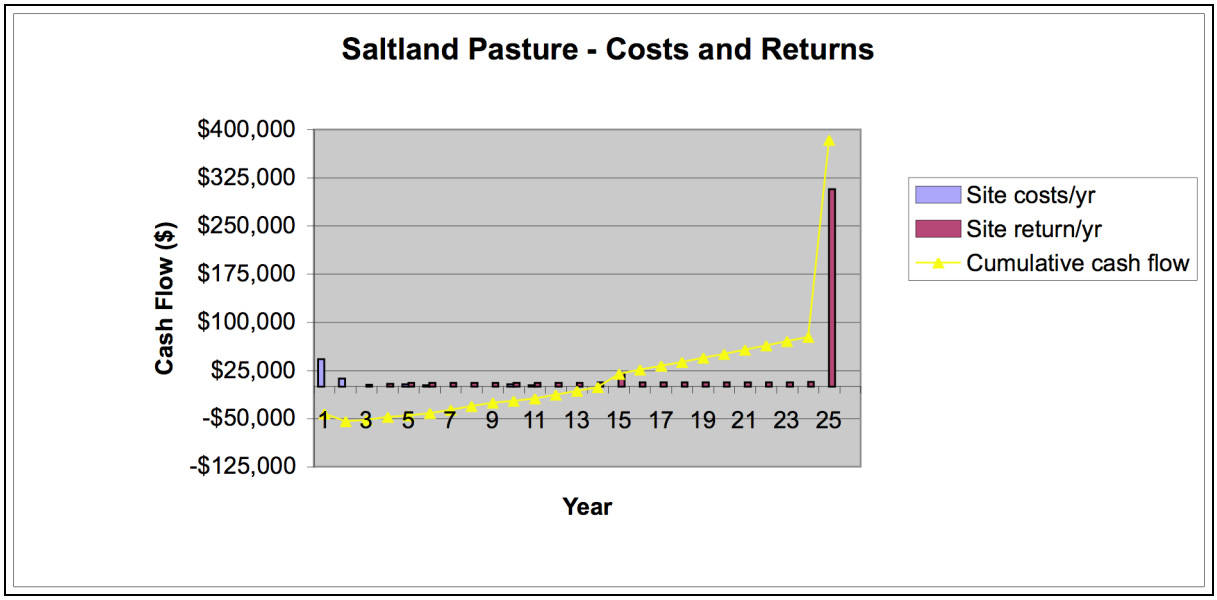

Table 3 Profitability indicators

NPV	$30,412
Benefit Cost Ratio (25 yrs)	1.51

The forestry and saltland pasture system at Kamarooka has a NPV of $30,412 a payback period of 13 years and a BCR over 25 years of 1.5 meaning farmers will get back $1.5 for every $1 of investment over that timeframe.

This tells us that revegetating saltland is a long-term investment due to the relatively large capital establishment costs and the modest returns that will be generated.

From a purely commercial stance the investment in saltland revegetation is not advisable as higher returns are likely to be achievable over the same timeframe by investing funds elsewhere.

Caution needs to be taken, as it is difficult to generalise about the profitability of saltland pasture improvement, due to the wide range of situations that are specific to each landholder's situation. Research in WA[4] reports an average cost of establishment of $510/ha with a range of $156/ha to $1,383/ha (excluding farmer labour costs). The average cost at Kamarooka (including labour) is $1,303.

The Kamarooka analysis has shown that profitability depends on a number of interacting factors. These are:

- site specifics;
- cost of establishment;
- cost of infrastructure;
- chance of failure;
- timing;
- productivity and utilisation.

The value assigned to a grazing day has significant impact on profitability. Grazing day values are subsequently determined by grain and hay prices at the time the analysis is undertaken.

3.2 Farm stocking rate and grazing system

It is important to consider how the saltland pasture and lucerne grazing system operates on the Hay's property. The benefits throughout the year are particularly apparent during late summer and autumn due to the altered grazing cycle compared to the original system. This has allowed Andy Hay to increase stocking rates over the entire property by around 10 percent.

In addition, the revegetation has provided Andy Hay with additional management options such as resting his ewes in the plantation immediately following shearing which acts to reduce mortalities. There may also be potential to access different markets or to alter lambing times given the increased flexibility with the new system.

Table 4 shows the comparison between monthly stocking rates over the entire property under the new saltland and lucerne based system compared to the previous annual and lucerne based system. The stocking rates on the previous system are based on the number of sheep the Hays were able to run over their pasture and crop stubble area. The saltland and lucerne based system is an estimate of the change over the two systems. The stocking rates are represented as a Dry Sheep Equivalent (DSE) per ha.

[4] Allan Herbert (2006). Sustainable Grazing on Saline Land Producer Network WA Economics. Observations and results of investigations and analysis of 21 Producer Network case studies in WA.

Table 4 Monthly stocking rates: DSE/ha

Farm grazing system	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Ave
Annual and lucerne based system	3	3	3	2	2	2	4	5	7	7	6	5	**4**
Saltland and lucerne based system	5	6	6	4	2	2	2	3	4	5	7	7	**4.4**
Difference	+2	+3	+3	+2	0	0	-2	-2	-3	-2	-1	-1	**+0.4**

The highest overall stocking rates are in spring when the farm is growing the most pasture but the real benefit from the saltland system is in summer and autumn when there is normally a high opportunity cost on the pasture due to the need for supplementary feed.

The presence of lucerne and the saltbush may allow for different management/marketing options such as altering the timing of when cast for age ewes are sold, which is normally in summer to reduce the demand on tight feed supplies.

3.3 Other important drivers

Left unmanaged degraded saline areas pose a real risk of continuing to spread, reducing amenity values on farms, productivity and subsequently placing pressure on long-term business survival. This analysis has not accounted for any additional lost production resulting from the spread in salinity.

3.3.1 Environmental

Environmental benefits such as reduced soil erosion, improved water quality and enhanced biodiversity are evident on the Hay's property. These values have not been included in the analysis as they are very difficult to quantify. A biodiversity survey undertaken in October 2006 recorded 35 different bird species using the site.

Andy Hay indicated that environmental and aesthetic values were primary motivators for action however it is difficult to value these benefits in such an investment analysis.

3.4 Sensitivity analysis

Risk and uncertainty is part of agriculture and should be accounted for when analysing new production systems. It is useful to understand the likely impact and importance of certain variables used in determining the profitability of the system.

Sensitivity analysis allows us to explore 'what if' calculations. For example what is the impact from a different equivalent feed cost, and discount rate?

The following table shows the effect of changing both the discount rate and equivalent feed cost associated with grazing the saltbush. The equivalent feed cost represents the value of a

sheep grazing day minus any feed costs such as roughage whilst the stock are grazing saltbush.

The impact on the NPV is highlighted in the table with the value shown in brackets representing an overall negative value over the life of the project. Other variables in the model are held constant whilst sensitivity parameters are changed.

Table 5 Discount rate and equivalent feed cost impact on the NPV (25 years).

		Discount rate					
		7%	**8%**	**9%**	**10%**	**11%**	**12%**
Equivalent feed costs	$0.03	$30,975	$16,277	$4,443	($5,115)	($12,859)	($19,153)
	$0.08	$53,399	$36,631	$22,992	$11,854	$2,721	($4,800)
	$0.13	$75,823	$56,985	$41,542	$28,824	$18,301	$9,553
	$0.18	$98,247	$77,339	$60,091	$45,793	$33,881	$23,906
	$0.23	$120,671	$97,694	$78,641	$62,762	$49,460	$38,259

The results of the sensitivity analysis show that the profitability of the Kamarooka site is highly sensitive to the underlying assumptions used.

If the cost of supplementary feeding is high (i.e. grain and hay prices) then the benefits from saltland pastures will also be high making the investment more profitable. This is due to the feed costs saved through filling the feed gap associated with the existing annual/lucerne based system.

The weighting placed on the alternative value of investment dollars will also significantly affect the profitability of the investment. This depends largely on the risk profile of the landholder and their attitudes to the value of natural resource management projects. If the discount rate is set below alternative commercial rates then the investment is attractive, however if the landholder is driven entirely by commercial gains then the investment does not compare favorably with alternative options.

4 Conclusion

RMCG was engaged by NUFG to undertake an economic evaluation of their revegetation project of saline land at Kamarooka.

The economic analysis is based on an equivalent feed cost, which is determined by valuing grazing days at 13 cents (sheep) minus the cost of any supplementation. This equates to an equivalent feed cost of 10 cents per sheep per day. Benefits are also derived from reclaimed cropland, forestry returns and shelter benefits for stock.

The analysis shows that the NPV of the investment at the Kamarooka site is likely to range between $20,000 and $40,000 with a BCR of 1.5 over a 25-year period. The following factors impact on the BCR and NPV:

- Value of a grazing day determined by grain and hay prices at the time.
- Discount rate used in the analysis.
- Establishment costs which are strongly influenced by site selection.
- Production performance of saltbush and the forestry enterprise.

The key conclusions from this study are:

- Decisions around revegetating saline land are likely to be driven more by environmental imperatives rather than commercial interests. The aesthetic and environmental benefits are likely to have equal or higher importance than the commercial outcomes from investing in revegetating saltland pasture.
- Saltland pastures provide important grazing benefits relating to on farm grazing systems such as the ability to fill feed gaps, increase stocking rates and improve livestock management and marketing flexibility.
- Landholders interested in investing in saltland pastures should assess the investment against a range of other investments the farmer might make both on and off the farm.