# Financial analysis of pasture improvement on Earnscleugh Station

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## Abstract

The financial benefit of improving depleted pastures in the New Zealand high country is considered. Two models were developed based on Earnscleugh Station in Central Otago using RANGEPACK HerdEcon with data gathered from a large-scale pasture development trial. One model developed 721 ha of extra pastures using the costs and production gains expected while the other did not undertake development. The cash surplus accumulated after taxation was 4.7% higher after 10 years if no development occurred while the Net worth was 1% better if nothing was done. Reducing developed costs to $50/ha did not achieve a payback within 10 years whereas a marginal increase in stock numbers of 2.25 stock units achieved this. It was estimated that some of the landforms on Earnscleugh Station's pasture development trial did achieve this level of productivity. The overall poor performance of the development simulations was concluded to be a result of developing marginal landforms, which although cheap to develop make the scenario unprofitable.

**Keywords:** development, financial analysis, fine wool, merino, pasture improvement, price variability

## Introduction

The vegetation and subsequent pastoral productivity of large areas of the South Island high country can be severely depleted by overgrazing (Warner 1956). The introduction of Rabbit Calicivirus Disease (Guthrie 1996) in 1997 had a dramatic effect in reducing numbers and maintaining them at low levels (Otago Regional Council 1998).

The question today, which this paper addresses, is what to do with this depleted land now rabbits are controlled. Should this land be improved with seed and fertiliser so it can provide a good level of grazing and subsequent income, or does it make better economic sense not to provide inputs and hope for some natural recovery that may allow limited grazing?

## Methods

### The Shepherds Flat development project

In 1991, a pasture development project was initiated on a 280 ha block of depleted land known as "Shepherd's Flat" on Earnscleugh Station to demonstrate practical ways to improve such country once rabbits had been controlled. Subsequently, another block called Buckley's was developed using the same methods. This project was a community effort involving farmer, consultant, industry and science support (Earnscleugh's Future 1992). The project was a real example of land restoration, and included a variety of pastoral development methods according to landform. Ongoing monitoring of results has provided the necessary information for the cost/benefit analysis undertaken in this study.

### Simulation approach

A study group comprising the owner of Earnscleugh Station, the Earnscleugh Station farm management consultant, a Regional Council consultant, two farm systems analysts and a local farmer met on Earnscleugh Station to consider what the financial analysis needed to address. It was agreed the analysis should focus on the financial viability of further pasture development on Earnscleugh Station, in particular the cost of development relative to the increased returns.

Information from the Shepherd's Flat development was used to simulate development of a further 721 ha of similar country. This was compared with a base of "do nothing" which simply maintained the existing pasture development. RANGEPACK HerdEcon (NZ) (Stafford & Foran 1988) was used to simulate the two options over 20 years to ensure all benefits of pasture development were captured. This decision support tool can run analyses through multiple years incorporating both biological and financial parameters of production, including the effects of adverse climate and market fluctuations.

## Model parameters

*Area and methods of development*

An area with the same five landform categories as Shepherd's Flat was chosen for the development scenario. The proportions of the landform categories present in the 721 hectares were estimated using aerial photos (Table 1).

From the experiences and results achieved on Shepherd's Flat, four pasture development methods were used according to the various landforms for the simulation. The Jethro drill (Horrell *et al.* 1991) was used on flat to rolling country where rocks did not inhibit access, and the Baker boot drill was used on slightly inclined scabweed faces. On the steeper sunny and shady slopes, seed and fertiliser were simply oversown by plane. Fifteen percent of the area was considered unsuitable for development because of rock cover and lack of topsoil.

**Table 1** Landform classifications, areas estimated from aerial photographs, and development methods used for calculating the costs of the 721-ha development scenario.

| Landform | Area (%) | Area (ha) | Method |
|---|---|---|---|
| Flat to rolling excluding rock outcrops | 23 | 166 | Jethro direct drill |
| Slightly inclined aspects excluding rock | 28 | 202 | Baker Boot drill |
| Steeper sunny aspects including rocks | 12 | 87 | Oversowing |
| Steeper shady aspects including rocks | 22 | 159 | Oversowing |
| Rocky outcrops and very steep areas | 15 | 107 | - |

*Productivity pre- and post-development*

Stock movements, recorded using Endeavour2 and previously using Farm Tracker (farm recording programs for computers), were provided by Earnscleugh management (Table 2).

**Table 2** Stocking rates recorded on blocks developed on Earnscleugh Station as part of the pasture development trial.

| Year | Shepherd's Flat | Buckley's |
|---|---|---|
| 1994/95 | 2.95 | 1.9 |
| 1995/96 | 2.78 | 2.0 |
| 1996/97 | 2.13 | 1.55 |
| 1997/98 | 3.33 | 1.88 |
| 1998/99 | 2.4 | 2.0 |
| **Average** | 2.7 | 1.87 |

Since development in 1994, the overall stocking rate has been 2.3 su/ha/yr on Shepherd's Flat and Buckley's (Table 2). Stocking rates on undeveloped paddocks that comprised predominantly one landform were used to estimate pre-development carrying capacities for each landform (Table 3).

Because the developed paddocks contained all landforms, the stocking for each landform was calculated from pasture cutting trials in the 1995/96 pasture growing season. These measurements were converted into stock units using the following formula:

**Table 3** Pre- and post-development stocking rate estimates for the various landforms used for calculating the marginal increase in stocking rate for the 721-ha development scenario.

| Method | Area (ha) | Stocking rate (su/ha/year) Pre-development | Post-development | Marginal increase |
|---|---|---|---|---|
| Jethro | 166 | 0.6 | 3.7 | 3.1 |
| Baker | 202 | 0.2 | 2.7 | 2.5 |
| Sunny oversown | 87 | 0 | 0.5 | 0.5 |
| Shady oversown | 159 | 1.25 | 2.5 | 1.25 |
| Nil | 15 | - | - | - |
| **Total** | **721** | **0.45** | **2.21** | **1.74** |

**Carrying capacity** (su/ha/yr) **= (G/2)/E**

where **G** = Total Forage grown (kg DM/ha/yr); **2** = 50% Pasture Utilisation (based on Rattray *et al.* 1982 where paddocks grazed with lactating ewes at a total dry matter allowance of 4.1 kg DM/ewe/day achieved a 50% utilisation of pasture offered); and **E** = annual forage requirement per stock unit (assumed at 550 kg DM/su/yr).

These values, together with the areas of the various landforms (Table 1), were used to calculate the marginal increases in stocking rate used for the development scenario (Table 3).

*Development costs*

Development costs for fertiliser, seed and drilling or aerial application were assessed according to commercial rates based on current contractor charges (Table 4). Fertiliser rates were based on maintaining the fertility status for each landform. The current standard of fencing and tracking was considered adequate for stock control, considering the assumed level of pasture utilisation.

*Stock numbers*

Earnscleugh Station's livestock performance is above the regional average with ewes producing 4.15 kg of 18.7 micron wool (Merino Monitoring Group 2000). Because of this, the study group agreed that management

**Table 4** Costs ($) per hectare for each landform used to calculate the overall development cost of the 721-ha development scenario.

| Landform | Seed | Drill | Fertiliser | Total Cost |
|---|---|---|---|---|
| Jethro Drill | 93 | 90 | 39 | 222 |
| Baker Boot | 67 | 90 | 39 | 196 |
| Sunny oversowing | 11 | - | 21 | 32 |
| Shady oversowing | 38 | - | 44 | 82 |
| **Overall** | | | | 150 |

would best respond to increased pasture productivity by increasing stock numbers rather than increasing the individual performance of existing livestock (Table 5).

*Biological rates*

Wool production, lambing percentages and death percentages are based on figures currently achieved on Earnscleugh Station (Table 6). These have shown little year-to-year variation, reflecting the low stocking rates. The study group however considered that hogget wool weights would inevitably increase with the higher quality forage offered.

*Product prices*

Prices were developed with reference to the past 5 years of prices received. A feature of fine-wool farming is large fluctuations in wool returns, and these greatly affect the value of sale stock. Because of this, RANGEPACK HerdEcon (NZ) was set up to run the 20-year simulation 500 times with each year randomly choosing a year type from Table 7. The figures reported are the mean of these 500 simulations.

*Farm finances*

The base model runs 20 500 stock units and has a capital value of $4.7 million made up of land and building $3.5 million, and stock $1.2 million. The farm services a debt of $1.4 million, which equates 30% of capital value, at an interest rate of 11%. Farm operating costs were derived from the past 3 years annual accounts (Table 8). A breakdown of working expenses is presented in Table 9.

Market variations in fine wool and livestock values have a significant effect on the cash surplus. In a good year (parameters shown in Table 7), the cash surplus will increase to $523 000, while in a poor year, it will decrease to a deficit of ($80 000).

*Financial analysis*

Pasture development was determined as profitable when there was a pay-back on the investment associated with development. Pay-back was achieved when the development simulation gained a higher accumulated bank balance than the 'do nothing' option. The accumulated bank balance is the tax-paid profit a farmer could expect to bank after meeting personal drawings, debt servicing and capital replacement. The accumulated farm profit

**Table 5** Stock numbers in the base model and the hypothetical pasture development scenario.

| Stock classes | Base model | Development scenario | Additional stock required |
|---|---|---|---|
| **Sheep** | | | |
| Ewes | 8700 | 9600 | 900 |
| Ewe Hoggets | 3100 | 3400 | 300 |
| Wether Hoggets | 3100 | 3100 | - |
| Wethers | 6000 | 6000 | - |
| Rams | 200 | 220 | 20 |
| **Cattle** | | | |
| Cows | 380 | 380 | - |
| Rising 2-year heifers | 60 | 60 | - |
| Rising 1-year heifers | 170 | 170 | - |
| Rising 1-year steers | 170 | 170 | - |
| Bulls | 20 | 20 | - |

**Table 6** Biological rates for stock.

| Stock classes | Birth rate (%) | Death rate (%) | Wool growth (kg/hd/yr) |
|---|---|---|---|
| **Sheep** | | | |
| Ewes | 84 | 6.0 | 4.1 |
| Hoggets | - | 3.5 | 2.7* |
| Wethers | - | 4.0 | 5.0 |
| Rams | - | 6.0 | 6.0 |
| **Cattle** | | | |
| Cows | 90 | 5.0 | - |
| Rising 2-year heifers | - | 3.0 | - |
| Rising 1-year cattle | - | 3.0 | - |
| Bulls | - | 3.0 | - |

* Note: hogget wool growth was assumed to increase 0.1 kg/hd/yr following pasture development.

**Table 7** Product prices for sheep, wool and cattle for three year-types of Good, Okay and Poor, randomly selected during the simulations of the development scenario.

| Stock classes | Livestock sale prices | | | Wool prices | | |
|---|---|---|---|---|---|---|
| | Good | Okay | Poor | Good | Okay | Poor |
| **Sheep** | | | | | | |
| Ewes | 50 | 40 | 30 | 12.00 | 8.00 | 6.00 |
| Hoggets | 45 | 40 | 25 | 18.00 | 10.80 | 8.00 |
| Wethers | 35 | 25 | 15 | 8.00 | 6.50 | 4.80 |
| Rams | - | - | - | 8.00 | 6.50 | 4.80 |
| **Cattle** | | | | | | |
| Cows | 380 | 380 | 380 | | - | |
| Rising 2-year heifers | 450 | 450 | 450 | | - | |
| Rising 1-year steers | 550 | 550 | 550 | | - | |
| Bulls | 800 | 800 | 800 | | - | |

**Table 8** Revenue and costs used to set up Earnscleugh Station in the RANGEPACK HerdEcon model for the "Okay" year.

| | Total ($) | $/Stock unit |
|---|---|---|
| **Gross farm revenue** | | |
| Livestock sales | 338000 | 16.48 |
| Wool sales | 676000 | 32.98 |
| Total gross farm revenue | 1014000 | 49.46 |
| **Farm expenditure** | | |
| Farm working expenses | 623000 | 30.39 |
| Interest on debt | 184000 | 8.98 |
| Capital replacement | 22000 | 1.07 |
| Personal drawings | 35000 | 1.71 |
| Total farm expenditure | 864000 | 42.15 |
| Cash surplus | 150000 | 7.32 |

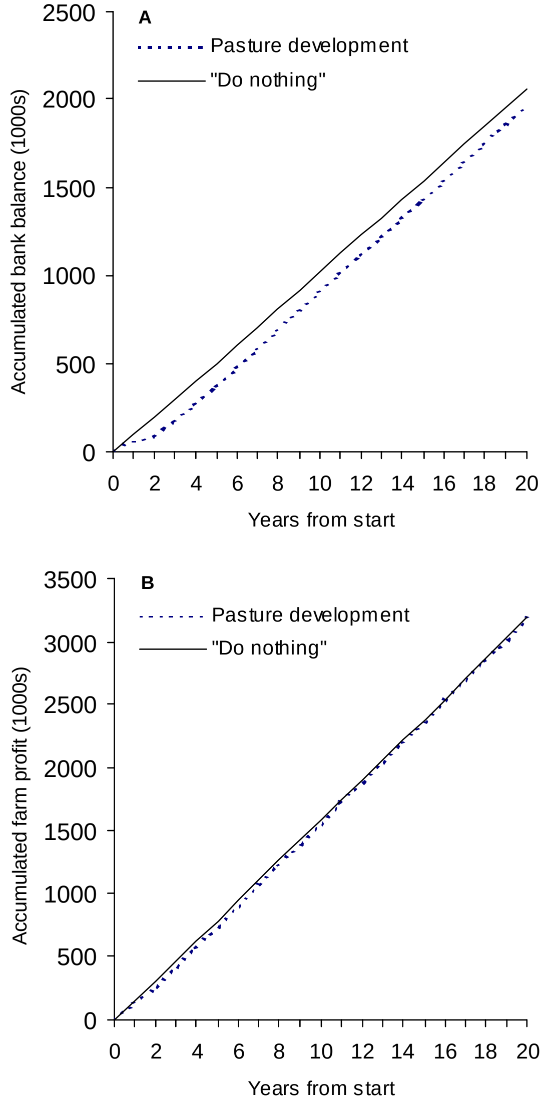
**Table 9** Farm working expenses used to set up Earnscleugh Station in the RANGEPACK HerdEcon model for all year-types.

| Item | ($) |
|---|---|
| Wages | 74200 |
| Animal health | 71500 |
| Breeding expenses | 10200 |
| Weed & pests | 165000 |
| Shearing and crutching | 80000 |
| Pasture maintenance | 75000 |
| Vehicles | 22000 |
| Electricity | 6000 |
| Feeds | 1000 |
| Repairs & maintenance | 23000 |
| Freight | 16500 |
| Administration | 43100 |
| Insurance | 6600 |
| Rates and rent | 28800 |
| **Total farm working expenses** | **623000** |

(net wealth) is also reported and includes the increased value of livestock.

The cost of development and the potential increase in stock carrying capacity were two areas of uncertainty highlighted by the study group. Simulations were re-run for 10 years using sensitivity analyses. Development costs were varied from $50 to $350/ha in $100 increments, and marginal stock increases were varied from 1.25 to 2.75 su/ha in increments of 0.5.

**Figure 1** The mean results of two scenarios modelled for Earnscleugh Station run through 500 simulations with randomly varied wool prices over a 20-year period. One scenario developed 721 ha of new pasture, the other did no development. Figure 1A. Accumulated bank balance. Figure 1B. Accumulated farm profit.




## Results and discussion

### The development scenario verses 'do nothing'

The anticipated marginal stock increase of 1.74 su/ha, together with a development cost of $150/ha, led to a reduction in the accumulated bank balance (Figure 1a). At 20 years, the accumulated bank balance for the 'do nothing' option was $94 000 higher (4.7%) than for pasture development ($2 057 000 versus $1 963 300 respectively). This margin was reduced to $16 000 (1% higher) when the accumulated farm profit, which takes into account the value of extra livestock, was compared at year 20 ($3 191 000 versus $3 175 000 respectively) (Figure 1b).

Decision making based on "cash in the bank" would conclude the pasture development scenario is inferior to the "do nothing" option. However, if decisions were based on overall net wealth then the added value from increased stock numbers almost offsets the cost of the pasture development – the farmer is neither better nor worse off.

**Effect of different development costs**

A reduction to $50/ha did not result in the accumulated bank balance improving from the "do nothing" approach within the 10-year time frame (Figure 2). Even by year 20, the accumulated bank balance for developing at $50/ha was $1 906 000, versus $1 954 000 for "do nothing".

**Effect of various increases in stocking rate**

When the marginal increase in stock carrying capacity was increased to 2.25 su/ha, a payback was reached within 10 years (Figure 3). Payback at stocking rates lower than 2.25 stock units were not achieved within a 20-year time frame.

Changes to the marginal increase in stocking rate had a greater impact on financial outcomes than changes to development costs. While a 300% decrease in development costs ($150/ha to $50/ha) did not enable a pay-back, a rise in the marginal increase in stocking rate of 29.3% (1.74–2.25 su/ha) enabled pasture development costs to be recouped within 10 years.

The success of pasture development in driving stocking rate is a crucial factor governing financial returns. It is clear the marginal increase in stocking rate varies greatly between different landforms. Interestingly, while the Jethro development cost was $222/ha (Table 3), the marginal increase in stocking rate was 3.1 su/ha/yr (Table 2), suggesting that this component of the development scenario was profitable. The same argument applies for the Baker boot development – it appears that it is the oversowing of the marginal land that, although relatively cheap to do, made the scenario unprofitable. Also, the specific mix of landforms on the Shepherd's Flat Block achieved 2.7 su/ha/year (or a marginal increase of 2.25 su/ha/year), indicating it would be profitable compared with Buckley's Block which achieved only 1.88 su/ha/year.

## Conclusions

At the level of productivity expected from pasture improvement on Earnscleugh Station, this analysis shows there are compelling reasons to 'do nothing'. Development reduced cash in the hand and, while there was no loss, there was no increase in net wealth. However, focusing on better landforms, and on blocks with proportionally more of the better landforms, can be shown to increase both profitability and net wealth.

The study has highlighted that productivity, not cost, drives financial success in pastoral improvement programmes. Farmers contemplating pastoral development must carefully assess the potential increase in stocking rate from the area concerned. Unfortunately, there is insufficient information at the landform level in many parts of Central Otago, and elsewhere in the high country, to accurately assess potential gain from development. This appears to be an important prerequisite before farmers can confidently assess this investment opportunity.

**Figure 2** Sensitivity to the accumulated bank balance over 10 years to variation in the cost of pasture development

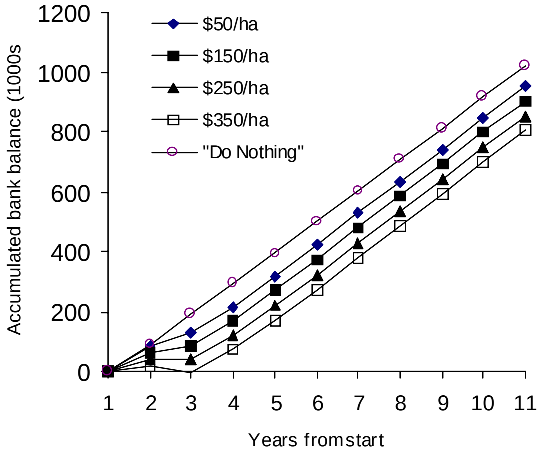
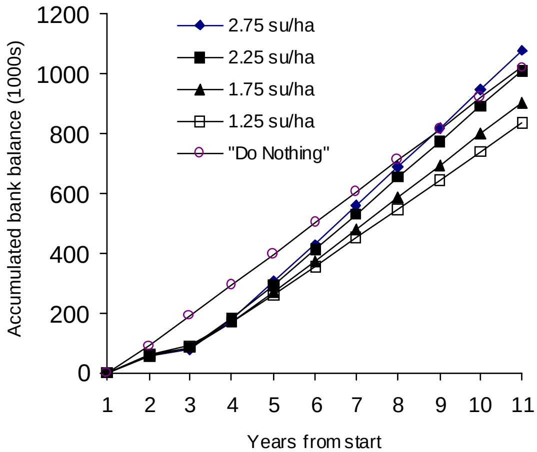



**Figure 3** Sensitivity of the accumulated bank balance over 10 years to variation in marginal stock increases arising from pasture development.

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