Can Forestry Land Produce Milk?
An Economic Analysis of Changing Rural Land Use.

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Abstract

Over the last decade there has been a marked increase in dairying land use in New Zealand. Many hectares of land previously used for sheep, beef and cropping production are now in dairy production. Investors interested in dairy conversion prefer properties with reasonable scale and there are now limited opportunities for large scale dairy development in the North Island. This study gives consideration to dairy conversion of land currently in forestry production. The physical feasibility of dairy conversion of forestry land is investigated and a model is built to investigate the financial viability. The study utilises computer spreadsheets, the residual method of valuation and discounting cash flow methodology. Risk is analysed using the Monte Carlo simulation process.

Results of the analysis show that a change in land use in the Kaingaroa Forest from production forestry to dairy farming is physically possible and that an investor with 50% debt and a required post taxation return rate of 7% could afford to pay between $4,500 and $6,000 per hectare for a 420 hectare block in stumps and slash.

The results of the model were then compared with prices being paid in the current real estate market for developed dairy farms. The market evidence supported the price range of $4,500 to $6,000 per hectare.

Introduction

In recent years in New Zealand the profitability of dairy farming has increased and the profitability of timber production has declined. This has led to investors questioning the viability of conversion of forestry land to dairying. While no large tracts of land have been converted to pastoral use from forestry to date several small parcels have and investors are now looking for conversion opportunities with scale.

The pumice lands of the Kaingaroa forest in New Zealand provide this scale. This area was originally intended for agricultural settlement but by the late 1890's farmers were walking off the land in despair as stock died of 'bush sickness'. The afforestation of the region followed. In the 1930's cobalt was identified as the deficient mineral causing ill thrift in stock and today mineralized fertiliser applications easily remedy the deficiency. Dairy farming is now seen as a profitable land use on the pumice country of this region. Since the late 1980's dairy farming in the Reporoa region, bordering the Kaingaroa forest, has expanded as a large number of dry stock farms have been converted into dairy farms. It is now possible that dairy farming is the highest and best use for land currently in production forestry.

This paper presents results of research to assess the viability of dairy conversion of a hypothetical block of 420 hectares in the Kaingaroa forest.

Research Objectives

The first objective was to determine the physical feasibility of conversion of Kaingaroa forest land to dairy production. The second objective was to investigate the financial viability of developing a dairy farm from Kaingaroa forest land following clear felling of the pine trees. The third objective was to compare the financial model to market evidence.

Physical Feasibility of Dairy Conversion

The physical feasibility of dairy conversion is dependant on suitability of the land for dairy production and determining a financially and environmentally sound process for clearing the land of stumps and slash.

Kaingaroa Forest Land

The Kaingaroa forest comprises an area of more than 150,000 hectares in the central North Island of New Zealand. The forest estate is currently managed by Fletcher Challenge Forests and the land is Crown owned and subject to Maori land claims before the Waitangi Tribunal. Over 90% of the planted area is established in Radiata Pine with Douglas Fir (7%) and other species making up the balance. The first plantations were established in the late 1800's and large tracts of land have been in plantation forestry since the 1930's.

The physical factors that have the greatest impact on suitability of the Kaingaroa forest land for dairy use are topography, soil type, water supply, climate and access.

The forest is on a large plateau, mainly flat to rolling in contour, at an elevation of 450 to 650 meters above sea level. The contour is very suitable for either forest production or dairying.

Soils on the plateau comprise mainly Kaingaroa sand and Kawhatiwhati sand. Kawhatiwhati sand is described by Rijkse, (1997) as a shallow black friable sand with weakly developed structure that overlies pale brown and yellow gravely sand with bands of compacted sand. Kaingaroa sand is black silty sand that overlies reddish brown silty sand on compact yellow sand. These soils are free

draining which is advantageous for dairy farming allowing higher stocking rates to be carried without pasture damage occurring during wet periods. However natural fertility levels are low. Rijkse (1997, p 56) states that the topsoil has only medium levels of organic carbon. The soil also has high phosphate retention and low calcium, magnesium, sodium and potassium levels. These deficiencies can be corrected with appropriate fertiliser programs. The soil type is well suited to dairy production.

There are virtually no natural watercourses through the forest so stock water would have to be pumped from bores. Good underground water has been sourced on an adjoining dairy farm on the plateau at 100 to 200 meters. Water supply should not limit dairy production.

The climate is well suited to seasonal dairy production. Mean annual rainfall for the area is 1400 to 1450 mm/year with reasonably even distribution throughout the year. Winter temperatures are low limiting pasture production and ground frosts are often experienced from March through to November and may occur during the summer months.

The forest is divided into blocks by a grid of forestry roads. Some of these roads are sealed but the majority have a gravel surface, are well formed and suitable for the requirements of logging transport. Improved roading infrastructure would be necessary for large scale dairy development in this area.

Dairy Farming in the Reporoa Region

The Reporoa region borders the Kaingaroa forest. Large scale agricultural development of the pumice country in this region began in the late 1940's. Research in the 1950's showed that the productivity of pumice land would increase over time as the soil consolidated and fertility levels improved. In the 1960's dairy farms in the Reporoa area were producing 313 kilograms milksolids per hectare (kgms/ha), the average production in this area in the late 1990's was 765 kgms/ha and highest production levels are now in excess of 1000 kgms/ha.

A change in fertiliser programs has been one of the most important factors leading to increases in production. The pumice soils are low in organic matter and require high and frequent fertiliser inputs.

With the anticipated improvement in dairy returns many dry stock farms were converted to dairy farms in the Reporoa region during the early 1990's. These properties are now successful and profitable dairy operations and Reporoa is known as a sound dairying region.

Land Clearing

The change in land use from exotic forestry to pastoral farming is very uncommon in New Zealand. The options available for land clearing are;

1. Complete removal of stumps and slash from the site.
2. Root raking stumps and slash into windrows and leaving to rot. Estimated time frame of 10 years for windrows to rot.
3. Grinding stumps and slash and incorporating into soil profile.

The first option is not viable given the large scale of the development and the quantity of waste that would have to be removed from the site. The second option is the cheapest and has been used for small scale developments in the region. It is estimated that 5 to 15% of the land area would be lost with windrows. However windrows create management problems for the successful operation of a dairy unit. It is imperative that stock can move freely over the land and feed conservation for maximum productivity is important. Feed conservation would be restricted by the presence of windrows. The grinding of stumps and slash is an expensive operation. This method has not been

carried out on the pumice soils of the Central North Island but is used for removal of stumps in peat swamps and cost estimates of $3,000 per hectare are based on that. Grinding has the advantage of incorporating organic material into the soil profile immediately. The ground stumps and slash would rot quickly and the process could be accelerated by the application of nitrogen. This process should aid the establishment of a pasture sward.

Research into the physical viability of dairy development determined that the Kaingaroa forest land is suited to dairy production and can be cleared of stumps and slash in an environmentally sound manner at a cost of approximately $3,000 per hectare.

Financial Viability of Dairy Conversion

Methodology

Land development for agriculture takes several years with high costs incurred during the initial stages of development. Income levels will increase in the years following development as farm productivity increases. In order to assess the value of a development project initial costs need to be compared to future earnings. It is not possible to directly compare costs incurred today with future returns as a dollar today is worth more than a dollar in the future. So future cash flows are discounted in order to estimate the present value of a development project.

Jefferies (1995) states that properties where the value is dependent on future irregular cash flows may be effectively valued using discounted cash flow techniques. He cites forestry blocks undergoing development and land under transition from rural to subdivisional use as situations where a discounted cash flow technique is appropriate for determining value.

Discounted cash flow analysis is commonly used in the evaluation of forest projects (Maclaren (1993)). This method can be used to determine a land expectation value. This equates to the amount that an enterprise can afford to pay for land given assumptions about future cash inflows and outflows and discount rates.

Ward et al (1966) and Chisholm (1963) used present value analysis for the economic comparison of forestry and agriculture. Ward's study related to a development on the pumice soils of the central North Island where land use was changing from a raw undeveloped state into either pastoral or forestry use.

Discounted cash flow analysis is an accepted method of investigating the financial viability of a rural development and was applied in this study. Income, expenditure and the capital structure was assessed on an annual basis, this was discounted to assess a fair present value per hectare of the land ring fenced in a state of stumps and slash. The following assumptions were made.

Cash flow frequency

Dairy farm income is received each month and for greatest accuracy cash flows could be discounted monthly. In this study cash flows were analysed on an annual basis with end of year payment assumed. This was done for simplicity owing to the long-term nature of the analysis.

Investment period

Consideration had to be given to the project length. The development of a dairy farm is a long-term project with stabilised net cash flows likely to take in the order of ten years. In this study it was also important to be able to compare dairy farming land use with the existing land use of forestry. The investment period was taken to be equivalent to one forestry cycle of 25 years.

Allowance for inflation
Forecasting future costs and prices in the agricultural sector is extremely difficult but as income and expenditure are not neutral to inflation an allowance should be made for it.

Taxation
Some capital development expenditure is tax deductible and other capital expenditure can be depreciated with depreciation claimed as a tax-deductible expense. This tax shelter provides further incentive for development projects. It was considered important that the analysis was conducted on a post taxation basis.

Financing
A development of this type is most likely to have debt and equity finance. An assumption was made that 50% of the cost of development was financed with term lending.

Discount rate
The discount rate used in the analysis should reflect the risk of the project. Factors to consider include potential variance in development and conversion costs, the likelihood of achieving forecast milksolids production and the stability of future milksolids prices. In determining the appropriate discount rate consideration was also given to discount rates currently applied in the assessment of forestry projects. Current discount rates used for the analysis of forest projects are 8 to 9% pre tax. A post taxation discount rate of 7% was used in the model.

Terminal value
Terminal value in a discounted cash flow analysis is commonly estimated with regard to net income at the end of the holding period. Value of dairy farm land has historically been strongly dependent on milksolids payout and farm production (gross income potential). This was used as the basis for determination of the terminal value.

Results

Farm Development
The farm development involves the clearing of stumps and slash from the land, establishment of permanent pastures, application of capital fertiliser and the construction of farm improvements.

The farm set up cost for the 420-hectare dairy farm is summarised in table 1. This data has been sourced from Lincoln University (1999), Crafer, Hathaway and Vander Bilj (1996), Jones and Fairweather (1996) and industry quotes and was current at March 2003.

Table 1. Farm Set Up Cost

Cost of Farm Improvements				
Item				
Cowshed, plant and site preparation			770,000	
Water supply			118,300	
Effluent disposal			27,000	
Power supply			25,000	
Housing			405,000	
Farm buildings			55,000	
Stock races			63,000	
Tanker track			10,000	
Fencing			89,000	
Total cost of improvements				**1,562,300**
Land Development				
Grinding stump and slash	3,000	420 hectares	1,260,000	
Disc, harrow and roll	150	420 hectares	63,000	
Regrassing	125	420 hectares	52,500	
Capital fertiliser	350	420 hectares	147,000	
Total cost of land development				**1,522,500**
Total costs of development				**3,084,800**

Fair Value of the Undeveloped 420-Hectare Block

Fair value of the 420-hectare block (ring fenced in stumps and slash) is estimated by discounting the future cash flows from the dairy farming operation over the 25-year holding period. These cash flows include the initial farm development, annual income and the sale price of the operation in year 25.

Farm income and expenditure is assumed to reach a status quo situation in year 10 of operation.
The value of the farm (including dairy company shares) at the end of the project is estimated using a productive approach. Total production in year 25 is multiplied by 5.1 times the milksolids payout to estimate the value of land, buildings and dairy company shares. Tables showing years one to five of the income and capital assumptions and years one to eleven of the discounted cash flow analysis are included in the appendix.

Discounted cash flow analysis of the purchase and development of land in stumps and slash into a dairy farm shows that a purchaser with 50% debt and a post taxation return requirement of 7% could afford to pay approximately $5,300 per hectare for the land. This assumes the land is ring fenced with power and sealed road to the gate.

Risk Analysis

Investigation of the risk associated with the output is an important component of an investment analysis that is dependant on the volatility of the inputs. There are a number of inputs that are subject to variation. Table 2 details inputs identified as most risky and provides a probable value

range for each. The value ranges have been defined following analysis of both historical series and industry projections and tend to be conservative.

It is unlikely that the payout will fall below $3.60 in year one as a projected range of $3.70 to $3.90 has been announced by Fonterra for the 2003/2004 season. The 2003 May Update of the MAF SONZAF report projects payout levels increasing to $5.13 per kgms by 2008, this level is considerably higher than the most optimistic level used in the analysis.

A per cow production level of 250 kg ms is conservative and well below the national average. The maximum per cow production level of 320 kg ms per cow is the average level achieved since 2000 published by Dexcel (2003).

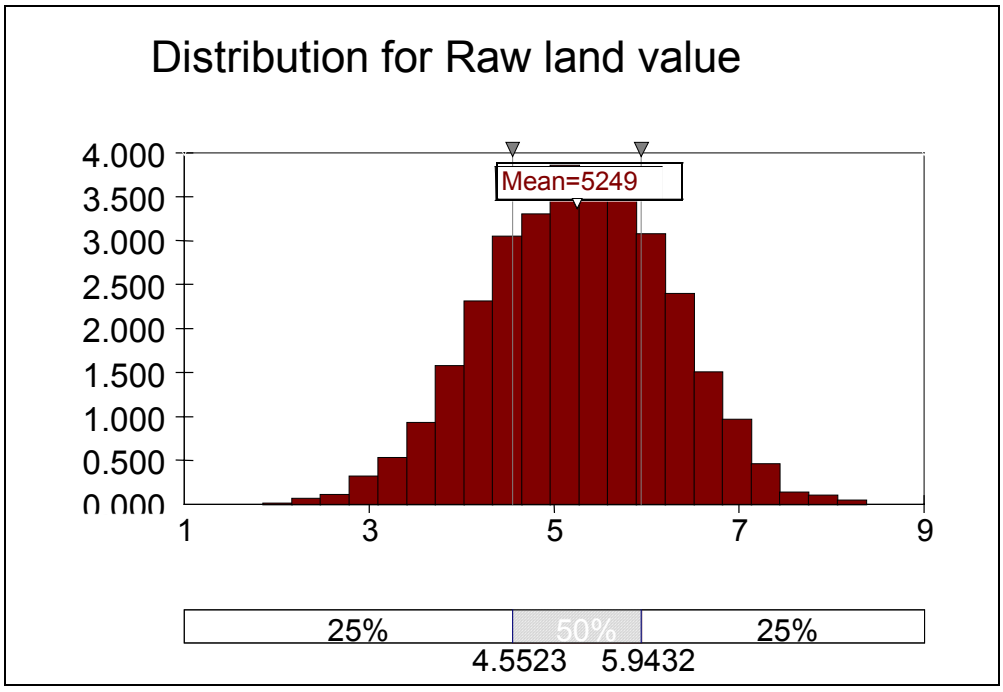
Farm development costs can be estimated with a reasonable degree of accuracy with the exception of stump grinding. Large scale development of land from stumps and slash after exotic forest production into pasture has not been carried out in New Zealand. The cost of clearing the land has been estimated by contractors with limited experience in large scale stump grinding and costs could vary; a range of 13% above or below the initial estimation is used.

Table 2. Probable Distribution of Risky Input Variables

INPUT TABLE	Current value	Distribution	Probable Distribution	
Inflation Rate	2.0%	Triangular	1%	3%
Taxation Rate per $	$ 0.33	Triangular	0.31	0.35
Mortgage Interest Rate	7.0%	Triangular	6%	8%
Payout year 1	$ 3.60	Triangular	$ 3.50	$ 3.70
Annual increase in payout	$ 0.08	Triangular	$ 0.06	$ 0.10
Per cow production yr 1	250	Triangular	235	265
Increase in per cow production	8	Weibull	2	15
Cost of Dairy Company Shares	$ 4.95	Triangular	$ 4.85	$ 5.05
Annual Increase in Share Cost	$ 0.05	Triangular	$ -	$ 0.10
Land Development Cost	$ 1,522,500	Normal	$ 1,322,500	$ 1,722,500

Comprehensive risk analysis can be undertaken using the @RISK add in to Excel (Palisade Corporation (2002)). This programme enables the user to input all risky variables in terms of a probability distribution. A simulation run then provides a distribution of possible results for the defined output. Figure 1 shows the distribution of value of undeveloped land per hectare given the probability distributions listed in table 2.

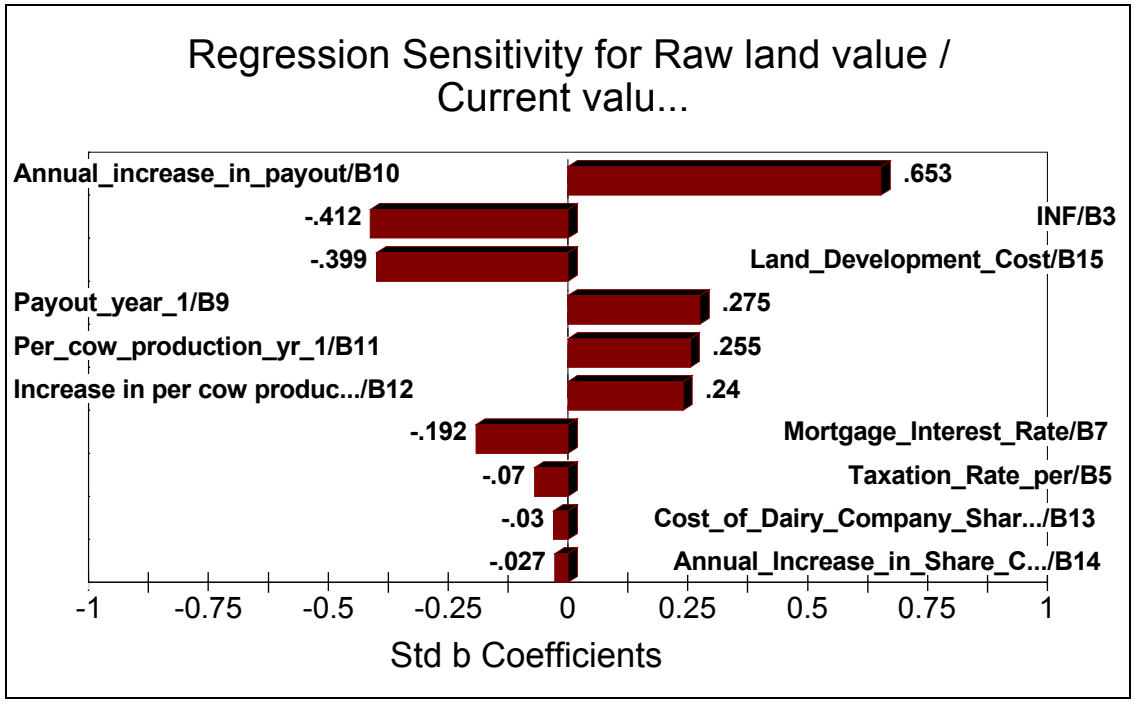
Figure 1. Distribution for Raw Land Value



This shows that there is a 50% probability that the investor will show a post tax return of at least 7% if a price of between $4,500 and $6,000 is paid for the undeveloped land per hectare.

Figure 2 illustrates the risk associated with each of the input variables. Change in payout has the greatest effect on the profitability of the investment as this determines annual cash flow and the residual value of the farm business. Initial land development cost and the ongoing farming expenses (influenced by inflation) also impact strongly on the profitability of the investment.

Figure 2. Risk associated with each input variable.



Sales Evidence

The discounted cash flow analysis provides an estimate of the present economic value of the land. In an informed market this would be expected to be equivalent to the price paid currently for a comparable class of land under willing buyer willing seller conditions. It is important to investigate recent sales of properties suitable for conversion and dairy farm sales to verify the model.

The table 3 summarises recent dairy farm sales in the Reporoa region. Sale price per hectare paid in 2001/2002 range between $11,000 and $18,000 and average $15,200 per hectare.

Table 3. Recent Reporoa Dairy Farm Sales

Address	Land Area (ha)	Sale Price	Sale Date	Sale Price per hectare
Humphrey Rd	29	$ 400,000	Oct-01	$ 13,793
Springs Rd RD2	89	$ 986,000	Apr-01	$ 11,079
Forest Rd	77	$ 1,380,000	May-01	$ 17,922
Tirohanga Rd	83	$ 1,500,000	Jan-02	$ 18,072
Springs Rd	155	$ 2,000,000	Nov-01	$ 12,903
State Hway 5	120	$ 2,120,000	Jan-02	$ 17,667

Cost of developing the land from a state of stumps and slash to productive dairy units is estimated at approximately $7,300 per hectare and the cost of purchasing dairy company shareholding at $4,200 per hectare. Therefore around $11,500 per hectare would have to be spent in addition to raw land purchase. If the raw land ranges in value between $4,500 and $6,000 per hectare this equates to a total per hectare price range of $16,000 to $17,500. Thus there is little difference between cost of an existing unit and developing a unit from forestry land. However a newly developed unit has the advantage of scale, a high standard of improvements, new pasture species and convenient layout.

Since 1999 there have been two central North Island sales of land in trees where the land has been sold to dairy farmers for conversion from forestry to dairy use. A 93 ha block sold for $5,300 per ha and a 183-hectare block sold for $4,450 per hectare. These two sales support the price levels derived from the economic analysis. Inspection of these properties two years after conversion confirmed that land that has been planted in exotic forestry could be successfully converted from stumps and slash to productive pasture within a short time frame.

Conclusions

The pumice country of the Volcanic Plateau is suitable for dairy conversion. The flat topography and free draining soil are sought after for dairying. The climate is suitable with adequate rainfall, however low winter temperatures could limit the growing season. Productive dairy units adjoin the forest confirming the suitability of this land for dairy production.

A change in land use from exotic forest production to pastoral farming has not been conducted on a large scale in New Zealand and this study has made assumptions regarding conversion and development. However successful small scale developments of exotic forestry land to pastoral use show that a change in land use is physically possible. Research is required to confirm the most appropriate method of land conversion and the time frame for development. This study has adopted a conservative approach to conversion and development.

The discounted cash flow is an accepted method for estimating value where value is dependent on future irregular cash flows. The value of the 420-hectare farm in a state of stumps and slash is estimated at a value range of $4,500 to $6,000 per hectare. The analysis is based on actual cost and

production data from the Reporoa region where it is available. Costs of farm development have been budgeted at a realistic level assuming a high standard of improvements. The time frame for farm development is unproven but believed to be realistic with current management practices. Farm income streams are based on the current payout for milksolids that is at a low point in the commodity cycle.

The value estimate of $4,500 to $6,000 per hectare for a 420-hectare block in a state of stumps and slash following clear felling can be supported by two recent sales of forestry land for dairy conversion at rates $4,450 and $5,300.

This research has shown that if Kaingaroa land in a state of stumps and slash could be purchased for under $6,000 per hectare in 2003 it would be financially viable and physically possible to convert it to dairying.

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Appendix

YEAR	0	1	2	3	4	5
Payout /kg		3.60	3.68	3.76	3.84	3.92
Land Area ha's			420	420	420	420
Stocking Rate /ha			2.0	2.1	2.2	2.3
Cow Numbers			840	882	924	966
Production in kg milk solids						
- Total			210,000	227,845	246,389	265,632
- Per ha			500	542	587	632
- Per cow			250	258	267	275
Calves Sold %			65%	65%	65%	65%
Sale price - calves			24	25	25	26
Cull Cows %			10%	10%	10%	15%
Sale Price - Culls			407	416	425	434
CAPITAL INVESTED						
Property Value						
- Land development		1,522,500				
- Buildings and other improvements		1,562,300				
Total		3,084,800				
Value of land and buildings			2,587,410	2,916,990	3,270,049	3,647,375
Stock Values per head						
Mixed age cows		817	814	832	850	868
R2yr hfrs		717	714	732	750	768
R1 yr hfrs		409	407	416	425	434
Bulls		409	407	416	425	434
Total stock value		926,066	922,125	990,238	1,060,446	1,132,750
Plant		100,000	5,000	5,100	5,202	5,306
Total estimated value		100,000	100,000	100,100	100,297	100,588
Depreciated Value		80,000	72,250	65,748	60,307	55,771
Dairy Co Shares		1,268,190		91,007	95,502	100,066
Total value Shares		1,268,190	1,268,190	1,359,197	1,454,699	1,554,766
Total Capital Invested		5,379,056	4,877,725	5,366,525	5,885,492	6,435,479

Table 1. Income, production and capital invested years 1 to 5.

Table 2. Cash flow years 1 to 11.