Taihape | Lazy G Ranch (#8)

Integrating Forestry for Profitable and Sustainable Land Use

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With funding support from
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Forestry New Zealand

Executive Summary

- Graeme Gibbs farms the Lazy G Ranch, a 445 ha hill country property located 2 km south-west of Taihape.

- This cases study explores forestry options for a steep, poorly-accessible block on the farm which is reverting to mānuka and scrub. The eligibility of the block for carbon credits was questionable and this was also a focus. Graemes' goal was to determine whether the area was better off in trees for carbon and timber or whether money should be spent to bring it back to a productive farming level.

The three scenarios explored were:

- Pinus radiata for carbon and timber with harvest at 28 years;
- Redwoods for carbon and timber; and
- Mānuka for carbon, inter-planted with rimu for timber. Mānuka honey revenue for 11 years is possible before the mānuka fully matures, with the area regenerating to native bush. The rimu and redwood scenarios assume harvesting is done progressively once trees are older under a continuous cover regime.

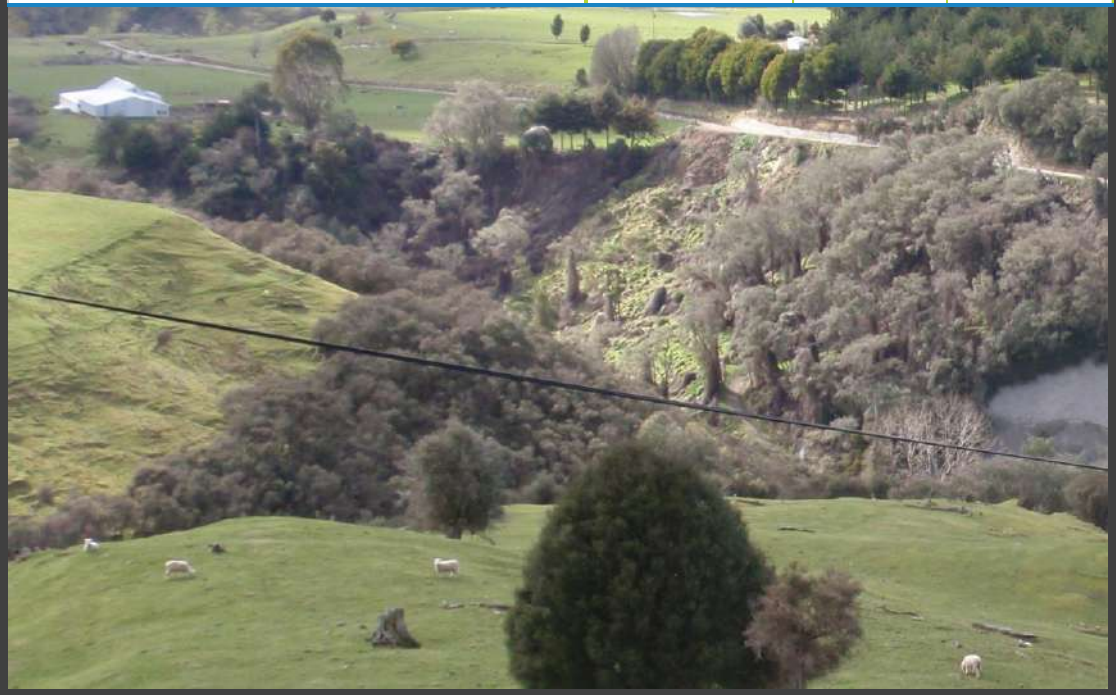
- Integration of species such as mānuka, redwoods and rimu as well as radiata pine offers the opportunity to improve environmental resilience, diversify income and enhance the property's biodiversity and aesthetics.

- The importance of long-term thinking around land use decisions and stewardship are highlighted by this case study. Capital costs and changes to cash flow need to be considered along with personal and environmental factors.

- Planning for right tree, right place and right purpose is fundamental in achieving landowner objectives.

Table 1. Key physical metrics for the status quo and tree scenarios modelled

Farm parameters	Status quo - "unplanted"	Tree Scenarios	Variance
Total farm size (ha)	445.3	445.3	0
Farmed area (ha)	375.4	352.2	-23.2
Permanently retired (ha)	63.3	60.6	-2.7
Timber woodlots (ha)	6	31.9	25.9
Stocking rate (SU/ha)	12.4	12.5	0.1
Sheep:Cattle	84%:16%	83%:17%	
Standardised stock numbers (SU)	4,655	4,402	-253
Sheep SU	3,910	3,654	-256
Cattle SU	745	748	3
kg liveweight wintered/ha	687	696	9
Meat & wool produced per ha/year (kg)	254	255	1
Pasture production (t DM/ha)	8.4	8.5	0.1



Case Study Overview

Tree scenarios for integration with the farm's existing activities were developed in association with the owner, ensuring scenarios aligned with their objectives and tree species of interest to them. The owner was interested in scenarios suited to timber and carbon, with non-pine exotics or natives. Financial and environmental analysis demonstrate potential returns, impact on improving the farm's environmental resilience, and total farm business performance of the integrated options compared to the existing farm system. The full case study report with detailed analysis can be found at www.mpi.govt.nz/forestry/ and www.perrinag.net.nz/planting-trees/.

Sections covered in this case study include:

CURRENT FARM BUSINESS

This section presents a snap shot of the businesses background, goals, and current performance. The data from the 2018/19 season is utilised to form the 'status quo system' to provide a base comparison to integrating trees into the sheep and beef unit. Graeme Gibbs would like a little more biodiversity on the property and to have the tools to monitor the environmental impact of the farming system.

Read more on page 4

RIGHT TREE RIGHT PLACE RIGHT PURPOSE

Factors motivating tree plantings and land use change are outlined to understand 'why' trees are being considered. As tree planting is a generational decision it is essential to plant the right tree in the right place to achieve the right purpose.

Read more on page 5-6

WHOLE BUSINESS ANALYSIS – BEST FUTURE LAND USE & FARM SYSTEM

The forestry options at an enterprise (sheep and beef and forestry) and a whole farm business level are analysed to show the performance of each integrated forestry option compared to the status quo and identify which option best supports the attainment of the owners' objectives.

Read more on page 7-13

Farm Overview (Status Quo Farm System)

Graeme Gibbs farms Lazy G Ranch, a 445 ha hill country property located 2 km south-west of Taihape, in the Lower Hautapu catchment. The property includes 375.4 effective ha in pasture, 69.5 ha of non-effective land of which 4 ha are commercial woodlots, 6.8ha indigenous bush and the remainder regenerating scrub.

In total 21% of the farm is flat to rolling comprising land up o 15% slope, 23% is steep at between 20°-35° in slope (which tends to be the most erodible due to soil type) and a further 35% is very steep at more than 35° in slope. Of the 69.4 ha retired block,79% is either steep or very steep contour.

Integration of forestry offers the opportunity to improve environmental resilience, diversify income and enhance the property's biodiversity and aesthetics while supporting the sheep and beef operation.

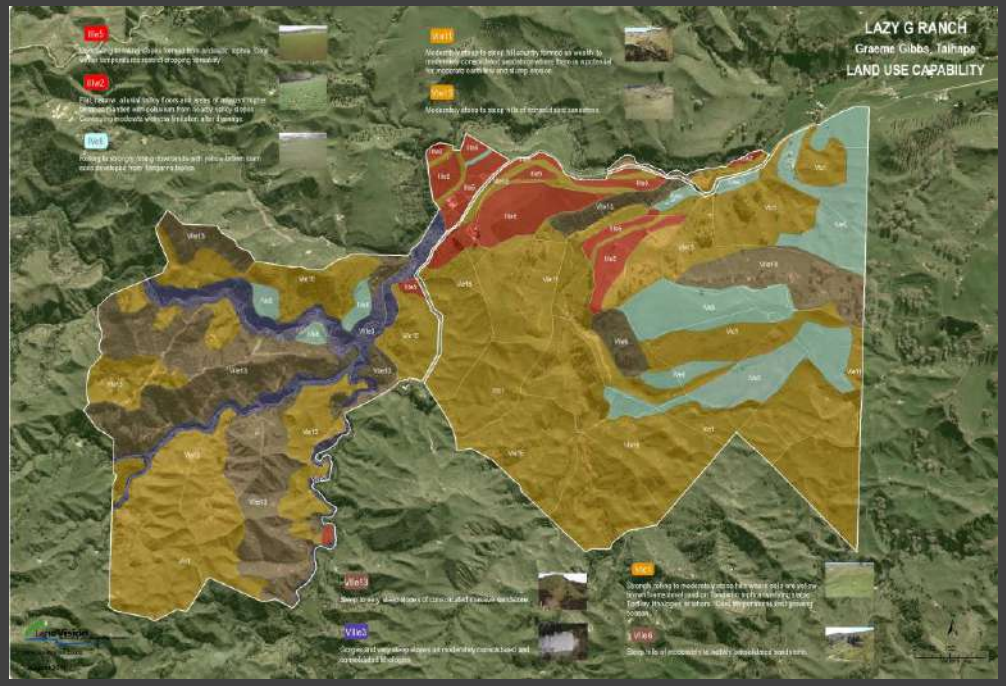
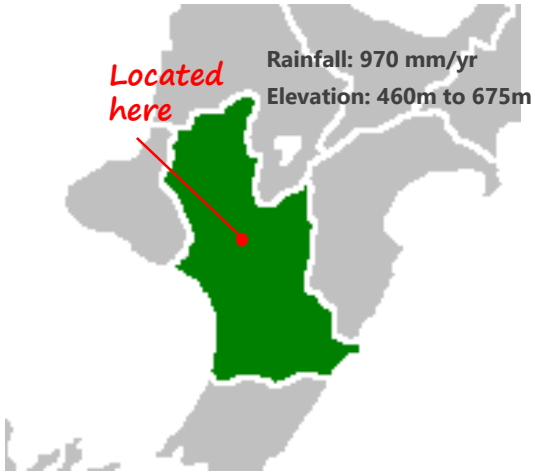


Figure 1: Gibbs Land Use Capability

Location



Farm Details

Home farm (ha)	**445.3**
Effective pasture (ha)	**375.4**
Soil type	**65% brown soils 35% allophanic soils**
Water course	**Otaihape Stream**
Est. pasture grown (per effective ha/yr	**8.4 tDM**
Est. pasture eaten (per effective ha/yr)	**6.8 tDM**

Livestock Details

Flock size (ewes)	**2,250**
Lambing %	**137%**
Ave lamb ccwt (kg)	**16.6**
Herd size (cows)	**70**
Calf weaning wt (kg)	**208**
Sheep/cattle ratio	**84%:16%**

Performance Indicators

Stocking rate (su/ha)	**12.4**
Operating profit ($/ha)	**698**
Return on asset (ROA%)	**3.2%**
N leaching (kg N/ha/yr)	**9**
P loss (kg P/ha/yr)	**0.3**
Biological GHG emissions (t CO_2 eq./ha)	**4.2**

Factors Motivating Tree Planting and Land Use Change

Physical Constraints

- There has been little erosion on the farm (nil to slight) although there is potential for sheet and rill erosion on the flatter areas if they were to be cultivated (currently no cultivation), and potential for slump, soil slip and sheet erosion particularly on the steep hills (Sheppard Agriculture, 2011).
- There are no lanes on the property, but a little-used, no-exit road running through the property acts as a boundary between two blocks on either side of the road and serves as a laneway. The property has 15.5 km of waterways. Some of these flow through major gorges which run across the property on the west side of Otaihape Valley Road effectively making access difficult. Stock water is provided by reticulated water and troughs, or dams. The owner identified the lack of a water scheme as a limitation.
- The impact of colder winters and poorer soils particularly at steeper terrain limiting pasture growth is shown in Figure 2. At between 460 to 675 m above sea level, significant snowfalls occur every few years. Average rainfall is 970 ml per annum. Traditionally considered summer safe, droughts are now experienced every few years.

Environmental Constraints

- **Annual N loss** at **9 kg N/ha** is **low** in **line with** the **high sheep to cattle ratio at 84:16** and **lower stocking level** reflective of pasture grown on this land class.
- P loss at **0.3 kg P/ha** reflects there currently being no cultivation. There would be only a small decrease in P loss if more area was planted due to any proposed area already having little or no fertiliser applied and very low stocking levels.
- While **Greenhouse Gas (GHG) reduction targets** are not yet explicitly in the Emissions Trading Scheme (ETS), all farmers under the **Zero Carbon Act 2019** will need to reduce biogenic methane emissions by 10% by 2030 (December 2017 baseline). Lowering the **GHG** footprint from **4.2 t CO2e** at Lazy G Ranch will come from lowering total DM intake as stock numbers are replaced by trees.
- The **integration of trees** may provide a valuable tool to reduce environmental losses. For example, retiring low quality land into a low N land use while reducing P loss and sequestering carbon over time.

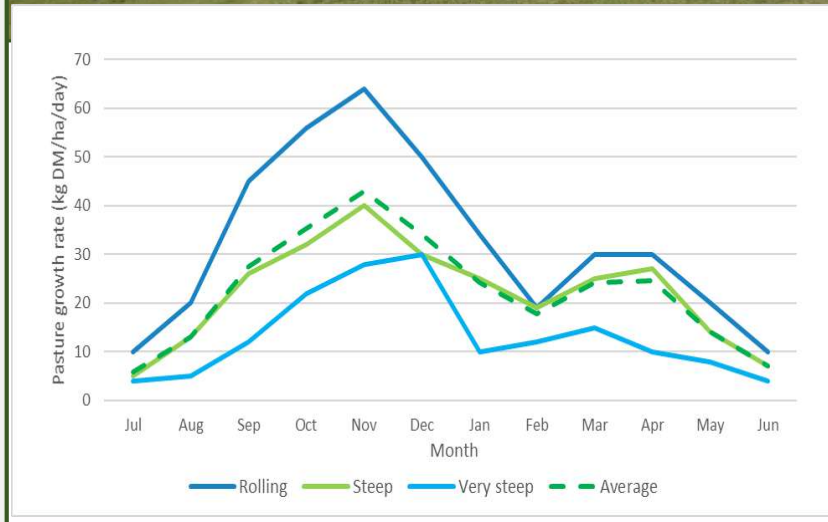


Figure 2: Estimated pasture growth for main land classes at Gibbs

Right Tree Right Place Right Purpose

Factors other than profitability can influence enterprise selection or tree species choice. Owners of multi-generational properties, such as in farming family businesses, can take a particularly long-term view. Options which may not be profitable for the first generation, may in fact be more profitable and self-sustaining as a long-term enterprise for succeeding generations. The advantages and disadvantages of the tree options for Lazy G Ranch are explained. The variation in landscape suits multiple tree species being planted within forestry compartments rather than a singular species.

Regenerating bush area

The owner is keen to plant trees to harvest for timber income as well as for carbon. As the land in question has had recurring scrub and regenerating bush on it in 1989/90, it is uncertain how much of the area is eligible for a carbon claim if planted in trees.

Tree planting could also reduce erosion compared to the alternative option under consideration which is converting the regenerating scrub area to improved pasture for farming.

However, carbon returns from alternative tree species could be lower or take longer to attain compared to radiata pine.

Redwoods

- The owners prefer alternative exotic species or natives for timber to *Pinus radiata*. Radiata pine, being prone to snow damage, is not particularly suited to the Rangitikei climate.
- Where drainage is poorer, Redwood (*Sequoia sempervirens*) can be well suited. Redwood develops an extensive root system useful for erosion control on lower slopes. Being shade tolerant they can cope with south facing slopes and can be harvested under a mixed-age continuous canopy where individual trees are harvested on reaching a particular size rather than a particular age. However, on very wet sites a "nurse" crop of moisture removing trees will assist with establishment.

Native nurse crop with Rimu

- Planting a native nurse crop followed by Rimu, with their continuous harvest regimes potentially offer a more self-sustaining, high-value enterprise for future generations than the radiata scenario**.**
- The plan is to plant mānuka as a nurse crop thereby providing a revenue stream from honey once the mānuka is established and up until around year 11 before this area regenerates to native bush.

Integrated Forestry Analysis

Waterways flow through major gorges which run across the property on the west side of Otaihape Valley Road effectively making access difficult. A 25.9 ha area of this poorly accessible area which is reverting to mānuka is being considered for tree planting. This area is relatively steep, consisting of 23% steep and 52% very steep land, with the remaining quarter 16% easy hill and 9% flat to rolling.

The alternative to investing in trees, is to improve the pasture (spraying, subdivision, fertiliser) and better utilise this poorly accessible area. If this area is not retired or planted, 5 km of fencing will be necessary to fence off the gorges and established bush and reverted areas. Pastoral farming of these areas would also lead to more erosion on these steep areas as well as higher N and P losses.

Three scenarios were tested

Pinus radiata for carbon and timber; Redwoods for carbon and timber; and

Mānuka for carbon, inter-planted with rimu for timber. The number of years mānuka honey revenue can be obtained before this area regenerates to native bush is also considered

•Smaller blocks of higher-value, continuous cover trees integrated into farm and forestry businesses can provide best use of land from an economic and environmental perspective, while diversification can reduce business risk. These trees are also more suited than radiata pine to areas where it snows. The smaller blocks of progressively harvested trees can be more manageable than large forests in areas such as Taihape where the window of opportunity for harvest access can be narrow.

•Similarly, the more complex harvest requirements for smaller blocks on farm not suited to farming could provide opportunities for smaller forestry management and harvest. From an employment perspective, continuous harvest forests can provide regular, sustainable employment opportunities for local tree management and harvest gangs, possibly with specialised equipment suited to harvesting smaller blocks. Providing regular local work also benefits the community which is particularly important for communities in isolated areas.

•Continuous cover tree blocks of mixed age trees and/or fewer harvests are better for the environment than clearfell radiata pine blocks i.e. less run-off, sediment loss, waterway impediment from logging debris.

•Permanent tree blocks are more attractive than blocks such as radiata pine, which when fully harvested are particularly unattractive for years until the trees gain some size. While attractive tree blocks may not result in a better return, they are preferred by those living on the land. And from a more national tourism perspective, attractive tree blocks on the landscape are preferable and fit with the mosaic landscapes concept proposed by Our Land and Water.

•Small, continuous cover blocks of alternative species in areas with poor access, distance from port and low priority by harvest gangs are likely to benefit from growing alternative species to supply limited quantities of high-value timbers, anticipating that markets will develop and expand for these specialist timbers by the time these trees are mature.

Scenario Design

Tree planting Scenarios

Scenario design considered the owners' tree planting objectives which included:

•Generating returns equivalent to, or better than, farming.

•Generating timber returns.

•Being eligible for carbon returns (and finding out how much of the block would be eligible).

•A preference for non-radiata pine timber species, either native or exotic.

•Limiting or reducing erosion impacts.

The three scenarios considered planting 25.8 ha in either Radiata, Redwood or Native with Rimu,

The proposal considers planting 25.8 ha in trees, reducing farmed area by 6.2% from 375.4 ha to 352.2 ha plus converting 2 ha of the retired area. The tree block has 9.6% flat to rolling slopes, 15.8% easy hill, 23.1% steep and 51.5% very steep. This area has primarily been taken from steeper areas on the farm (19% or 12.6 ha of the very steep block, 4% or 9.5 ha of the steep block).

As the pasture graph (Figure 2) showed, pasture production from the steeper areas is comparatively low. Hence, it could be expected that the impact on the per hectare farm production will be less than the relative reduction in land area used for farming (6.2%).

Figure 3: Proposed plantable block with scattered regenerating mānuka

A strategy to help with success for selling forest products into smaller markets is to take the product as far as possible towards a finished product within the farm. That might mean using a portable sawmill so that timber is produced on site. Or it might go further and include drying, and potentially dressing the timber before it is sold to the buyer. The further down the process you take the product the less reliant you are on small scale processors and marketing.

Results of Forestry Scenario Analysis

The investment outcomes are summarised in Table 2 over a 56 year period equivalent to two full forest rotations for the radiata. The actual rimu "harvest" would not occur then so these have been valued at this point. Carbon sequestration has been included at both 50% and 100% level for each scenario given the area previously had some scrub cover.

Forestry enterprise returns (discounted cash operating surplus) include: timber, carbon, subsidies and honey (rimu and native). Subsidy and honey income is received in the earlier years: undiscounted values are $38,760 for the Radiata and Rimu scenarios, and $213,020 for the Rimu scenario (includes honey). Results are presented for the forestry enterprise, with and without carbon returns.

NPV (6% discount rate) returns are negative for all forestry ventures, with low IRRs of 3.6%, 3.0% and 2.4% for Radiata, Redwood and Rimu scenarios, respectively with no carbon. This is largely due to the impact of discounting to represent the time value of money, with these ventures having high costs early on and income later, particularly with redwood and rimu which are not 'harvested' until year 56. The timing of income and expenses has a large impact with Radiata having a harvest at 28 years as well as 56 while redwood and rimu have high initial costs and a long wait until harvest. The slower growth rate for rimu and natives, and the fact that the rimu are interspersed with natives so are less densely planted, will contribute to this scenario's comparatively low carbon and timber income. Results suggest a tree enterprise is unlikely to be profitable if a pre-tax 6% return is required. The only profitable return is from the Radiata scenario if 100% of the area is eligible for carbon, which is unlikely in this case.

Table 2: Investment performance of the forestry enterprise for each of the tree scenarios with two different carbon eligibility options (50% and 100% of the block planted).

Forestry enterprise financial results	Radiata		Redwood		Native & Rimu	
	100% C	50% C	100% C	50% C	100% C	50% C
NPV of investment (6%, pre-tax, 56 years)						
Forestry enterprise - no carbon	-$59,386	-$59,386	-$195,001	-$195,001	-$147,357	-$147,357
Forestry enterprise - with carbon	$54,930	-$6,217	-$104,872	-$154,828	-$100,430	-$128,785
Difference (carbon)	$114,316	$53,169	$90,129	$40,173	$46,927	$18,572
NPV of investment (per ha)						
Forestry enterprise - no carbon (per ha)	-$2,298	-$2,298	-$7,546	-$7,546	-$5,703	-$5,703
Forestry enterprise - with carbon (per ha)	$2,126	-$241	-$4,059	-$5,992	-$3,887	-$4,984
Difference (carbon)	$4,424	$2,058	$3,488	$1,555	$1,816	$719
Internal rate of return						
Forestry enterprise - no carbon	3.6%	3.6%	3.0%	3.0%	2.4%	2.4%
Forestry enterprise - with carbon	9.3%	5.7%	4.3%	3.6%	3.4%	2.8%

The areas on the property where trees are being planted on the farm are steeper, less accessible or on poorer quality land, so a lower return rate than that from the farming enterprise can be considered acceptable with respect to alternative land use options. Therefore, returns in the vicinity of the lower return for these scenarios (IRR from 2.4% to 3.6%) may still be acceptable in some situations, and may be comparable with farming returns in some areas.

The Radiata scenario is the only one returning a positive NPV for 75% or 100% of the area at $25/NZU, and for 50% of the area and greater at $35/NZU and $50/NZU. The IRRs associated with these range from 7.4%, to a healthy 17.9% for 100% of the area and a $50/NZU price. However, farming still exceeds these returns with IRRS over 20%. In contrast, the IRRs for the Redwood and Rimu scenarios for 100% of the area with a $50/NZU price are considerably lower at 5.9% and 4.8%, respectively. The current carbon price is just over $35/NZU which would return 12.8%, 4.9% and 4.0% on investment (IRR return) respectively, for the Radiata, Redwood, and Rimu and Native scenarios. It is likely only 50% of Graeme's block may be eligible for carbon which would reduce these to 7.0%, 3.9% and 3.0%.

Impact on the Farm Enterprise

The impacts of the proposed land use change to forestry on the farm enterprise are summarised below.

MEAT AND WOOL PRODUCTION

In the Tree scenario farming operation, stock numbers decreased by 5.4% compared to the Status Quo scenario, which was less than the 6.2% reduction in land area as expected. Stocking rate increased marginally (12.5 per ha cf 12.4) reflecting the marginal 1.4% increase in average per hectare pasture production which will have contributed to the marginal increase in per hectare animal production (an extra kg meat and wool per ha). However, overall, there was a 5.2% decrease in total animal production (4,924kg) due to the decrease in farmed area.

The reduction in area farmed will have a positive impact from a management perspective since the owner provides most of the labour on the property with some casual input. Excluding the less manageable tree block, where work will be done by contractors, and reducing farmed area will make his job easier. Labour costs are unlikely to reduce much, if at all, because he will still need to draw a full salary equivalent but this will have be beneficial from a workload and lifestyle perspective.

Table 3: Tree scenario and sheep and beef enterprise financial performance.

Financial KPIs	Tree scenario	SQ area	Total decrease
Gross Farm Income ($/farmed ha)	1,149	1,078 (-57)	-21,279 (-5.0%)
Gross Farm Income ($/kg meat & wool produced)	4.50		
Operating Expenses incl WOM ($/farmed ha)	768	720 (-16)	-5,826 (-2.1%)
Operating Expenses ($/per kg meat & wool produced)	3.00		
Operating Expenses (% of GFI)	67%		
Operating Profit ($/farmed ha)	381	358 (-41)	-15,453 (-10.3%)
Operating Profit ($/per kg meat & wool produced)	1.49		
Operating Profit Margin (OP/GFI %)	33%		
Cash Surplus after Interest and Tax ($/ha)	201	188 (-30)	-11,127 (-13.6%)
Asset Turnover (GFI/Asset value %)	8.6%		
ROA (OP/Asset value %)	2.9%		

PROFITABILITY

The income returns presented on a reduced per farmed hectare basis increased slightly ($1149/ha cf $1078/ha), however, the costs also increased ($768/ha cf $720/ha) as fixed costs were spread over fewer hectares with the overall impact reducing operating profit from $381/ha to $358/ha. The impact on farming costs and returns on the overall business is better reflected by presenting the results over the status quo farmed hectare area, or by presenting total returns. The 6.2% reduction in farmed area resulted in a 5% lower farming income, but only a 2.1% decrease in total farm operating expenses (now 67% of GFI compared to 65% for the status quo), reducing the income available after costs by over 10% as demonstrated by the 10.3% reduction in operating profit and 13.6% reduction in cash surplus after interest and tax.

The size of the farming enterprise relative to the tree enterprise meant low tree enterprise returns had only a small impact on whole farm business returns: business IRRs were about 19% for radiata, 17% for rimu and 16.5% for redwood. Farming returns are still sufficient for the business to operate profitably with good cashflow should Graeme opt to plant trees for non-profit reasons. However, anyone considering tree enterprises on farms should ensure the area planted does not result in the business becoming unviable from a profit or cashflow perspective.

The timing of income and costs for the timber enterprises means that these enterprises require capital sourced from other income or investment funds, with considerable capital required up front and with some ongoing for many years before any enterprise income is achieved. It is critical for operations such as thinning that are time sensitive to be done on time and not held up due to limited finance. Hence, a farming enterprise of sufficient size to viably support the farming family and possibly fund the ongoing forestry investment is required. With less free operating cash flow available it is important to understand whether the business still generates enough cash to meet debt servicing and repayment, tax, development requirements and additional reward for management

Environmental Performance

Water Contaminant Losses (Nitrogen and Phosphorus)

Total **N loss** to water under the current farm system is very low at **9 kg N/ha.** Reducing the farmed area by 6.2% would result in a 5.4% reduction in stock numbers which will help mitigate environmental externalities. As this area has had little, or no, fertiliser applied any reduction in fertiliser use from planting trees will be minimal and therefore, planting trees will contribute little to reducing fertiliser-related environmental impacts such as nitrous oxide and phosphorous.

Modelled **P loss at 0.3 kg P/ha** remains unchanged across the scenarios. However, as **P loss** is strongly correlated to soil loss, planting these steeper poor farming areas in mānuka, which would protect soils from overland soil flow, would also help reduce P loss.

The alternative is to improve the block with fencing and fertiliser to make better use of this in the farming enterprise by comparison converting the areas to trees means no more fertiliser or stock are added.

Table 4: Summary of environmental indicators for status quo and with tree scenarios

Environmental Indicators	Status quo - "unplanted"	With tree scenario
Total N leached (kg N/yr)	4,090	3,945
N leached per hectare (kg N/ha)	9.0	8.9
N surplus (kg N/ha/yr)	69	63
N Conversion Efficiency	8%	6%
kg net meat & wool/kg N leached	23.2	22.8
Farm Operating Profit per kg N leached ($/kgN leached	36.6	$34.04
P Loss (kg/ha/yr)	0.3	0.3
bGHG/ha (t CO_2 eq./ha)	4.17	3.78
Green House Gas emissions (kg CO_2 /kg meat & wool)	19.6	18.7

Biological Greenhouse Gas (bGHG) Emissions

The total farm biological greenhouse gas emissions in the tree scenarios are **9.6%** lower than the Status Quo scenario, largely due to the reduction in stocking numbers. This decrease will help the business meet the reductions in greenhouse gases that farmers are likely to have to meet once agriculture enters the Emissions Trading Scheme (ETS) and all farmers are required to make changes to reduce on-farm GHGs to contribute to the GHG reduction targets.

Methane is related directly to dry matter intake (DMI x 21.6 g/kg DM eaten) so lowering the GHG footprint at Lazy G Ranch will primarily require lowering stock DM intake. In contrast, nitrous oxide (N2O) is driven by nitrogen fertiliser use, total annual nitrogen excreted and soil type (higher losses on heavier soils). Lazy G Ranch's biological greenhouse gas (GHG) emissions have averaged **3.8 t CO2e** per hectare in the last three seasons and are 78% methane and 22% nitrous oxide.

While the farming enterprise will continue to generate methane and nitrous oxide in perpetuity, the net CO2 equivalents sequestered in trees will cease eventually, so this is not a long-term permanent solution to lowering the farm's net emissions. However, in the short-term (first harvest cycle) this does provide a way for the farm business to lower their overall emissions footprint (CO2, CH4, N2O) and provide a fiscal hedge to any potential financial liability resulting from pastoral agriculture needing to account [and "pay" for some] of their biological greenhouse gas emissions.

Whole Farm Business Analysis

The profitability of the three tree enterprises and the Status Quo scenario is outlined in Table 6. Values are discounted cash operating surplus for the 56-year period of the analysis. The comparative contribution of the farming and forestry enterprises is shown. Business equity at the end of the 56-year period is also presented.

In terms of profitability, in total and per hectare, the Status Quo scenario outperforms the three tree scenarios (21%) and the farming operation in the tree scenarios (20.3%). That is not to say there will not be benefits to farms in this area putting poorer quality or more difficult land in trees or planting tree blocks for other reasons e.g. easier management, environmental and biodiversity reasons, aesthetics, carbon sequestration, succession and retirement planning.

The returns from the tree enterprises are considerably lower (some less than 6% IRR resulting in negative NPV returns) and reduce the overall business return, although returns still all exceed a positive 16% because the tree area only replaces a small proportion (6.2%) of the farmed area. Farming returns are still sufficient for the business to operate profitably should the owner choose to plant trees for reasons other than profitability e.g. better manageability, financial benefits for future generations of the family.

Equity continues to be built over time for all scenarios. Only the Redwood scenario has greater equity than the Status Quo scenario in year 56, returning 9.2% and 6.5% more than the Status Quo scenario, with 100% and 50% of the area eligible for carbon, respectively. The differences between the Status Quo and the Radiata and Rimu scenarios are quite small (4.5% or less), with rimu outperforming radiata pine.

Table 6: Financial performance results for the whole farm business (farming and trees) for the scenarios.

Integrated business financial results	Status quo	Radiata		Redwood		Native & Rimu	
		100% C	50% C	100% C	50% C	100% C	50% C
NPV of investment (6%, pre-tax, 56 years)	$1,806,650	$1,663,536	$1,581,687	$1,503,733	$1,453,778	$1,508,176	$1,479,820
Sheep & beef enterprise		$1,608,605	$1,608,605	$1,608,605	$1,608,605	$1,608,605	$1,608,605
Forestry enterprise		$54,930	-$6,217	-$104,872	-$154,828	-$100,430	-$128,785
NPV of investment (per ha)	$4,813	$4,400	$4,184	$3,978	$3,846	$3,989	$3,914
Sheep & beef enterprise (per ha)		$4,567	$4,567	$4,567	$4,567	$4,567	$4,567
Forestry enterprise (per ha)		$2,126	-$241	-$4,059	-$5,992	-$3,887	-$4,984
Internal rate of return	21.0%	19.3%	18.9%	16.7%	16.4%	17.2%	17.1%
Sheep & beef enterprise		20.3%	20.3%	20.3%	20.3%	20.3%	20.3%
Forestry enterprise		9.3%	5.7%	4.3%	3.6%	3.4%	2.8%
Projected equity at Year 56							
Opening equity	$3,847,240	$3,812,774	$3,812,774	$3,812,774	$3,812,774	$3,812,774	$3,812,774
Closing in Year 56	$9,530,136	$9,330,168	$9,237,609	$10,016,927	$9,867,878	$9,371,026	$9,295,816
Change in equity	$5,682,896	$5,517,394	$5,424,835	$6,204,153	$6,055,104	$5,558,252	$5,483,042
Difference from base system		-2.9%	-4.5%	9.2%	6.5%	-2.2%	-3.5%
Closing in Year 56 with interest*	$12,122,219	$11,639,649	$11,440,402	$11,995,235	$11,747,292	$11,391,405	$11,258,663

If Redwood or Rimu were planted the current owner would likely benefit only from some of the carbon income, the subsidies, and honey income for the rimu and native block. Future generations will benefit from all timber returns and some carbon returns. So for the current owner to plant these species, he will be anticipating benefits to future generations. In contrast, for the radiata enterprise the current generation could benefit from subsidy income, all carbon income and half the timber income, whereas future generations will only receive half the timber income, will be obliged to incur all replanting costs from the clearfell planting regime and will need to contend with the environmental impacts that can pose a hazard in early years after felling e.g. erosion, slash in waterways, and possibly other negative impacts from radiata.

Summary

- Farming returns in this area can be relatively high, hence tree returns need to be high to compete with farming. However, there are other reasons for planting trees such as aesthetics, environment, land retirement, benefit to family e.g. planting long term species on inter-generational family farms.

- Taking the area for the tree block out reduced the farmed area in the tree scenarios by 6.2%, increasing income and costs per hectare (better land farmed but fixed costs spread over a smaller area) compared to the Status Quo farming scenario, resulting in a 5% lower farming income and a 2.1% decrease in total farm operating expenses, thus reducing farm operating profit by 10.3% and cash surplus after interest and tax by 13.6%.

- Cashflow is as important to business viability as profitability: these farming enterprises also returned a steady cashflow or cash balance sufficient for drawings/income, debt repayment and early forestry expenses in the tree scenarios in most years.

- In contrast, forestry returns were low. Factors affecting species' differences were: earlier, less discounted radiata returns (Year 28 as well as 55), higher redwood and rimu costs with most in the earlier, less discounted years, whereas their log income (year 55 harvest valuation) was highly discounted. Most redwood income is received in year 55 from timber, whereas the Rimu and Native scenario are assumed to received a higher subsidy and some honey income in the less discounted earlier years. However, the Redwood scenario had a higher IRR than the Rimu scenario because redwood costs were lower and later (more discounted) than rimu, and the net redwood income was very high.

- For enterprises, such as rimu and redwood that primarily benefit future generations, when considering whether an enterprise is worth investing in, it is critical to consider both the NPV as well as the IRR figures and how the rankings of scenarios alter at varying discount rates. There may be merit in a lower discount rate when comparing IRR and enterprise NPV. While this is likely to result in a fairer evaluation, this still leaves the investor with the challenge of deciding how much they are prepared to trade off personal gain, for future generation gain and environmental and biodiversity benefits. This will vary between investors.

- In a family situation such a Lazy G Ranch's family business, this trade-off may be acceptable. The importance of long-term thinking around land use decisions and stewardship are highlighted by this case study.

Lazy G Ranch I Taihape

Definitions

SU/ha	Stock units per ha based on 550kg DM eaten per year
Pasture eaten (t DM/ha)	Measures how much pasture grown that is being eaten and is measured in kilograms or tonnes of dry matter per hectare, standardised at 11 MJ ME/kg DM
kg DM	Kilograms of dry matter
Kg product sold	Net increase in kilograms of meat(eg beef/lamb/mutton) and wool grown on farm

Nitrogen loss	An estimate of the N that enters the soil beneath the root zone (>60 cm) , expressed as kg N/ha/year
N surplus	The quantity of N supplied that exceed plant requirements
Green House Gas Emissions (GHG)	Green house gases on a whole farm basis expressed as CO_2 equivalents
Biological Green House Gas Emissions (bGHG)	A measure of methane (CH4) and nitrous oxide (N2O)emitted from a farm as CO_2 equivalents. CO_2 from electricity, fuel, and fertilizer manufacturing is excluded because a levy is applied by the supplier and included in the cost of goods
FWE (farm working expenses)	Direct farm working costs including owner operator remuneration before depreciation and financial costs
Operating profit	A measure of farm profitability use for benchmarking comparison between farms. Dairy operating profit is dairy gross farm revenue less dairy operating expenses
Capital expenditure (CapEx)	Funds used by a business to acquire, upgrade, and maintain physical assets such as property, building, plant and equipment
Present value (PV)	Is the current value of a future sum of money or stream of cash flows given a specified rate of return. Future values are discounted at the discount rate, and the higher the discount rate, the lower the present value of the future cash flows
Net present value (NPV)	The different between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyze the profitability of a projected investment or project
Discount rate	Interest rate used to determine the present value of future cash flows in a discounted cash flow analysis. The weighted average cost of capital (WACC) is commonly used for a businesses discount rate when completing an investment analysis
Weighted average cost of capital (WACC)	Is a calculation of a businesses cost of capital in which each category of capital is proportionately weighted. All sources of capital are included
Internal rate of return (IRR)	Used in capital budgeting to estimate the profitability of potential investments. The IRR is a discount rate that makes the net present value (NPV) of all cash flows from a investment equal to zero

Project Details

Name: Integrating Forestry for Profitable and Sustainable Land Use

Completed by: perrin ag NEW ZEALAND AGRI-BUSINESS ADVISORS

Subcontractor: PF OLSEN NEW ZEALAND

Funded by: Te Uru Rākau Forestry New Zealand

Co-funders:

DairyNZ

LIVING WATER

Fonterra Dairy for life

Department of Conservation Te Papa Atawbai

Waikato REGIONAL COUNCIL Te Kaunihera ā Rohe o Waikato

BAY OF PLENTY REGIONAL COUNCIL TOI MOANA

FOREST GROWERS RESEARCH

horizons REGIONAL COUNCIL

Farmlands co-operative