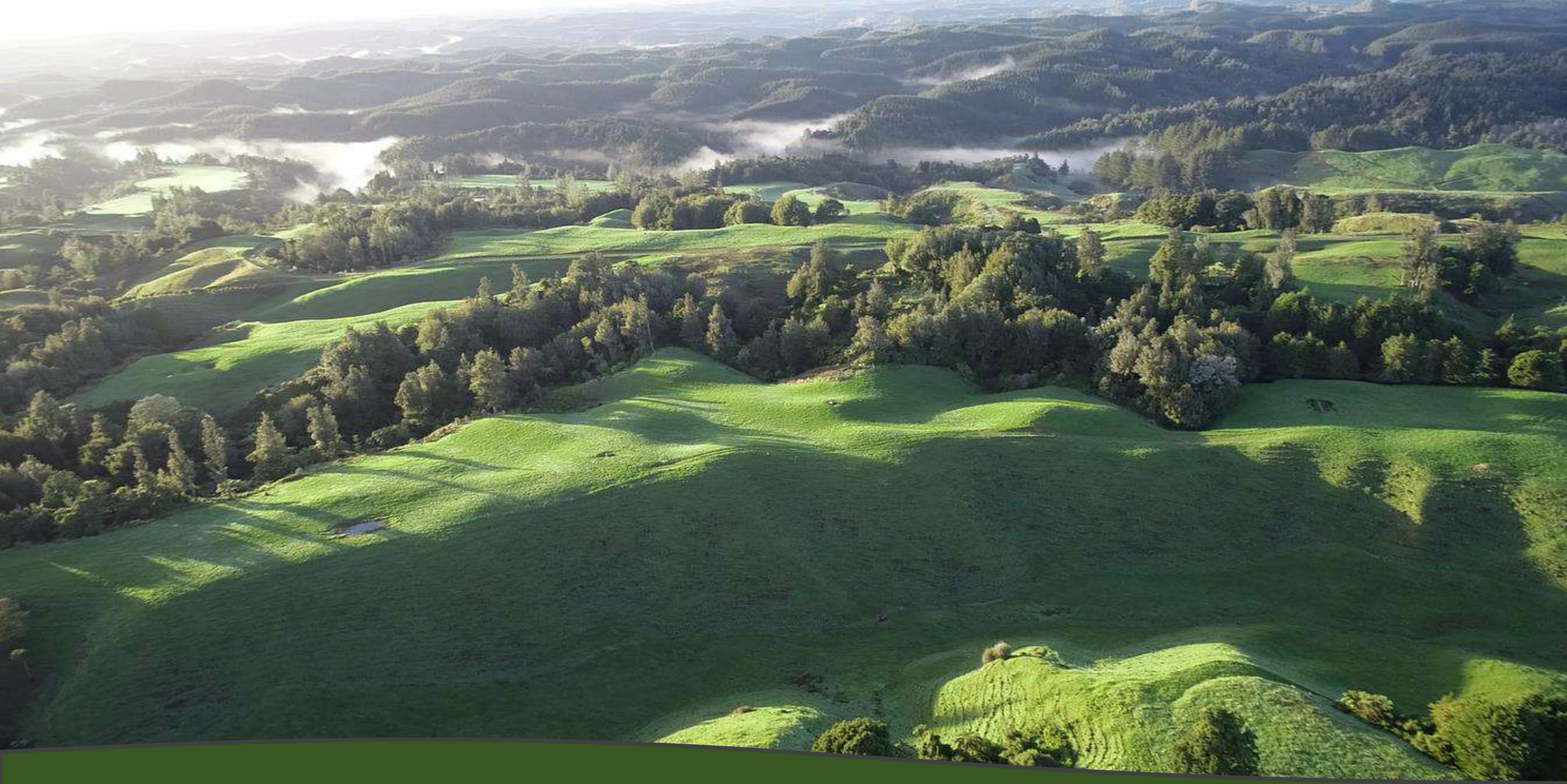

Te Ranga | MW & FK Linton (#4)

Integrating Forestry for Profitable and Sustainable Land Use

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Executive Summary

- MW & FK Linton is a family-owned business situated in Te Ranga, 17 km south of Te Puke. The business operates 423 hectares of mixed contour including a 172 ha dairy platform, 59 ha of young stock grazing, 3.6 ha of kiwifruit, 38.8 ha of plantation woodlots (*Pinus radiata* and *lusitanica*) with the balance in native bush.
- Opportunities exist to convert pastoral land to alternative uses (kiwifruit and forestry) that provide improved financial and/or environmental performance. Competing requirements for capital impact the rate and direction of change. Providing detailed analysis of integrated forestry options will help inform the most suitable course of action regarding forestry land use change.
- Three scenarios evaluate the impact of planting *Pinus radiata* timber woodlots on 36.6 ha of steeper contoured hills and gullies. *Pinus radiata* was chosen for it strong proven economic performance aligning with the land owners priorities.
- The scenarios differed in their management of forest edges against pasture. Scenario 1 ignored the extra costs of managing edges, Scenario 2 incorporate higher spraying, pruning and thinning costs within 10 m of the forest edge, and Scenario 3 builds on Scenario 2's spray/prune/thin regime and incorporates natives to reduce the amount of area that are of narrow plantings (1.3 ha).
- Options to manage forest edging to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability.
- Modelling showed the existing farming operation is more profitable than any of the integrated forestry scenarios considered.
- The integrated forestry scenarios reduced N loss, P loss and bGHG emissions thereby aligning with the Linton's objective to reduce their environmental footprint through retiring marginal land and focusing more of the business resources to lift productivity on the better quality land.

Table 1. Snapshot of integrated forestry analysis with 36.6 ha extra trees.

Farm Parameters	Base system	Change
Effective pastoral area (ha)	231	-16%
Milking platform	172	-15%
Support land	59	-17%
Timber Woodlots (ha)	38.8	93%
Native (ha)	153.2	0-1.3
Peak cows milked	440	-10%
Stocking rate (c/ effective grazing ha)	2.58	5%
Production	145,000	-7%
per hectare (kg MS/ha)	843	10%
Total Farm N Loss (kg N)	13,115	-6.2%
P Loss (kg P/ha/yr)	3.5	-17.3%
bGHG/eff. ha (t CO2 eq./ha)	4.3	-10.3%
Green House Gas emissions (kg CO2 /kg MS)	12.2	4%

- The benefit of environmental externalities (N & P loss, bGHG emissions) is crucial for evaluating the integration of trees.
- It is important to assess the best use of individual classes of land as productivity differences between pasture and trees create opportunities to retire poor quality land and achieve improvements through alternative land use.
- The planning and analysis provided demonstrates integration of **Right Tree, Right Place** to achieve the **Right Purpose**: optimising land use while meeting environmental obligations.
- Assuming the case study farm operated at average dairy debt levels there would be insufficient cash flow to cover minimum debt repayments. Hence such farms may struggle to take advantage of the opportunity for land use change from existing business cash flow and would require access to grants to alleviate cash flow constraints before they were able to convert marginal land.

Case Study Overview

This case study illustrates the impact of integrating various forestry options into a pastoral dairy farm business. The options analysed are specific to the Linton's farm and farming aspirations. Financial and environmental analysis demonstrate potential returns, impact on reducing the farm's environmental footprint, 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 2019/20 season is utilised to form the 'status quo system' to provide a base comparison to the forestry options analysed.

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. The property's three land classes (flat to rolling, gullies, and steep slopes) are evaluated for their physical characteristics and determining what trees are best suited. 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 (dairy 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)

MW & FK Linton farm 423 ha including a 172 ha dairy platform, 59 ha of support land, 3.6 ha of kiwifruit, 38.8 ha of plantation woodlots (*Pinus radiata* and *lusitanica*) and the remaining land in native bush .

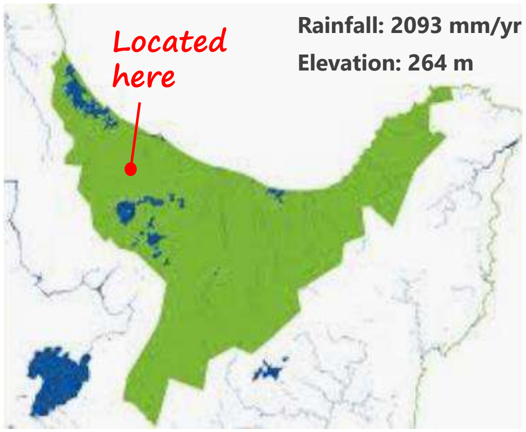
The Linton's are interested in how the inclusion of trees can support their goal of developing a more environmentally and finally robust business. Well thought out integration of trees offers the opportunity to convert marginal pastoral land to high productive plantation woodlots, reduce contaminant loss and improving biodiversity.

The Linton's criteria for integrating trees on farm include:

- Raising productivity on the quality land, managing nutrient loss, and pushing steep country back into trees.
- Supporting high standards of animal welfare through providing shade and shelter.
- Use of good science and tested information to support decisions.

Figure 1. Aerial map of MW & FK Linton farm with red lines depicting the steep contoured land.

Location



Farm Details

Total area (ha)	**423**
Effective pasture (ha)	**231**
Soil type	**Oropi, Ngakura, & Otanewainuku loam**
Total milk production (kg MS)	**145,000**
% imported feed	**14**
Est. pasture eaten (per effective ha/yr)	**10.0**

Livestock Details

Breed type	**Crossbred**
Herd size	**440**
Production per cow (kgMS)	**330**
Liveweight per cow (kg)	**450**
Stocking rate (cows/ha)	**2.56**
Planned start of calving	**20 Jul**

Performance Indicators

Production per hectare (kg MS/ha)	**843**
Operating profit ($/ha)	**940***
Return on asset (ROA%)	**2.1***
N leaching (kg N/ha/yr)	**54***
kg MS/kg N leached	**11.4**
Biological GHG emissions (t CO_2 eq./ha)	**7.8***

** Note the performance indicators are calculated against the effective pastoral area.*

Right Tree Right Place Right Purpose

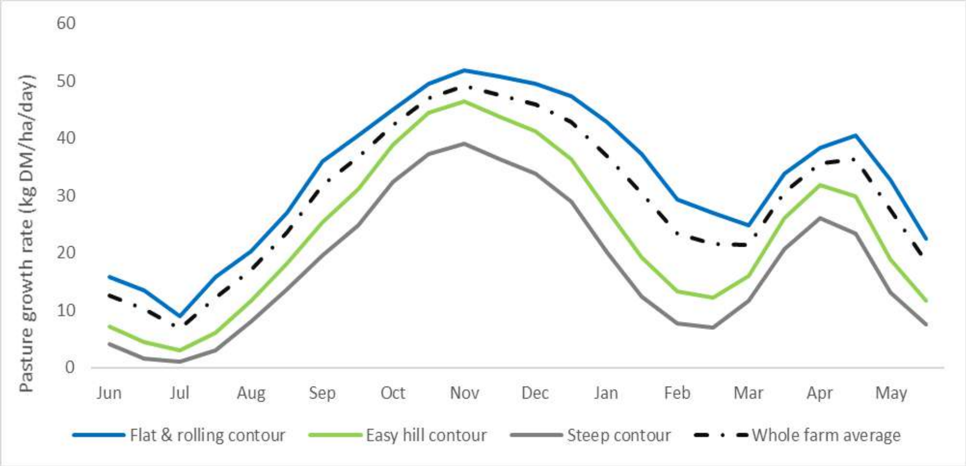


Figure 2: Estimated Pasture production

Understanding a planting site and its effect on tree performance and future harvesting operations is essential for selecting the right tree to achieve the desired outcomes. In this section the tree options for the different land classes on the Linton's farm are explained. The property is characterized by three distinct land types, the flat to rolling terraces of productive land, easy hill and the steeper gully systems.

Pasture production variation

- The steep contoured land covering 67% of the pasture area is estimated to produce 61% of the farm's average pasture growth with species largely unimproved pasture which contributes to lower feed quality.
- The flat to rolling contour land is estimated to grow 12.2 t DM/ha/yr compared to 8.6 t DM/ha/yr on the easy hill and 6.6 t DM/ha/yr on the steep contour.
- The area has high rainfall (2,093 mm) providing good growing conditions.

Easy hill land

- The easy hill areas cover 50 ha and have a mean slope of 18.2 degrees. The dominant soil type is Oropi loam with smaller areas of Ngakura loam. These soils are classified as deep (>1 m) with no significant rooting barrier, are well drained with low vulnerability of water logging, and have high soil water holding capacity.
- The climatic conditions and deep soil types on this area of the farm provide good growing conditions for timber species. The easy slopes support ground based extraction. Site access is good with well-formed central races to most areas. ***Pinus Radiata*** provides a resilient species capable of good growth across a wide range of sites.

Steeper contour and gully systems

- The farm area categorised as steep covers 26.6 ha with an average slope of 28.5 degrees. These areas are less productive compared to the easier slope classes due to shading, less topsoil and lower soil fertility. The dominant soil type is Otanewainuku loam. Gully slopes are also shadier and more prone to frosts than the upper zones which impacts tree selection.
- Species such as **Tasmanian Blackwood (*Acacia melanoxylon*)** tolerate these conditions. The flat zones at the bottom of the gullies are often wet, prone to frost, and may be exposed to periodic flooding and/or sedimentation. Trees such as **Coast Redwoods (*Sequoia sempervirens*)** or some species of ***eucalyptus*** can thrive under these conditions (Satchell, 2018).

A Note On Setting Up A Wood Harvesting Agreement

- Good harvesting outcomes for landowners are driven by the wood harvesting agreement and selection of experienced and professional forestry consultants or contractors. Small forest landowners should engage professionals with good track records. The NZ Institute of Forestry has a register of professional forestry consultants required to meet their standards and may be a good starting point (NZFFA, 2015).
- The first step is undertaking a pre-harvest assessment which evaluates the forest area, financial feasibility, state of the market, forest access and availability of contractors (Visser, 2016). A forestry expert should be selected to develop a harvest plan, required by law, forming a key part of the agreement that sets out expectations of when and how the harvest is completed. It should include a map of the harvest area and operation, the location of roading and landing sites, and specify the harvesting system. It is important the harvest system and equipment used, which will guide the forestry company selection, matches the forest stand, terrain and landowner objectives. The system needs to be physically feasible, safe, have a low environmental impact and be cost effective (Visser, 2016).
- The harvest plan should provide guidance on health and safety requirements, physical hazards and any environmental or resource consent requirements. Any additional landowner requirements should also be added which may include restoring fences, removing wood waste or requesting a summer harvest on dry ground to minimise soil disturbance (Visser, 2016).
- The agreement should also state the manner and standard of performance expected, method and timing of payment, consequences of breach or delay and how disputes are to be resolved.
- Many small forest owners select a managed sale when selling their farm woodlots appointing a professional harvesting or marketing company to oversee all aspects of the project. The owner receives a detailed report of all revenue and costs incurred during the project. However, as an open book project, the owner takes all the market risk of selling the logs. An option is a stumpage sale, where the forest owner receives an exact figure per tonne of logs sold. The disadvantage is the stumpage buyer will usually discount the buy price to offset any grade, volume or market risk (Woodbank, n.d.).
- After harvest, owners should complete a post-harvest inspection. Checking all saleable timber has been transported to market and no logs of value have been left in the cut-over or landing site and that slash has been managed to the standard defined in the harvest plan and contract. Skid trails should also be inspected. These provide tracking for soil and debris to rapidly and easily flow into waterways. At the end of harvest these trails should be closed off by water bars at regular intervals to avoid sedimentation (Visser, 2016).

Integrated Forestry Analysis

The criteria for further tree plantings on the Linton's marginal land are to provide an equivalent return to livestock and be affordable from a cashflow perspective. Steep land is challenging to manage, particularly during the spring flush when stock need to be pushed to utilize the growth otherwise feed quality deteriorates significantly leading into summer. These areas were identified by the Linton's for potential tree planting.

The Linton's showed interest in *Pinus radiata*, largely because of its strong financial returns and greater ability to sequester carbon relative to other species. Their goals for increased efficiency and proven returns makes radiata pine an obvious component of tree planting scenarios, complemented by native to support improved environmental and biodiversity outcomes. Radiata pine is widely grown locally with strong infrastructure and supply chains in place to support planting, silviculture, harvest and the sale of timber. If logs were harvested during summer the potential planting sites would require minimal roading development and soil damage can be minimised.

Three scenarios with the same planting area were tested. Matching planting areas (36.6 ha) meant the net impact on the livestock business was the same. Afforestation was classified as either timber woodlot or native. Woodlots were assessed for economic potential (including carbon) while native plantings were included as costs for establishment (less any grants assumed to be available for planting), plus any carbon revenue they would accrue over time for areas that were eligible for registration in the ETS.

For this case study it was assumed that grants similar to both Te Uru Rākau and Bay of Plenty Regional Council landowner grants were able to be secured to support planting and fencing costs. The cost of seedlings assumed a small number of species and not pre-spaced to keep planting costs at the lower end of the range for natives. Costs for follow up weed and pest control for up to two years after planting were included without subsidies.

The integrated forestry analysis that follows shows the physical, financial and environmental impact of three forestry options on the dairy and the business overall.

Scenario Design

The forestry scenarios evaluate a range of options for managing forest edges against pasture. Within 10 metres of a forest edge it is difficult to use helicopter spraying without risk to pasture resulting in more expensive use of ground-based spraying by knapsack. Higher pruning and thinning costs can also be incurred due to larger branches and having to push trees into the forest to avoid fences. Repairs to fences are also an ongoing issue especially in the last ten years before harvest. Due to the dispersed nature of the Linton's identified planting areas, the proportion of forest edges relative to the total forest area is much higher than larger more contiguous forestry blocks.

Details for each scenario design are provided below:

Scenario 1 – Ignored the extra costs of edges. The planted area contains 36.6 ha of ***Pinus radiata***.

Scenario 2 – Includes the same planting area as scenario 1 and incorporates higher spraying, pruning and thinning costs within 10 metres of the forest edge.

Scenario 3 – Includes some narrow-planted sections in native to reduce the amount of higher cost edge *Pinus radiata* and incorporates scenario 2's spraying, pruning and thinning costs within 10 m of fence lines. The planted area includes 35.3 ha of Pinus radiata plus 1.3 ha of native.

For all scenarios the effective pastoral areas for the dairy platform and support block reduce from 172 and 59 ha to 145.4 and 49 ha, respectively as indicated in Table 2.

While peak cow numbers reduce by 45 cows the stocking rate actually increases by 6% as the remaining pastoral area is more productive than the marginal land modelled to go into trees.

Table 2. Summary of farm physical parameters including the forestry

Farm Parameters	Base system	Forestry scenarios
Effective pastoral area (ha)	231	194.4
Milking platform	172	145.4
Support land	59	49
Timber Woodlots (ha)	38.8	74.1-75.4
Native (ha)	153.2	153.2-154.5
Peak cows milked	440	395
Stocking rate (c/ effective grazing ha)	2.58	2.72
Production	145,000	135,000

Figure 3: Forestry scenario design map

Results of Forestry Scenario Analysis

Table 3 summarises the investment outcomes from two full forest rotations (plan, grow, harvest, replant, grow, harvest), both excluding and including carbon revenues.

Scenario 1 The net undiscounted proceeds for timber only over 56 years (2 rotations) was **$52,200/woodlot ha** pre tax which included revenue of **$71,978/ha** less expenses of **$19,728/ha**. Over this timeframe, this is equivalent to an annuity (annual payment) of $5,984 or $164/ha in present value from the 36.6 ha planted. By way of comparison, at the same discount rate, the existing **dairy** farm enterprise generates a return equivalent to an **annuity of $961/ha.**

Applying a discount rate of 6 % provided a positive present value of $2,623/woodlot ha. The IRR for this investment was a modest 7.94 % over the 56-year investment period.

Including the "safe tradeable carbon" from the woodlots lifts the present value of free cash flow over the whole term to $5,230/total planted ha and provides a healthier **IRR of 10.4 %.** The equivalent **annuity is $326/ha.**

Scenario 1 provides the highest return of the three scenarios. Carbon and log revenue/ha of planted forest is slightly lower than Scenario 3 but incurring lower expenses provides an overall higher net return.

Scenario 2 Higher revenue equivalent to an annuity of **$5,266 or $144/ha**. was achieved from more extensive silviculture on the forest perimeter slightly improving log quality and yield. The higher revenues received were insufficient to offset additional silviculture costs but the net difference compared to Scenario 1 is not significant (-$17,233 or -0.9%). The forestry analysis does not account for increased fencing repairs caused by fallen limbs/trees or the value of improved aesthetics which may have a higher weighting for the Linton's.

Applying a discount rate of 6 % to the whole term provided a positive **NPV of $2,305/ha** and an **IRR** of **7.6 %,** the lowest of the three scenarios. If the **'safe tradeable carbon'** is sold the present value of free cash flow over the whole term increases to **$4,909/ planted ha** and provides an **IRR of 9.9 %** and an equivalent **annuity of $306/ha.**

Scenario 3 provided non-discounted proceeds for timber only (pre-tax) of **$52,102/ha.** This is equivalent to an annuity of **$5,294 or $150/ha at a 6 % discount rate**. The total net return is the lowest of the three scenarios due to the reduced forest area (-1.3 ha) but the NPV ($84,862) and **IRR of 7.72%** was the second highest. Scenario 3 provided similar revenue per hectare planted as Scenario 2 but the costs incurred were lower as **narrow planted sites** were retired into **native species**. Applying a discount rate of 6 % to the whole term provided an **IRR of 10 % being 0.4%** lower than Scenario 1. Scenario 3 provides an option to minimise fence maintenance across the lifecycle of the forest, improve aesthetics, and provide biodiversity corridors by linking to native bush nearby.

Table 3. Summary of individual forest scenario investment performance.

	Scenario 1		Scenario 2		Scenario 3	
Area in P. radiata	36.6	ha	36.6	ha	35.3	ha
Area in native	-	ha	-	ha	1.3	ha
Area in ETS qualifying native and riparian	36.6	ha	36.6	ha	35.3	ha
Returns over two rotations (56 years)	**Total**	**/ woodlot ha**	**Total**	**/ woodlot ha**	**Total**	**/ woodlot ha**
NET PRE-TAX LOGS (undiscounted)	1,910,537	52,200	1,893,304	51,730	1,839,721	52,102
Present Value for whole term (WACC = 6%)	95,911	2,623	84,403	2,305	84,862	2,403
Internal Rate of Return (IRR)	7.9%		7.6%		7.7%	
	Total	**/ planted ha**	**Total**	**/ planted ha**	**Total**	**/ planted ha**
NET PRE-TAX LOGS & CARBON (undiscounted)	2,120,908	57,948	2,103,325	57,468	2,041,643	57,821
Present Value of free cashflow (WACC = 6%)	191,238	5,230	179,575	4,906	176,359	4,995
Internal Rate of Return (IRR)	10.4%		9.9%		10.0%	

Impact on the Dairy Enterprise

MILK PRODUCTION

Total milk production for the forestry scenarios decreased by 10,000 kg MS or 6.9 % compared to the base system. As the effective milking platform reduced by 15%, the change in production was less significant reflecting lower productivity land being retired. This is supported by the average feed eaten across the pastoral area increasing by 0.6 t DM/ha or 6%. Consequently, per hectare milk production increased by 10.1%. Lost milk production off the area now in trees is partially offset by increased per cow performance (+ 12 kg MS/cow or 4%) as the animals are not required to expend as much energy harvesting challenging areas, overall feed quality is higher, and imported feed is spread across fewer cows. Higher per cow productivity also ensures a higher proportion of feed eaten is partitioned to milk production relative to maintenance, having a positive impact on environmental performance indicators Impacts to other performance indicators such as young stock growth rates and reproductive performance were outside of the scope of this analysis. However, anecdotal evidence would suggest an improvement in animal feeding would have a positive impact on these areas.

Table 4. Summary of financial performance indicators for the dairy enterprise only.

Farm parameters	Base system	Forestry Scenarios
Gross farm income ($/ha)	$5,817	$6,400
Farm working expenses ($/ha)	$3,888	$4,293
Total dairy cash operating surplus	$331,883	$306,350
Change from base system		$25,533
$/ha	$1,930	$2,107

PROFITABILITY

Total gross income reduced by $70,053 due to lower milk proceeds ($62,400), less dividend ($2,000) and lower livestock proceeds ($5,653) from operating less animals (-10.2 %). Per hectare gross farm income was slightly higher ($583/ha or 10 %) than the base model due to higher milk production per hectare and a slightly higher stocking rate.

Total farm working expenses (FWE) reduced by $44,520 which was insufficient to offset the reduction of gross farm income. The resultant cash operating surplus decreased by $25,533 or 7.7 %. Larger reductions in expenditure related to animal expenses (animal health, breeding, shed expenses) and cost associated with the retired land (fertiliser). However, "sticky costs" such as labour, vehicle, and feed expenses saw little change while areas such as administration, insurance, rates and depreciation did not change. Consequently, FWE on a per hectare basis increased. Even though poor-quality land was retired, the dairy operation shows the effects of scale on cost dilution and the cash operating margin per kilogram of milk solids. This has consequences for the business's exposure to milk price risk and increases the likelihood of generating a cash operating deficit in a lower milk price year.

With less free operating cash flow available it is important to understand whether the business still generates enough cash to meet debt repayment, Capex requirements, and ultimately the cash the Linton's want to draw from the business. To remain viable the business would need to operate with less debt to asset levels relative to the base to support land being planted in trees.

Total milksolid production has the largest bearing on IRR varying 2.9 percent for the status quo and between 2.7-2.8 percent for the forestry scenarios. Higher productivity alleviates liquidity challenges and would support the business rate of land use change (into either kiwi fruit or forestry).

Environmental Performance

Water Contaminant Losses (Nitrogen and Phosphorus)

The steeper sidlings, while free draining,, are prone to hoof damage and soil moving down slope when conditions are wet. Considering the heavy stock class utilised, these areas represent risk for sediment and phosphate loss.

Total N loss for the property is 13,311 kg N/yr or 31 kg N/ha/yr as modelled in Overseer v6.3.4. Per hectare N loss is much lower because 192 ha of the 423 ha is in forestry or native bush which leaches only 2-3 kg N/ha/yr. Excluding this area, the pastoral N loss is 12,735 kg N/yr or 54 kg N/ha/yr.

The forestry scenarios demonstrate a 760 kg or 5.8 % reduction in total N loss achieved by less livestock (-10.4 %), lower total production (-6.9 %), and reduced N fertiliser use (-9.3 %). N surplus and N leaching loss on a per pastoral hectare basis actually increased (11 %) as the remaining land is farmed more intensively reflected by the stocking rate, pasture eaten and milk production per hectare increasing. Reported P loss decreases by 0.5 kg, primarily from reduced P fertiliser use (from the reduction in grazeable area) and exclude any reductions associated with improving land stability and providing contaminant buffers.

Planting the bottoms of gullies with trees can also act as a mitigation for sedimentation and nutrient loss, particularly phosphorus, from harvesting of the upper slopes. Permanent species such as natives are a good choice for these areas and help maintain or improve water quality. The ecosystem improvements provided by these changes are not costed in the analysis but would provide meaningful benefits to the Kaituna River and the Maketu estuary by reducing contaminant load.

Biological Greenhouse Gas (bGHG) Emissions

The farm's biological greenhouse gas (GHG) emissions are 76% methane and 24% nitrous oxide and average 8.1 tonnes of carbon dioxide equivalents per hectare per year (CO_2e/ha/yr) across the pastoral area (231 ha). Methane is directly related to dry matter intake (DMI x 21.6 g/kg DM eaten) whereas nitrous oxide (N_2O) emissions are driven by nitrogen fertiliser use, total annual nitrogen excreted and soil type (high losses on heavier soils).

Table 5. Summary of water contaminant losses.

Nitrogen and phosphorus*	Base system	Forestry Scenarios
Total Farm N Loss (kg N)	13,115	12,355
N loss attributed to pastoral area (kg N)	12,539	11,669
N Loss/ha (kg N/ha)*	54	60
N surplus (kg N/ha)*	162	178
Kg MS/kg N leached*	11.6	11.3
Total Farm P Loss (kgP)	1,483	1,192
P Loss/ha (kgP/ha)	3.5	3

* Calculated against effective pastoral area.

Table 6. Biological Greenhouse Gas (bGHG) Emissions

Greenhouse gases*	Base system	Forestry Scenarios
Total biological GHG (t CO_2 eq./ha/yr)	4.3	3.9
Methane (t CO_2 eq./ha/yr)	3.3	3.0
Nitrous oxide (t CO_2 eq./ha/yr)	1.0	0.9
GHG emissions efficiency (kg CO_2 eq./kg MS)	12.6	12.6

Biological GHG emissions at a whole property level, modelled in OVERSEER, reduced by 0.4 t CO_2 eq./ha/yr (refer to Table 6), mostly from lower methane emissions (less feed intake), but also less nitrous oxide emissions (less N fertiliser use). The GHG emissions efficiency, measured by kg CO_2 equivalent per kilogram of milksolid produced remained unchanged. Improvements made in lowering Methane emissions from improved animal performance were offset by higher N fertiliser use relative to total milk production. Total annual biological emissions reduced to 1,664 t CO_2 eq/yr, down 161 t CO_2 eq/yr (9.7 %) compared to the base system reducing exposure to a potential future liability from biological emissions not able to be offset by sequestered carbon. Assuming these emissions were similarly price to carbon NZUs, this would save the business \$4,029 per annum at a \$25/t CO_2e price point.

Whole Farm Business Analysis

Whole business cash flows, with and without, carbon for the three forestry scenarios compared to the base system were completed and analysed using discounted cash flow analysis. Table 7 summarises the results.

For this case study, the existing farming operation is more profitable than any of the forestry scenarios considered and has the highest Net Present Value (NPV).

The improvement in per hectare productivity for the livestock enterprise after removing the most marginal land did not result in an improved IRR as the business lost economies of scale. 'Sticky costs' present challenges for small operations such as the Linton's as the business still requires a certain operating structure regardless of minor changes in livestock numbers.

Options to manage forest edging to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability. This provides the landowner with flexibility to select the most appropriate option that best meets their preference while achieving similar financial outcomes.

The ability to sell "safe" carbon has a significant impact on the relative profitability of forestry as a land use. Including the sale of carbon provided Scenario 1 with the highest wealth creation, (projected equity at year 28) (+$37,489 or 0.4 %), followed by Scenario 2 (+$18,177 or 0.2 %), while Scenario 3 provided similar results to the base system.

Although the net equity gain after 28 years is slightly above or similar to the pastoral enterprise, poor liquidity of the forestry scenarios meant the NPV was $102,000 to $117,000 less with carbon and $197,000 to $209,000 less without carbon highlighting weaker liquidity and net returns in the second rotation without the provision of grants and without the option to sell safe carbon.
At the milk, log and carbon prices assumed, none of the forestry scenarios can meet the assumed levels of term debt repayment for at least 10 years, as post-tax cash surpluses do not exceed $100,000 until at least that point in time. Without the sale of safe carbon, it would take a further two years.
Staggering plantings as the business strengthens its balance sheet or grows cash returns would be sensible to ensure the business maintains sufficient liquidity to meet its requirements for debt servicing, capex, and drawings.

Table 7. Summary of financial results from integrated land use

Integrated business financial analysis	Base system*	Scenario 1	Scenario 2	Scenario 3
Area in farming (ha)	231.0	194.4	194.4	194.4
Area in forestry (ha)	38.8	75.4	75.4	74.1
Excluding carbon				
Aggregate NPV of investment (over 56 years)	$ 3,559,647	$ 3,362,250	$ 3,350,742	$ 3,351,200
Aggregate internal rate of return	20.84%	19.58%	19.46%	19.52%
Farm enterprise	20.84%	20.48%	20.48%	20.48%
Forestry enterprise (woodlot and native)	-	7.94%	7.64%	7.72%
Projected equity at Year 28	$ 8,727,438	$ 8,486,940	$ 8,468,085	$ 8,460,938
Δ from base system		-$ 240,498	-$ 259,353	-$ 266,500
Including carbon				
Aggregate NPV of investment (over 56 years)	$ 3,559,647	$ 3,457,577	$ 3,445,913	$ 3,442,698
Aggregate internal rate of return	20.84%	19.85%	19.73%	19.78%
Farm enterprise	20.84%	20.48%	20.48%	20.48%
Forestry enterprise (woodlot and native)	-	10.40%	9.94%	10.02%
Projected equity at Year 28	$ 8,727,438	$ 8,764,927	$ 8,745,615	$ 8,727,766
Δ from base system		$ 37,489	$ 18,177	$ 328

Summary

- The improvement in per hectare productivity for the livestock enterprise after removing the most marginal land did not result in an improved IRR as the business lost economies of scale. ‘Sticky costs’ present challenges for small operations such as MW & FK Linton as the business still requires a certain operating structure regardless of minor changes in livestock numbers. Progressively retiring smaller parcels of land, starting with the least productive, offers the ability to lessen the impact on liquidity and allow the farm system to gradually adjust overtime. Staggering plantings would also provide the flexibility to utilise the sale of safe tradable carbon to fund planting, pruning and thinning requirements.

- Options to manage forest edges to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability. This provides the landowner with flexibility to select the most appropriate option that best meets their preference while achieving similar financial outcomes.

- The integrated forestry scenarios total property N loss reduced by 5.8 percent, P loss by 19.6 percent, and bGHG emissions by 9.7 percent. These results align with the Linton’s objective to increase the productivity of the better quality land while **lowering their environmental footprint.**

- Good harvesting outcomes for landowners are driven by the wood harvesting agreement, selection of experienced and professional forestry consultants or contractors, and ensuring contractors have the right equipment suitable for the land being harvested.

- Tree planting is expensive and is often a once in a generation decision with the quality of decisions made having a dramatic impact on the outcomes achieved. The long term nature of tree planting, means planning is crucial. Key considerations include cash flow and cost of capital over time, and how these align with the owner’s objectives at both in the long and short term.

- The planning and analysis provided in this case study demonstrates the integration of the **Right Tree** in the **Right Place** to achieve the **Right Purpose**: optimising land use while meeting environmental obligations and improving animal welfare through the provision of shade and shelter.

Project Details

Name: Integrating Forestry for Profitable and Sustainable Land Use

Completed by:

Subcontractor:

Funded by:

Co-funders: