Pukeokahu I Makokomiko (#10)

Integrating Forestry for Profitable and Sustainable Land Use

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Te Uru Rākau
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Executive Summary

- The Maata Kotahi Partnership Trust own and operate Makokomiko Station, a 2,283 ha hill country property 20 km north east of Taihape. In 2019 the Station comprised 1,997.5 effective ha and 285.4 ha of existing native bush, commercial woodlots and recently established mānuka plantings.
- The impact of establishing mānuka on the steepest land least suitable for pastoral grazing was evaluated via a number of scenarios, including the alternative business models for a honey enterprise, ignoring honey completely and a further scenario where the impact of accelerating podocarp regeneration in mānuka stands for a potential long-term high value timber option was considered.
- In all the analysed forestry scenarios for Makokomiko, the present value, to the whole business, of the investment made in mānuka planting was lower than continuing to farm the entire property, despite the lower productivity of the land retired. This is due to the several year lag in honey and carbon revenues following planting and the gradual decline in both these revenue streams over time. This was exacerbated when totara was also co-established and costs increased with insufficient increases in revenue.
- The opportunities provided by mānuka honey and the monetisation of carbon sequestration provide a financially viable pathway for land use to transition from pastoral agriculture to indigenous forest. Only one or the other being available would significantly impact business returns from such a land use change, but together they are a potential game changer for hard hill country land use. Projected equity is higher after 28 years under a share-farmed mānuka for honey scenario.
- Owning the beekeeping enterprise is considered less profitable than the assumed share-farming option due to the fixed cost of hive maintenance, lower efficiencies from a small beekeeping enterprise and the need to reinvest in hives every 10 years relative to the declining honey revenues from a mānuka forest that is reverting to a mixed indigenous forest. Once mānuka honey yields start to significantly decline at year 35, there is limited value to maintaining hives.
- With the long-term intention of the plantation to accelerate full indigenous reversion, actively establishing podocarps would potentially achieve reversion faster and create a sustainable timber resource. However, when the cost of establishment and relatively intensive post-establishment silviculture is combined with the significantly slower timber growth than exotics and an illiquid and speculative market for timber, conventionally assessed investment returns are low. Such activity may be difficult to justify on a large scale, even if it aligns with the goals and aspirations of the owners.
- Retiring the least productive hill country from grazing and using a mānuka plantation to cost-effectively re-establish native forest can potentially generate a similar level of return from the grazing enterprise it replaces for a 30-40 year period, diversifies revenue streams and lowers the overall environmental footprint. Combined with the long-term goals of the owners and their strong sense of kaitiakitanga, such a land use change decision on their hard Rangitīkei hill country is compelling.

Case Study Overview

This case study illustrates the impact of integrating mānuka afforestation scenarios into an existing sheep and beef farm and forestry business. The difference in returns between share-farming and owning hives was analysed. The benefits of accelerating podocarp regeneration in mānuka stands for high value timber was also explored. 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 environmental challenges. The importance of Makokomiko's objectives and values in forming appropriate scenarios is discussed in regard to the development of the best options for further analysis.

Read more on page 4-5

RIGHT TREE RIGHT PLACE RIGHT PURPOSE

With an intergenerational business focus and a strong sense of kaitiakitanga, the Maata Kotahi Partnership Trust has already undertaken a substantial amount of planting on their whenua and tried to balance economic, cultural and environmental drivers. Site selection criteria focused on determining what trees are best suited to: accelerating podocarp regeneration on easy hill country, environmentally sensitive areas and areas currently underutilised.

Read more on page 6-7

WHOLE BUSINESS ANALYSIS – BEST FUTURE LAND USE & FARM SYSTEM

Potential plantings were grouped into scenarios: mānuka for honey production and accelerating podocarp regeneration through use of mānuka as a cover crop. The differences in honey (and investment) returns between share-farming and owning hives is also analysed.

Read more on page 8-14

Farm Overview (Status Quo Farm System)

The Maata Kotahi Partnership Trust own and operate the 2,283ha Makokomiko Station, a hill country property located near Pukeokahu, 20 km north east of Taihape. The farm business which is owned by the Whenuaroa whānau is in the Middle Rangitikei and Lower Moawhango catchments and was started over a hundred years ago by the great grandparents of the current generation of owners, Te Okeke and Maata Kotahi.

The property in 2019 comprised 1998 effective ha with 285 ha of existing native bush, commercial radiata pine woodlots and recently re-established indigenous plantings of mānuka. By March 2021 a further 90 ha of mānuka had been planted. The Station also has kaitiaki over 45 ha of naturally growing native forest which bounds the Rangitikei River.

Makokomiko's goals in relation to this case study are to ascertain:

•The potential for mānuka plantations for honey production as a transition enterprise to full regeneration to be a more profitable alternative on marginal land than the sheep & beef enterprises they supplant;

•The differences in honey (and investment) returns between share-farming and owning hives; and

•The impact of accelerating podocarp regeneration in mānuka stands for a potential long-term high value timber option.

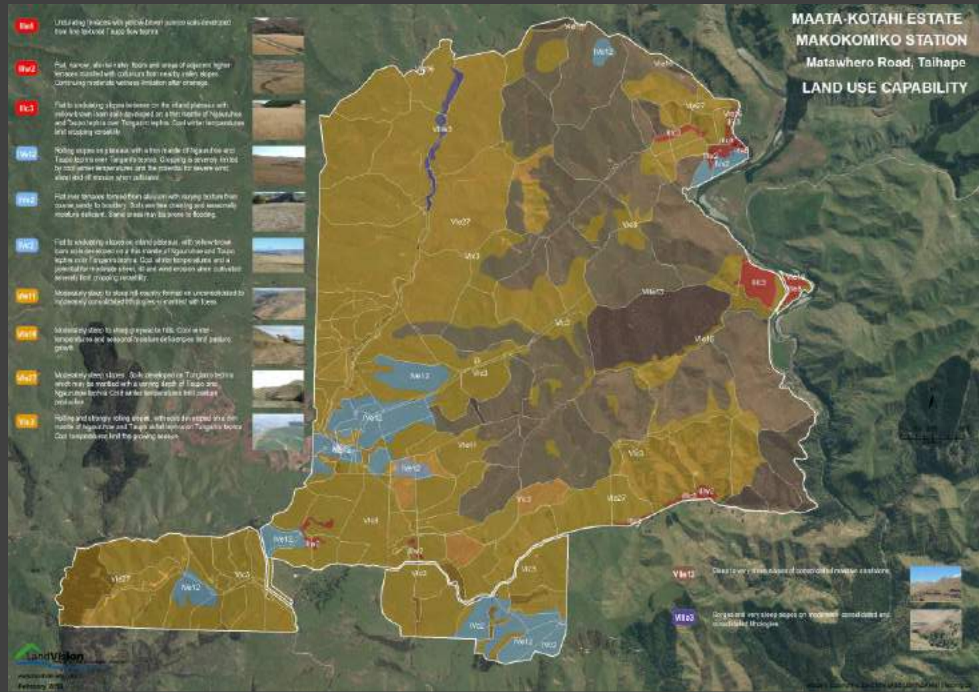
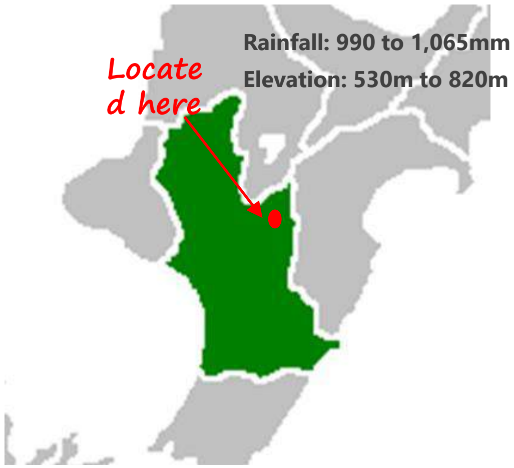


Figure 1: Makokomiko Land Use Capability

Location



Farm Details

Home farm (ha)	**2,283**
Effective pasture (ha)	**1,998**
Soil Type	**Brown (73%) and allophanic soils (27%)**
Water Course	**Rangitikei River**
Est. pasture grown (per effective ha/yr)	**8 t DM**
Est. pasture eaten (per effective ha/yr)	**5.2 t DM**

Livestock Details

Flock size (ewes)	**6,700**
Lambing %	**150**
Ave lamb ccwt (kg)	**18**
Herd size (breeding cows)	**580**
Deer (hinds)	**700**
Sheep/Cattle/Deer ratio	**55:36:9**

Performance Indicators

Stocking rate (su/ha)	**9.8**
Operating profit ($/ha)	**250**
Return on assets (ROA %)	**3.2%**
N leaching (kg N/ha/yr)	10.6
P loss (kg P/ha/yr)	**0.4**
Biological GHG emissions (tCO2 eq/ha)	**3.37**

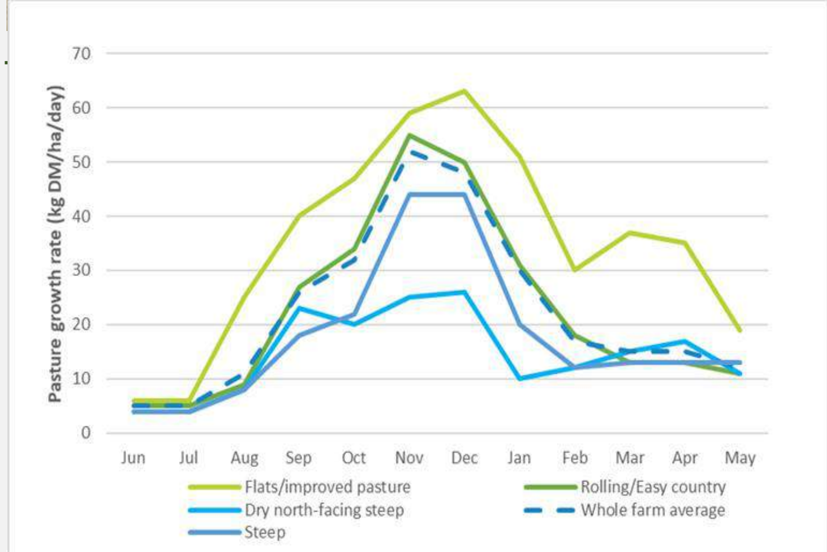
Factors Motivating Tree Planting and Land Use Change

Physical Constraints

- Seventy three % of the farm comprises brown hill soils on the harder hill country with the remaining 27% allophanic soils on the easier country.
- Only 7% (c. 140 ha) of the effective area is flat. In total 57% of the farm lies between 20°-35° in slope and a further 16% steep land >35° in slope. Approximately 460 ha is considered suitable for cultivation.
- The volcanic soils of the easier contoured parts of the farm are less prone to pugging risk during winter than the steeper parts of the property, which given their mudstone parent material are at risk from slips when saturated.
- The forestry paddocks at Makokomiko were selected for retirement due to their steep terrain and low fertility. The pine forests were selected for areas which had easier accessibility for roading and the mānuka paddocks were retired as they were not suitable for pine trees due to lack of road accessibility and the harvest viability of the terrain.

Environmental Constraints

- **Annual N loss** at **10.6 kg N/ha** is **low** in **line with** the lower cattle ratio and **lower stocking level** reflective of pasture grown on this land class.
- P loss at **0.4 kg P/ha** reflects the low proportion of the farm cropped. This would be reduced further by additional space planting and **taking steeper, stock tracked areas out** of **grazing**.
- While **Greenhouse Gas (GHG) reduction targets** – except nitrogen fertiliser, fuel and electricity – 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 **3.37 t CO2e** will primarily require lowering total DM intake with less stock as forestry replaces grazing land.
- The **integration of trees** may provide a valuable tool to improve environmental impacts. Retiring low quality land into forestry with low N loss and providing shade and shelter to support higher per head performance and reduce livestock wastage, and providing income from log sales or honey and carbon sequestration over time.



Right Tree Right Place Right Purpose

In this section the tree options for the different land classes are explained. With an intergenerational business focus and a strong sense of kaitiakitanga, the Maata Kotahi Partnership Trust has already undertaken a substantial amount of planting on their whenua and tried to balance economic, cultural and environmental drivers. Three scenarios involving the planting of mānuka as a transition crop between pasture and permanent indigenous forest have been considered in this case study identifying and planting underutilized land and planting riparian areas.

Alternate species for steep and underutilized land

- Trees on the steep hill country at Makokomiko should ideally be limited to trees for biodiversity, shelter and potentially carbon and honey income, rather than trees for timber.

- Mānuka (*Leptospermum scoparium*) has advantages as a shrub, minimizing the risk of toppling. Noxious weeds are suppressed by the plant's ability to readily revegetate. Droughts have however resulted in loss of plants.

- Drier steep areas of the farm have suited Radiata pine with one area in its second rotation. Staggered thinning has been used to reduce leader loss from snow weight and wind damage.

Accelerating Podocarp regeneration

- On easy hill country, 20°-35° slope, remnant native revegetation is also proving to be a suitable alternative to poplar poles as non-pasture vegetation within the farming system. Limiting stock density and grazing frequency allows these areas to slowly revert and provide both soil stability and valuable stock shelter at key times of the year (such as post-shearing).

- Supplementary planting with mānuka (*Leptospermum scoparium*) initially and then podocarps such as totara after 4 to 5 years will accelerate the reversion process and create a potentially valuable timber resource that non-conventional harvest techniques might be able to extract in the future without the need for clear-fell.

Riparian and erosion planting

- On any alluvial flats, riparian margins present the most obvious opportunity for revegetation. The chosen revegetation improves biodiversity, protects the alluvial flats from sediment depositing flood events and the fencing from flood debris.

- At Makokomiko, the fencing-off of some streams has commenced. Where the water courses are shared with neighbours' planting of the margins will occur once fencing is complete on both side.

- The restoration of native vegetation such as harakeke, hebes, kowhai, carexes, coprosmas, pittisporums and ti kouka along stream margins would be recommended.

Integrated Forestry Analysis

The governors of Makokomiko have adopted a number of forestry strategies over the years, most latterly the plantation establishment of eco-sourced mānuka with high UMF potential as a strategy for a cost-effective transition of land less suited to pastoral farming back to permanent indigenous forest.

Given the current environmental reforms, mānuka plantations on marginal hill country land can help reduce nitrogen and phosphorus losses, while sequestering carbon, albeit at a lower rate than Pinus radiata. Before planting mānuka, it is important to decide what the purpose of the mānuka block. One possibility is to plant and let the block revert into native bush over time. The main limitation of this is that the mānuka only has a productive life of 20 years for mānuka honey production, so the honey will not be able to be high grade mānuka in later decades. The other option is to manage the block in a way that mānuka honey can be harvested perpetually, through either pruning or replanting the mānuka. There is still some confusion around this second option as the canopy cover must reach 5 meters for the plantation to qualify for registration in the ETS and pruning and replanting may compromise this.

The next factor to consider is the type of mānuka trees that will be planted. Like all other trees, the motto "right tree in the right place" is applicable. Although mānuka tend to do well on less fertile land, factors such as climate, altitude, soil type and aspect have a considerable impact on the plants. There is also considerable genetic variation in mānuka trees, with some being more tolerant to certain conditions than others.

The local iwi places significant cultural value on planting local sourced mānuka. Cuttings of high fructose local varieties have been taken and grown to supplement the existing plantations and create new plantations. This practice is known as "eco-sourcing". However, for the financial success of all mānuka plantations the ability to produce high MGO mānuka honey is paramount. High value mānuka honey is UMF 16 and above, which can be classified as medical honey and valued at over $200/kg. If the mānuka plantation can produce honey of this quality, it could be more profitable than traditional sheep and beef farming, or pines for carbon given the current carbon price.

Planting rates should be considered. In earlier plantations the standard stocking rate was 1,200 stems/ha, but more recently stocking rates of 2,500 stems/ha are used on the premise that the potency of the honey will be greater, given more nectar is available to the bees. Areas should be at least 30-50 hectares to be financially viable and produce high-quality, monofloral mānuka honey, dependent on normal seasonal variation.

At Makokomiko, prior to planting mānuka paddocks are hard grazed by stock and the regrowth "chemically topped" with a light application of glyphosate (c. 200 mL in 100 L per hectare) to suppress, but not kill, resident pasture. Post-planting releasing is then undertaken as required directly around the plants. To control weeds some mānuka farmers are introducing sheep or young calves in the blocks (at a modest rate of one to two stock units to the hectare) to graze between the trees. Other more modern solutions include the use of a drone to identify and spray weeds through photographic imaging. The drone can be programmed to identify and precisely spray weeds amongst the mānuka, which reduces spray use and damage to mānuka plants.

Scenarios explored.

Scenario 1A – Mānuka planting for honey planting for honey production– Sharefarmed with beekeeper. Makokomiko providing the mānuka resource and partnering with an independent beekeeper who will provide the bees and hives and collect the honey under for a revenue sharing agreement. The revenue sharing mechanism is assumed to be the landowner receiving 25% of all honey revenue.

•60 ha of the "current" effective area is planted in mānuka, land that is north-facing, summer dry and of steeper contour.

•Tree establishment is based on the higher than typical planting density to assist with maximising floral density and tree survival.

•A 62% subsidy is assumed with the net cost of establishment at $1,525/ha.

•The beekeeping enterprise is based on a stocking density of one hive/ha (conservative) with an average yield of 20 kg honey/hive/year.

•The effective farm area reduces to 1,938 ha, with a commensurate reduction in livestock [beef cattle] numbers.

Scenario 1b – Mānuka planting solely for carbon sequestration

This scenario is identical to Scenario 1a, except it is assumed that the mānuka forest resource is not used for honey revenue. This situation replicates the Trust's assumed "business model" prior to considering the applicability of the forest for mānuka honey production.

Scenario 2a – Mānuka planting solely for honey production-owned hives

Scenario 2a is identical to Scenario 1a, except we have assumed the Trust will own and manage all of the hives used for honey production and will do so for the 50-year effective lifespan of the mānuka plantings for monofloral mānuka honey production.

•Revenue is assumed to be only 70% of what a commercial beekeeper would receive assuming Makokomiko were to pursue their own beekeeping enterprise, and accounts for learning and any additional costs that might result from a discrete single property beekeeping operation.

Scenario 2b – Mānuka planting solely for honey production-owned hives for 30 years

Scenario 2b is identical to Scenario 2a, except that the honey harvesting period is assumed to end 34 years after establishment, being the point at which the percentage of honey being harvested that can be considered monofloral mānuka drops below 50% and annual hive maintenance and operating costs are expected to be less than or equal to expected honey revenue.

Scenario 3 – Mānuka planting solely for share-farmed honey production with future heartwood timber crop

Scenario 3 is identical to Scenario 1a, except that at Year 5, totara trees are planted at 500 sph within the mānuka forest to accelerate the establishment of long-lived podocarps for selective harvesting of these trees for high value timber after a minimum period of 100 years.

Results of Forestry Scenario Analysis

The investment outcomes are summarised in Table 1 with the forestry-related revenues (such as carbon, honey and commercial timber) over a 56 year period equivalent to two radiata pine rotations and broadly in line with the effective lifespan of the mānuka (50 years) before they become completely overtaken by other indigenous tree species and monofloral mānuka honey harvesting becomes defunct.

Scenario 1a: Assuming mānuka trees are established at a density sufficient to be eligible for the ETS and for monofloral mānuka honey production after 5 years, then at a carbon price of $25/NZU, a 60 ha planting would generate in the order of $485,000 of carbon revenue from years 5-50 post-planting. Assuming a share-farming arrangement for 25% of all honey revenues, then this planting should also generate some $239,000 of honey revenue. Combined, the potential carbon and honey income, over the 56 year period considered generates a positive net present value (NPV) of $55,000 at a discount rate of 6%. With a positive NPV at the assumed discount rate, the internal rate of return (IRR) must be higher than that – in this case the IRR is 8.9%.

However, if there was no desire or opportunity to use these plantings for honey, then reliance solely on the estimated $485,000 of carbon revenues would see direct investment returns reduce. **For Scenario 1b**, no honey revenue lowers the IRR to 4.4% and accordingly delivers a negative NPV at the assumed discount rate of 6% (-$24,000) for the 60 ha of mānuka established. While still potentially a positive return on investment, at current interest rates, the return may not be sufficient to justify establishment for potential carbon returns alone, particularly when they will potentially stop after 50 years.

Scenario 2a generates a lower NPV at 6% than Scenario 1a (-$7,500) and a lower IRR at 5.4%. This is a better option than not utilising the mānuka for honey revenues at all (as in Scenario 1b) but is clearly less attractive than a share-farming arrangement.

Table 1: Summary of individual investment performance for the forestry investments, under each scenarios.

Forestry scenario	1a	1b	2a	2b	3
Area of hill country planted in mānuka at 2,000 sph	60.0		60.0		60.0
Podocarp underplanting	No		No		Yes
Bee keeping structure	Sharefarmed	None	Owned		Sharefarmed
Length of honey harvest	50 years	None	50 years	30 years	50 years
Cost of establishment over 56 years (total)	**-$91,520**	**-$91,520**	**-$201,920**	**-$163,520**	**-$307,520**
Pre-tax honey profit (undiscounted)	**$239,730**	**$0**	**$40,584**	**$152,424**	**$239,730**
Pre-tax carbon revenue (undiscounted)	**$485,100**	**$485,100**	**$485,100**	**$485,100**	**$485,100**
Value of commercial timber at 56 years (undiscounted)	**$0**	**$0**	**$0**	**$0**	**$397,560**
Present value for whole term (6% discount rate)	**$55,609**	**-$24,033**	**-$7,509**	**$6,578**	**-$264,090**
Internal rate of return	**8.9%**	**4.4%**	**5.4%**	**6.4%**	**-**

The reduced value proposition from owning the beekeeping enterprise results from: the assumption that any beekeeping enterprise operated by the Trust will be less profitable/productive than that of an established business, especially initially; establishing a beekeeping enterprise solely for a 60 ha mānuka stand that will lose potency over time is unlikely to be cost effective, particularly when high UMF yields all but disappear. Also the ongoing capital investment in hives and hive maintenance once the higher UMF derived yields decline.

Scenario 2b: Assuming that the beekeeping enterprise (and honey harvest) was discontinued once UMF potency ended improves the investment return for the Trust, generating a slightly positive NPV of $6,500 over the 56-year investment period and an IRR of 6.4%.

Scenario 3: The introduction of totara into the mānuka plantation to create a potential sustainable timber supply in 4-5 generations' time has a significant negative impact on the overall investment returns from the forest establishment. Planting totara at year 5 over the 60 ha area analysed in this case study will require in the order of $500,000 of capital within the first eleven years post-establishment (including the estimated $3,000/ha in planting costs), Demand for native heartwood could lift above the extremely conservative price/value assumptions we have made however potentially improving investment returns.

Impact on the Farm Enterprise

The loss of pastoral land for grazing reduces total stocking rate and net meat and wool production, however the loss of less productive land ultimately increases the average stocking rate and productivity of the residual land used for farming. Under the planting scenario for Makokomiko, the loss of the dry, steep, north-facing hills slopes from the pastoral enterprise were modelled to require a reduction in the number of beef cattle farmed. The rationale for this was that:

•The 60 ha planted was assumed to be outside the deer fenced area.

•The area had a flatter pasture growth curve and pasture quality characteristics best suited to utilisation by the beef cattle enterprise (due to the ability of the farm manager to restrict the intakes [quality and quantity] of the existing beef cattle with a lower impact on productivity than with sheep).

•The lower inherent profitability of the beef operation.

As larger areas of farm are converted to forestry a balanced approach to stock reduction is required and sheep numbers would also need to be reduced.

Table 2: Summary of physical performance indicators for the farm enterprise

Farm parameters	Status quo	Scenario 1	Change
Effective pastoral area (ha)	1,998	1,938	-3%
Total area of new manuka	-	60.0	
Stocking rate (SU/ effective ha)	9.8	9.9	1%
Sheep SU	10,769	10,769	-
Cattle SU	7,049	6,713	-5%
Deer SU	1,762	1,762	-
kg liveweight wintered/ha	586	590	1%
Meat & wool produced per effective ha/year (kg)	169	172	2%
Pasture eaten (t DM/ha)	5.24	5.30	1%

PROFITABILITY

The loss of 3% of the farm area to new forestry is estimated to lower operating profit by 2.6%. This results from the average gross farm income on the residual land being greater than before, but only some marginal costs of production can be saved through the retirement of these areas - overhead costs (including wages of management) and sticky operational costs (like R&M) are assumed to change little, with the relatively modest reduction in stocking levels. While operating profit per effective hectare is marginally higher than before, this isn't sufficient to offset the loss of grazing area. Although not overtly considered here, in practice some other efficiencies might be extracted from retirement of land, including mustering made less difficult, lower levels of stock misadventure and losses and less fence, track and dam maintenance at the margins.

Table 3: Summary of financial performance indicators for the farm enterprise

Farm parameters	Status quo	Scenario 1	Change
Gross Farm Income ($/eff ha)	$868	$885	1.9%
Farm operating expenses ($/eff ha)	$618	$633	2.5%
% GFI	71%	72%	
Operating profit ($)	$500,133	$487,131	-2.6%
Operating profit ($/ha)	$250	$251	0.4%

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 ultimately the cash the owners want to distribute to shareholders and beneficiaries. Based on Beef+Lamb Economic Survey, Class 3 farms in the Western North Island are estimated to have average debt servicing and rent costs of $70/ha in FY19. Average term debt is estimated $1,315/ha. For a farm like Makokomiko, this would equate to $2,628,000 of term debt, requiring $139,000 of surplus cash to meet current interest costs (at 5.3%) and a further $131,000 of after-tax surplus for repayment over a 20-year term, thereby requiring a pre-tax operating surplus of approximately $135/ha, reducing to $66/ha over time. At the Trust's level of operating performance, this level of debt servicing and repayment would likely be achievable and still provide for meaningful distributions, reinvestment in the farm business or investment in off-farm assets.

Environmental Performance

Water Contaminant Losses (Nitrogen and Phosphorus)

Total N loss to water from the property is expected to marginally decline under all of the forestry scenarios, all as a result of the reduced stock numbers (and the strong link between N loss and the urine patch). At Makokomiko the N loss reduction from 11 kg N/ha to 10 kg N/ha for the current state if no planting occurs is the only substantive change.

The expected reduction in P loss is more substantial with the retirement of steep land from pasture into permanent indigenous forest. While OVERSEER is unable to account for sediment loss, given P loss from faming is strongly correlated to sediment loss, the likelihood is that the retirement of 60 ha of pasture into mānuka would have a positive impact on reducing soil loss, particularly with the assumption that the accompanying reduction in carrying capacity would first be addressed through a reduction in cattle numbers. As cattle are heavier they have a greater impact on sediment loss on steep contoured land.

Biological Greenhouse Gas (bGHG) Emissions

With the property's bGHG emissions strongly linked to dry matter intake and livestock numbers, with the reduced carrying capacity expected from the 60 ha of mānuka planting, bGHG emissions are expected to decline under the three forestry scenarios. In this instance, a 3% reduction in pastoral area resulted in a 2% reduction in methane and nitrous oxide emissions.

As can be seen in Table 5, after 28 years, planting 60 ha in mānuka is sufficient to result in an 8% reduction in the net quanta of greenhouse gases (in CO_2 and CO_2e) expected to be produced by the farming enterprise during this time compared to no planting.

Table 4: Summary of environmental footprint indicators compared to the base system.

Integrated business environmental results	Status quo	Forestry scenario
Total N leached (kg N/yr)	24,280	23,901
N leached per hectare (kg N/ha)	11	10
N surplus (kg N/ha/yr)	52	51
N conversion efficiency	9%	9%
kg net meat & wool/kg N leached	13.9	14.0
P Loss (kg/yr)	913	803
bGHG/ha (t CO_2 eq./ha)	3.37	3.30
Green House Gas emissions (kg CO_2 /kg meat & wool)	19.9	19.8

Table 5: Net quanta of greenhouse gases (t CO_2/CO_2e) generated from establishment of 60 ha of mānuka at Makokomiko for the first 28 years.

Farm parameter	Status quo - "unplanted"	Forestry scenario
Area planted in mānuka (ha)	-	60.0
bGHG emmitted (t CO_2e)	215,090	211,198
CO_2 sequestered (t CO_2)		- 13,476
Total GHG profile (t CO_2e)	215,090	197,722
Change from status quo		-8%

While the farming enterprise will continue to generate methane and nitrous oxide in perpetuity, the permanent indigenous forest that emerges from the mānuka plantation will stop sequestering carbon at some stage, meaning the forest establishment as analysed is not a permanent solution to lowering the farm's net emissions, outside of the small permanent reduction in stocking rate resulting from the loss of pasture production under the mānuka. However, it does provide a way for farm businesses to lower their overall emissions footprint (CO_2, CH_4, N_2O) for a period of time, as well as provide a fiscal hedge to any potential financial liability resulting from pastoral agriculture needing to account [and "pay" for some] of their bGHG emissions.

Whole Farm Business Analysis

Whole business cash flows, with beekeeping and commercial timber variations are outlined for each scenario in Table 6: Results of forestry scenario analysis for each of the three mānuka forestry scenarios compared to the base system were completed and analysed using discounted cash flow analysis.

•In all the analysed forestry scenarios for Makokomiko, the present value, to the whole business, of the investment made in mānuka planting was lower than continuing to farm the entire property, but not necessarily significantly so. This is invariably due to the several year lag in honey and carbon revenues following planting and the gradual decline in both these revenue streams over time.

•Owning the beekeeping enterprise, based on the assumptions used here, is less profitable than the assumed share-farming option. This is essentially due to the fixed cost of hive maintenance and the need to reinvest in hives every 10 years relative to the declining honey revenues from a mānuka forest that is reverting to a mixed indigenous forest. As Scenario 2b demonstrates, once mānuka honey yields start to significantly decline at year 35, there is limited value to maintaining hives specifically for this purpose.

•The introduction of totara into the plantation to create a future commercial native timber crop lowers the overall investment returns of the business and the net equity from cash flows, largely due to the significant investment in tree stock and silviculture required to maximise the long term timber potential of the trees.

Equity (from operating cash flows) after 28 years was estimated to be higher under any of the assessed solely mānuka scenarios that utilised the mānuka resource for honey production (also see Figure 1), albeit it took a minimum of 20 years to achieve this. This is due to impact of the period from year 9 to year 35 where honey revenues are at their peak and the aggregate carbon and net honey revenues from the 60 ha planted are greater than the net revenues that would have been generated from farming that area.

Table 6: Summary of financial results from integrated land use over the first 28 years

Integrated business financial results	Status quo	Scenario 1a	Scenario 1b	Scenario 2a	Scenario 2b	Scenario 3
Effective pastoral area (ha)	1,998	1,938	1,938	1,938	1,938	1,938
Total area of new manuka (ha)	-	60.0	60.0	60.0	60.0	60.0
Aggregate NPV of investment (over 56 years)	$3,945,756	$3,858,307	$3,778,665	$3,795,189	$3,809,276	$3,553,674
Aggregate internal rate of return	12.2%	11.9%	11.8%	11.9%	11.9%	11%
Sheep & beef enterprise	12.2%	12.0%	12.0%	12.0%	12.0%	12.0%
Forestry enterprise	-	8.9%	4.4%	5.4%	6.4%	-
Projected equity at Year 28*	$22,597,603	$22,751,451	$22,580,001	$22,659,021	$22,659,021	$22,255,210
Δ from base system		$153,848	-$17,602	$61,418	$61,418	-$342,393

Risk analysis

On the basis that mānuka stands were large enough to be suitable for high UMF honey production, at a carbon price of $25/NZU, a 75% planting subsidy would be required before the expected rate of return for that land use change broadly equated to the expected return from farming livestock on the same landscape (about 12%). At an assumption that current ($35/NZU) carbon prices were maintained over the next 50 years, incentives for planting broadly in line with the combined total of recent assumed 1BT grants program and subsidies available from the Horizons Regional Council (c. 62%) would appear to be sufficient to equal expected pastoral farming returns over the same time period. The value of subsidies available have a significant impact on the value proposition.

With regard to the integrated business (using Scenario 1a as the example), given the relatively small proportion of the farm being considered for land use change and the subsequent amount of carbon and honey revenue relative to those of the underlying farming operation, dominated by lamb production, it is unsurprising volatility in average lamb price has a greater impact on the underlying level of return than the price of NZU

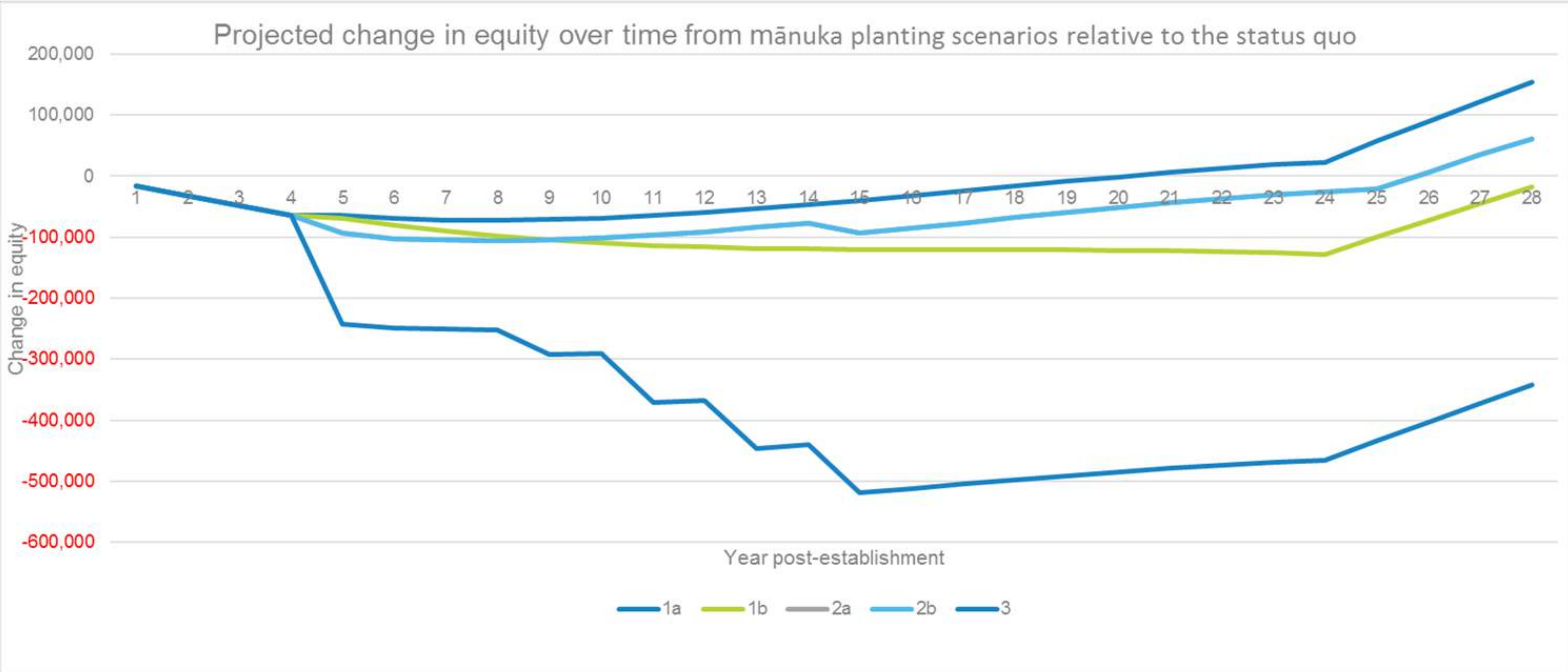


Figure 1: Comparison of total business change in equity positions for all scenarios relative to the base system including the sale of carbon ($25/NZU) and honey revenues if applicable (Note the 2a and 2b scenarios are identical over this time horizon)

Summary

- The opportunities provided by mānuka honey and the monetisation of carbon sequestration provide a financially viable pathway for land use to transition from pastoral agriculture to indigenous forest. Only one or the other being available would significantly impact business returns from such a land use change, but together they are a potential game changer for hard hill country land use.
- At a property like Makokomiko, retiring the least productive hill country from grazing and using a mānuka plantation to cost-effectively re-establish native forest can potentially generate a similar level of return from the grazing enterprise it replaces for a 30-40 year period.
- With the revenue generated from a mānuka plantation coming from the sale of sequestered carbon (NZUs) and from the sale of monofloral mānuka honey, the carbon price, the value of mānuka honey, honey yields and the ownership/management framework of how the honey is actually harvested and the proceeds shared, can all influence profitability.
- The precise level of financial performance depends on a number of factors, particularly the extent to which national or regional incentives to establish such forestry cover the cost of planting. The considerable sensitivity of investment returns to the cost of establishment is not surprising given the lag in both carbon and honey revenues post-establishment. Furthermore, from a practical perspective, the perceived "double whammy" from loss of farming revenue and the cost of establishment can often be a powerful disincentive for farmers to make land use change of this type. Having a strong balance sheet, a profitable business and a long term vision, all of which the Maata Kotahi Partnership Trust have, are all potentially important preconditions for this type of afforestation, particularly if subsidies are limited or unavailable.
- Our analysis suggests that a conventional share-farming arrangement for a 60 ha honey enterprise is likely to generate a greater level of return than if the owners owned and operated the hives themselves. This is largely due to the impact of a new entrant to the honey industry having to develop expertise and institutional knowledge about maximising performance over time and the higher per kg costs associated with being a smaller operator with a sole honey resource.
- With the long-term intention of the plantation to accelerate full indigenous reversion, actively establishing podocarps (as opposed to their slow naturalisation over time) would potentially achieve reversion faster and create a sustainable timber resource. Given high establishment and silviculture costs, slow tree growth rates and uncertain future returns this option may be difficult to justify on a large scale using conventionally assessed investment returns. However, where establishment of indigenous forests aligns with the goals and aspirations of the owners it might be suitable on a small part of the overall plantation.

Definitions

ETS	Emissions trading scheme
1BT	One Billion Trees
CAA	Carbon Accounting Area
Carbon average approach	New method of accounting for carbon which takes into account net C loss allowing for decay following harvest. Mandatory 1 Jan 2023.
Carbon sequestration	Long term capture and storage of atmospheric carbon dioxide.
NZU's	New Zealand Units traded in the ETS eg 169 tonnes CO2/ha = 169 NZU's/ha
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
sph	Stems per ha
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
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

Project Details

Name: Integrating Forestry for Profitable and Sustainable Land Use

Completed by:

Subcontractor:

Funded by:

Co-funders: