Forests or Fleece: The Future of the North Island's Marginal Country

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Contents

Executive Summary

The North Island's marginal country is undergoing a change in land use at a pace it hasn't seen since the wool boom of the 1950s. This is being driven in large part by afforestation with exotic trees, primarily *Pinus radiata* being planted for traditional timber harvest as well as for carbon farming purposes. This report seeks to understand the reasoning behind, and effects of, this change from an economic, environmental, and cultural perspective, and to look out 30 years to establish longer term viability of traditional farming, rotational and permanent forestry and Manuka plantation for the purpose of honey production and carbon sequestration.

Key Findings

- Afforestation of marginal land provides significant economic advantage over traditional grazing in all its forms. The benefit varies from 346% (Manuka) to 974% (Permanent forestry) of the average profit from hard hill country over the last decade. This disparity is likely to increase in the next 30 years as carbon prices rise
- Afforestation is not going to slow down in the medium term with projections suggesting another 1.5million hectares of planting will be required to achieve New Zealand's carbon targets.
- Currently the cost of establishing native forests is prohibitive and the carbon benefits are not competitive with exotic forests, primarily *radiata*. As such *radiata* will continue to be the tree of choice until substantial subsidies are provided or changes are made to the legislation.
- All afforestation options are superior in their environmental impact if managed properly. Manuka plantation is the most environmentally friendly option followed by permanent forestry, although this does have long-term risks if *radiata* is used.
- Both permanent forestry and Manuka plantation have negative effects on labour FTE's in rural communities compared to grazing on marginal land. Rotational forestry is significantly higher in both FTE and value chain than grazing but the location of these benefits is unknown, they may not be truly beneficial to the local community. This problem will only increase over the next 30 years as more marginal land is converted into permanent forest.
- Maoridom are generally pro exotic forestry establishment while being aware of the environmental risk and native forestry being the best option for them. This is due to historical marginalisation leaving Māori with significant areas of landholding where afforestation is the only profitable option.

Recommendations

- Central and local government need to support the establishment of native forests with the benefits that they entail. Significant subsidies need to be put in place to incentivise this form of afforestation.
- Government support of permanent exotic forestry via subsidies and entry into the ETS needs to be limited to class 6 & 7 land only, and proper site analysis undertaken to ensure soil types and contour are suitable for this purpose to slow the change of productive land from pasture into permanent forests.
- MPI should increase the threshold for land that is registerable under the MPI lookup table to a minimum of 200ha to streamline the process of registering land for entry into the Emissions Trading Scheme and the allocating of subsequent units, and minimise the cost for landowners looking to establish forestry on class 6 & 7 land.

- Landowners on marginal land need to isolate and establish accurate profitability information regarding their class 6 & 7 land and confirm a baseline, then environmental and cultural considerations need to be carried out by the landowner. This will help in establishing the best option for them.
- Investigation into potential afforestation options needs to occur on a case-by-case basis via communication with commercial rotational, permanent and Manuka forestry providers. Afforestation of marginal country is in most cases the most sensible outcome in any of its current forms. Landowners need to establish what options are available in their circumstance and establish a cost/benefit model for each of these.

1.0 Introduction

Will traditional predominant pastoral farming survive on the North Island's marginal country, or will the process of afforestation on this land type continue unabated until we have seen a once-in-a-generation land use change from pastoral farming to rotational and permanent forestry ? With the pricing and demand pressure on NZ's wool industry and the plummeting prices that that have resulted, the average price has dropped 33% since its high in 2015-2016 (Beef & Lamb NZ, 2021) and has heaped further economic pressure on land that was already being eyed up by foresters with capital to spend and the support of the Governments Billion Trees programs and the subsidies behind them.

The rise and rise of the price of, and demand for, carbon units received for new afforestation under New Zealand's Emissions Trading Scheme (ETS) has added further pressure and the economics of "Carbon Sinks" – planted forests consisting primarily of *Pinus radiata* valued for their fast growth and significant carbon sequestration ability. The spot price for a carbon unit, equivalent to a ton of carbon, has risen from $25.05 to $76.75 in the last three years, an increase of over 300% in 36 months (Kilsby. S, 2022) This has changed the landscape regarding land values, particularly in marginal country that was previously considered uneconomic for harvestable exotic forests. With Carbon foresters being able to model approximately 900 tons of carbon per hectare over 35 years depending on region, the potential returns are dwarfing those ever achievable by pastoral farming even in the best country

Along with the rise in Carbon economic considerations, there also needs to be considered the very thing that underpins the ETS, improvements in the environment. The New Zealand Government's announcement to include agriculture into the ETS by 2025 and the subsequent creation of He Waka Eke Noa as a non-Government industry group to help manage this process, means that pastoral farmers now must factor in the three decisions for their emissions moving forward; reduce, offset or pay.

There is also angst about the effect that afforestation is having on the numbers of people that remain in rural communities where this afforestation activity is being focused. Grassroots lobby groups such as 50 Shades of Green are active around the country protesting the afforestation with varying messages and levels of success

This research report intends to answer the two questions: what is the actual change in land use of the North Island's marginal country over the last 10 years and more importantly, where is this projected to trend over the next 20?

This report hypothesises that traditional pastoral farming in this marginal country no longer stacks up economically against traditional rotational forestry, carbon forestry and to a lesser extent even Manuka Forest intended for honey production and carbon benefit. To make the most of this land use class in both an economic and environmental sense, landowners will have to adapt to this new reality and diversify their farming system to some degree.

2.0 Project Scope & Objectives

The scope of this project is to find out the reality of what land use change has occurred in the North Island, specifically in the regions south of Gisborne, and how this change is likely to continue.

Area of Focus for Project

I have conducted an exploration of what I believe are the four most common options for rural landowners in these regions currently:

- traditional pastoral farming
- harvestable exotic forest
- permanent forest (carbon farming)
- Manuka plantation

There are three factors that this report will explore when considering the benefits and risks of these options:

- Economic
- Environmental
- Cultural

The objective of this report is to provide unbiased information regarding what has occurred up to now, and what the best options for land use are in this marginal country. The traditional way of farming may no longer be the best option, and there are options for positive change if we all keep an open mind.

3.0 Methodology

The methodology chosen to undertake this report is in the form of a literature review carried out of relevant journals, reports, publications, articles, and legislation as well as industry-specific commercial information where available. This has allowed comparative analysis to be carried out that provides the background of how marginal land management has become what it is, the development of alternative options and the risk/reward matrix for these alternate uses. These findings are then summarised and discussed to identify the key considerations to provide a set of recommendations.

4.0 Literature Review

The first task is to establish what exactly is marginal land in the context of this report. For this purpose, we are referring to land that is considered Class 6 & 7 per the Land Use Capability Classification (LUC) (Lynn Et al. 2009), Class 6 is considered "not suitable for arable use and has slight to moderate physical limitations and hazards…. erosion is commonly the dominant limitation. Land Class 7 is "unsuitable for arable use, and has severe physical limitations or hazards…it is high-risk land requiring active management to achieve sustainable production" (Lynn Et al. 2009)

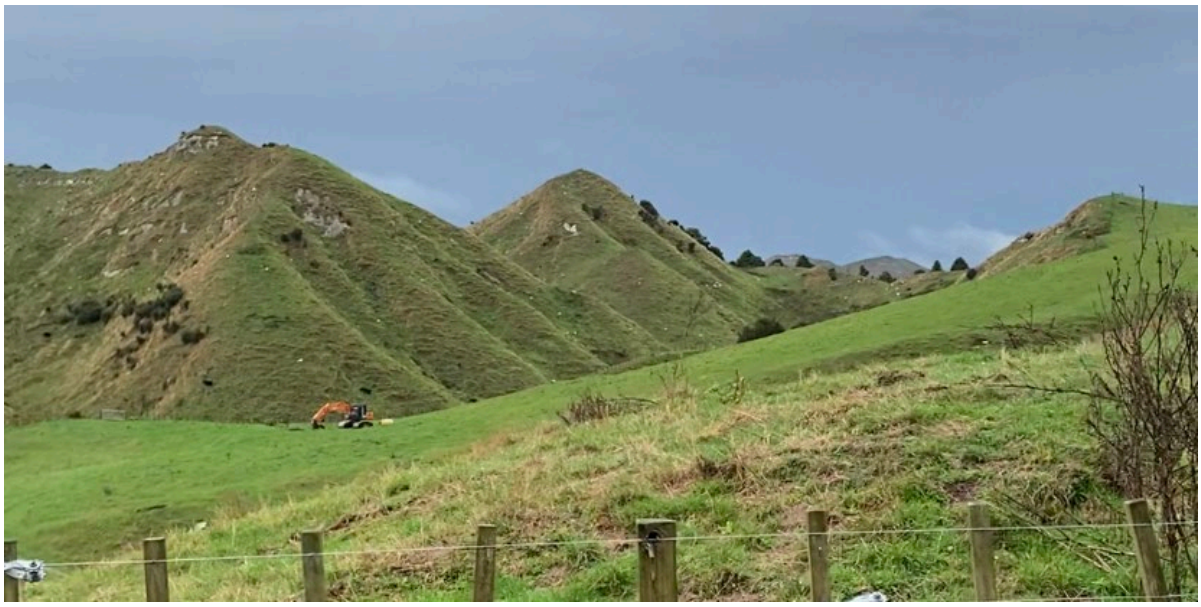

Figure 1: A property in the Ohura district shows LUC 6 in the foreground & LUC 7 in the background (Land Cover Database 5.0 scinfo.org)

4.1 Traditional Use & the Economic Reality

Traditionally marginal land such as this has been used for sheep and beef farming which remains the mainstay of pastoral land use in New Zealand. Per Statistics New Zealand's 2017 Agricultural Production Census there were 23,403 Sheep & Beef farms in New Zealand (45% of all farms) which encompassed 8,765,000ha (63% of Agricultural land). 920 of these farms are considered as North Island hard hill country as categorised by Beef & Lamb NZ. This is "steep hill country or low fertility soils with most farms carrying six to ten stock units per hectare" (Beef & Lamb. n.d)

Sheep & Beef farming was long the mainstay of the New Zealand economy, consistently being its largest export earner although this is now dwarfed by the dairy industry. In the year to 30 June 2022 New Zealand dairy exports totalled $21.6b while Meat & Wool achieved only $12.2b (MPI, June 2022).

The newest consideration to the economics of this land is that of Carbon credits. In 2002 the Climate Change Response Act became legislation. According to the Climate Change Response Act 2002, its main aims are to:

- Provide a framework by which New Zealand can develop and implement clear and stable climate change policies
- Enable New Zealand to meet its international obligations under the Paris Agreement & the Kyoto Protocol
- Provide for the implementation, operation, and administration of a greenhouse gas emissions trading scheme in New Zealand that supports and encourages global efforts to reduce the emission of greenhouse gases

Outside the environmental considerations that now need to be taken by landowners regarding this act which will be discussed later in the report, it is the implementation of the third purpose that has had the most significant impact on land use in the marginal country in the North Island. But first, let us look at the traditional economics of pastoral use of marginal land.

Sheep and Beef farming as an industry, including the North Island's marginal country due to its lower productivity has gone through some economic challenges since the 1990s.

The first thing to note is that the productivity of the industry as a whole has improved over the last 30 years. Lambing percentage has improved from 100% to 132% as a national average and carcass weights at slaughter have increased by 32% (Moot & Davison, 2021). What has not improved over the same period is the productivity of wool, this has remained relatively stagnant due to the focus of breeding improvements over the last 20 years being meat productivity (Ministry for Primary Industries, June 2019 Pg. 6). The demand for wool in our export and internal markets has also decreased over this time. This has resulted in a sharp decrease in revenue v shearing costs per stock unit from over $9 in 1990 to under $4 in 2017 (MPI, June 2019 pg. 6)

Marginal country by its nature is not substantially profitable. This can be seen by the operating margins achieved across land class 6 & 7 only over the last decade:

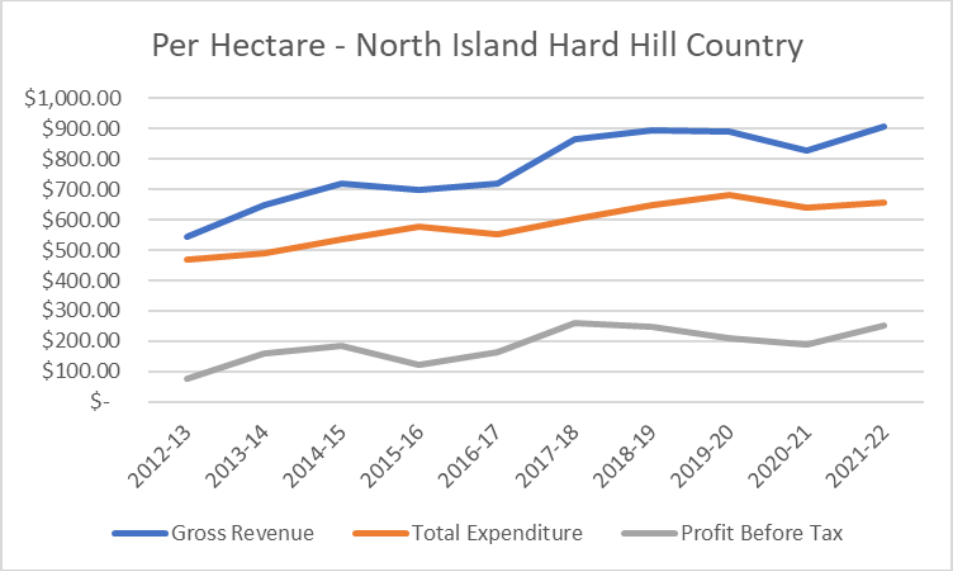

Figure 1: Average Revenue & Profit 2012-2022, (Beef & Lamb New Zealand Economic Service, March 2022)

With an average over the last decade of per hectare profit before tax at $186.40, this shows the limitations currently faced by traditional pastoral land use in the current climate.

Unfortunately, this is not currently forecast to improve significantly in the short to medium term. Export income from meat and wool is forecast to increase by only 12% between now and June 2025 (MPI, June 2022 pg. 9) while according to Stats NZ, annual inflation is running at a 32-year high of 7.3%.

Further economic pressure will be added to pastoral farming if the recommendations of He Waka Eke Noa – The Primary Sector Climate Action Partnership, are acted upon by the government. He Waka Eke Noa was formed to create a system for the reduction of carbon emissions at farm level as an alternative to entering agriculture into the ETS. The key benefits for agriculture contained in He Waka Eke Noa (May 2022) are.

- Agriculture would not be included in the ETS with the corresponding pricing concerns
- Short-lived gas emissions (Methane) and Long-Lived gas (Nitrous oxide from livestock & fertilizer and carbon dioxide from Urea) would be treated separately
- Potential discounts and ceilings on the pricing of emissions based on the cost of reduction rather than market prices

Even if we take the most conservative rates of stocking (6 su /ha), and Nitrogen application (20kg/ha yr) outlined in Hoogendorn. C Et al (2017), and the lowest proposed emission penalties outlined in He Waka Eke Noa; $0.11 per Kg of Methane, $4.25 per ton of long-lived gas this still accounts for approximately $9/ha of added cost in 2025 rising to $31.74/ha by 2030 (Ministry for the Environment, n.d). This would account for 17% of the average profit made on marginal country over the last decade.

4.1.1 Rotational Forestry as the Traditional Alternative

So, what are the alternatives for marginal land? Traditionally the answer for many parts of the country has been exotic forestry planned for harvest. Exotic forestry has been a part of the landscape in the North Island since 1897 when the Lands Department was set up and continued

under mainly government direction through the State Forest Service from 1921. From 1925 a program began to plant 121,000 acres of exotic forest and with this private companies became involved at scale due to the attractive returns from fast-growing trees such as *Pinus radiata* (Roche. M 2008)

As of 2020, there were approximately 1.7 million hectares of plantation forests in New Zealand with 1.5 million hectares of that being in *Pinus radiata* (PWC NZ, 2020). Of this total there are 850,145 hectares across the Central North Island, Hawkes Bay & the East Coast (Forest Owners Association 2021 Pg. 18). The economic benefit of production forestry comes in two parts, the value of the logs and if it is a first rotation forest planted post-1990, the carbon value that can be retained.

The value of production forest lies primarily in the value of the logs harvested at maturity, which for Pinus radiata usually occurs around years 25-30.

Table 1: Average Returns for Small Woodlots (West. G. 2019)

Variable	Total woodlot Cartage cost	All Harvest-ing (excl Roads) + transport to Port ($/t)	All Harvest-ing (excl Roads) + transport to mill ($/t)	A Grade price ($/t delivered to port gate)	Pruned log %	Total woodlot harvested Volume (t)	Volume per ha (t/ha)	Net return to grower for Total block	Net return per tonne ($/t)	Net return/ha ($/ha)	% of Revenues (non adjusted) paid to grower	Adjusted Net returns ($/ha) using June 2017 to May 2019 log prices	Adjusted Nominal annual returns ($/yr/ha)
Average	$75,918	$64.7	$51.4	$122.4	21%	7,594	562	$360,335	$43.3	$25,528	43%	$30,063	$1,156
Sample	32	80	30	68	75	188	188	210	183	215	81	215	110
Minimum	$2,130	$30.9	$29.3	$82.0	1%	255	124	$1,627	$4.6	$1,485	7%	$2,015	$56
Maximum	$815,228	$125.00	$68.20	$152.00	43%	51,269	967	$4,173,809	$104.1	$76,293	74%	$98,419	$2,941

When further analysis is carried out on the information made available in West. G 2019 to narrow the data down to the North Island regions we are focusing on in this report (Central North Island, Taranaki, Manawatu, Hawkes Bay & Wairarapa) - We get an average net return of $25,527.94 per hectare, or $911.71 per hectare per year over a 28-year cycle, almost 500% more profitable than the average profit from sheep & beef farming on hard hill country.

The future of Forestry appears to be secure with no significant reduction in forest area projected between now and 2060 (Margules Groome, August 2021) and while it does not suggest a significant increase in the land in production forest this could change depending on the value of ETS credits over the medium term.

Forests planted post-December 31, 1989, can also benefit from the carbon units created under the ETS. “When the trees are harvested, approximately 60-70% of the carbon leaves the land. The remaining carbon, tied up in the stumps, roots and slash, slowly decays away…. if the forest is replanted, the new growth from the second rotation will overtake the decay from the previous rotation and the forest will begin earning credits again” (AgMatters n.d). As such there are “low risk” credits that don’t need to be paid back to the government after harvest if the forest is replanted.

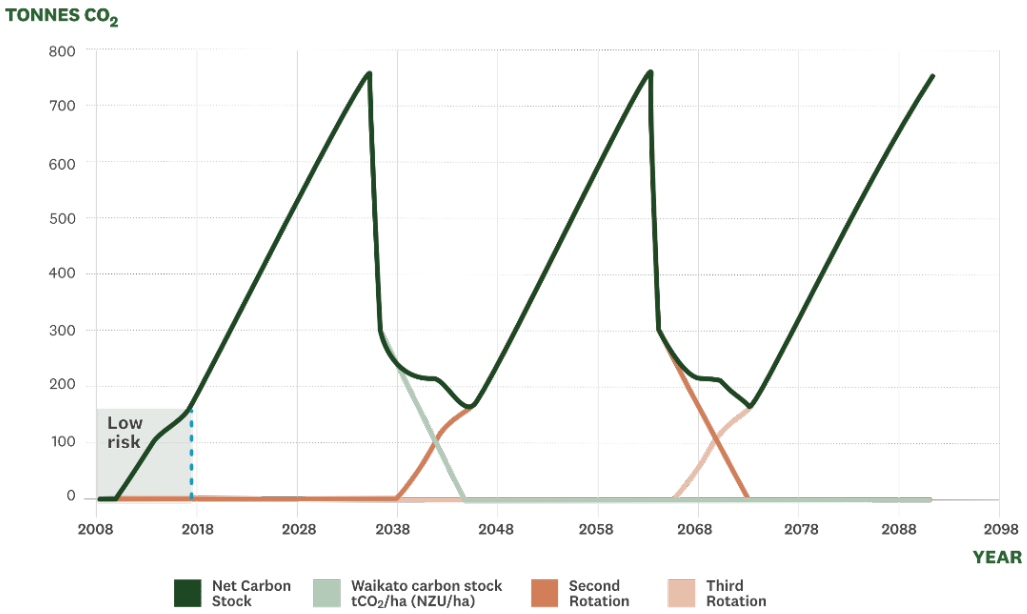

Figure 2: "low risk" carbon associated with a 28-year harvest rotation of radiata pine (Agmatters n.d)

With an assumption of 170 New Zealand units of carbon per hectare as "low risk" the forest owner can bank a further $14,569 per hectare as of September 2022's ETS auction pricing although this is only forecast to increase as the Climate Change Commission is indicating prices need to be over $138 per unit by 2030 & $250 per unit by 2050 to meet our Paris Accord obligations, and while this is not a forecast of pricing it does drive expectations (Kilsby. S, 3 Feb 2022)

4.1.2 Carbon Farming, The New Gold Rush?

An area that is expected to increase with significant impact on marginal country in the North Island is that of permanent forests for Carbon sequestration. North Island hill farms comprise about 45% of New Zealand's Sheep & Beef farming area (Woodford. K, June 2021) which equates to just under four million hectares of land. With the advent of the Emissions Trading Scheme, this land has seen a massive change in both land use and value with much of this impact being placed at the door of the advent of carbon farming.

Carbon farming is the practice of "receiving economic benefits for carbon sequestration" (Funk. J June 2009, Pg3) and for this report, I will limit the scope to the plantation of monoculture exotics to achieve this purpose as it is by far and away the largest proportion of this industry. In a practicable sense, it is the process of planting tracts of land in *Pinus Radiata* with no expectations of the harvest to allow for the "harvesting" of maximum carbon credits on a per hectare basis.

The benefits of *Radiata* for Carbon align with those for harvestable forests; it grows fast, and it grows almost anywhere. This allows it to sequester a substantial amount of carbon in a relatively short period, especially when compared to the slow-growing natives we have in New Zealand such as Beech, Kauri & Totara.

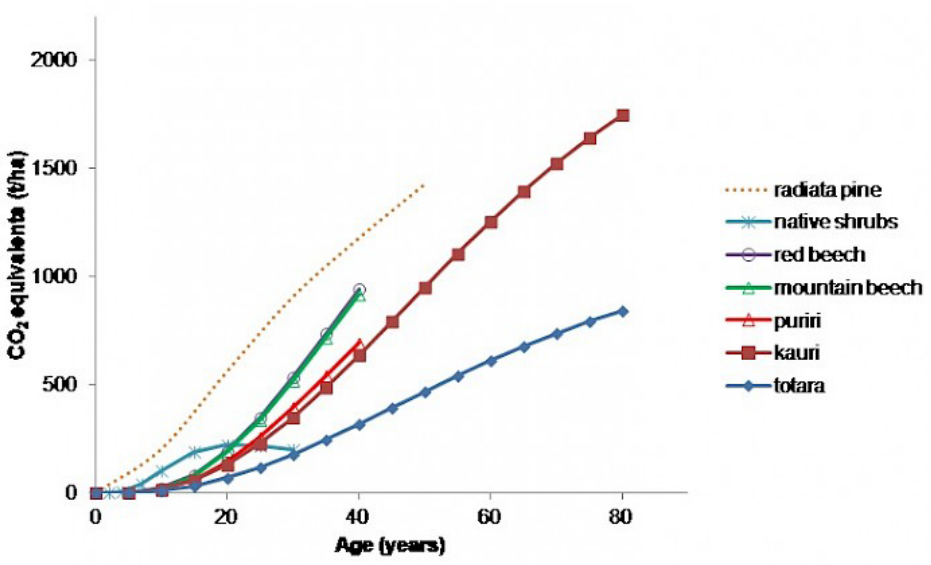

Figure 3: Comparative CO2 Sequestration rates of Radiata and NZ Native Trees, (TanesTrees.org.nz, 2014)

This is also seen in the comparative rates on the Carbon Look Up Table that supplies the actual unit allocation for several species in woodlots under 100ha. Using two figures: 28 years to align with a typical rotational forest lifespan, and 50 years as the maximum provided on the Look Up Table (MPI, 2017 pg. 39-40) we see the gaping disparity.

Table 2: Carbon Sequestration Potential per Region (MPI, 2017)

	Tonnes/Co2	
Species & Region	**28 Years**	**50 Years**
Radiata : Bay of Plenty	704	1187
Radiata : Waikato/Taupo	755	1296
Radiata : Southern North Island	797	1345
Indigenous Forest: NZ	242.2	323.4

On average Indigenous Forest provides 32.2% of the carbon sequestration of *Radiata* over 28 years and only 25% over 50 years which explains very quickly *radiata's* popularity for carbon farming purposes.

If all other factors are ignored and the focus is entirely on economics, then carbon farming on marginal country is the clear winner. Planting costs are in line with harvestable forestry at $1800 per hectare (Williams. D, Sept 2021) while also not requiring the cost of ongoing pruning and maintenance. Again, this compares very favourably against indigenous forests with a Review of Actual Forest Restoration Costs finding the average cost to plant and release native plants to be $10,360 per hectare (New Zealand Forestry Service, March 2022 pg. 8).

Against these low planting costs, the current returns for carbon farming are very compelling. Again, based on September 2022 auction pricing the 28-year income for the average carbon farm in the North Island would be $64,446 a hectare ($2,301/yr) or $109,352 ($2,187/yr) over 50 years with very little outlay for cost outside fencing maintenance. In other words, there is the possibility to return 10

times the value from carbon farming than there is from running sheep and beef in the same country. We have also seen that it outperforms the rotational forestry plus carbon option, especially in harder country where harvest is more difficult, lowering the final return for landowners (Woodford. K, Sept 2021).

This economic boon has driven the price of even marginal country up to record levels. Properties in Gisborne have sold for up to $17,000 per hectare, the King Country has achieved $14,000 and Hawkes Bay $15,000 (Woodford, K. August 2022) and Woodford goes on to say, “one of the remarkable things about carbon farming is that the returns are similar for both soft country and hard country, and largely independent of either on-farm infrastructure or distance to towns and ports.” This suggests that what is considered marginal country for sheep and beef farming is not viewed that way for carbon farming and is being priced accordingly.

The big question for carbon farming is where to over the next 30 years. As established earlier, predictions are that carbon prices will continue to rise over this period to further incentivise innovation in industry and lower carbon emissions. This is tied to the credits required globally to reach the Paris Agreement on Climate Change with its goal of limiting global warming to below two degrees, preferably to 1.5, of pre-industrial levels (United Nations, 2015, Article 2(a)). EY has forecast that internationally “scaling up credit volumes will quickly exhaust available low-cost supply, driving rapid increases in credit prices to 2035” (EY Net Zero Centre, 2022 pg. 32). They have also forecast a central price estimate of between $150-200 USD ($250 - $333 NZD) by 2050 as we can see in figure 6. Assuming that the prices for carbon units in New Zealand follow the international trend, it would suggest that carbon farming is here to stay for the foreseeable future.

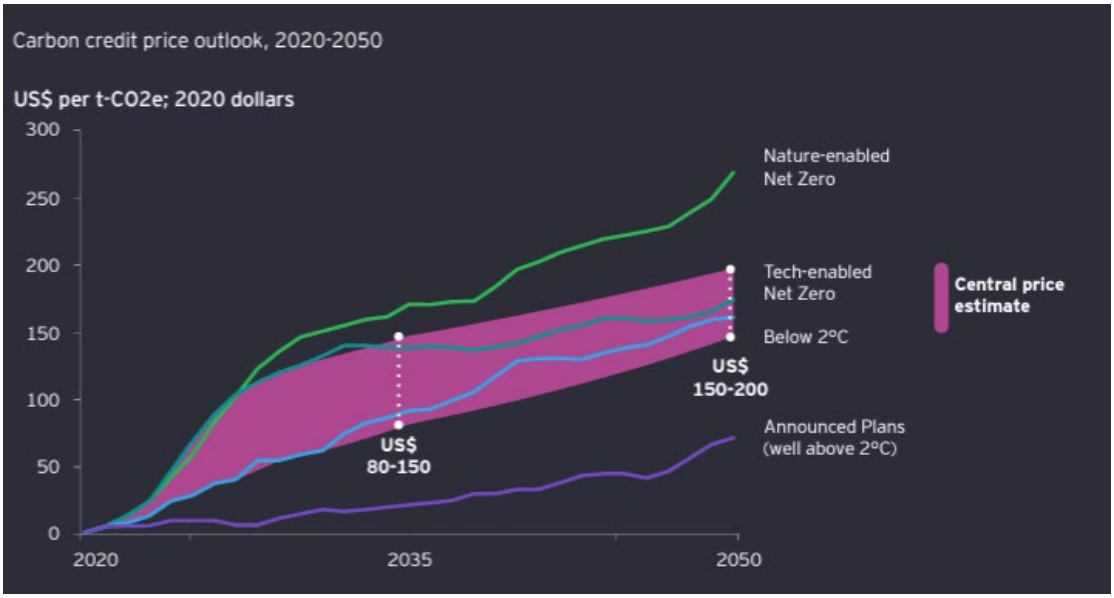

Figure 4: Carbon Price Outlook 2020-2050 (EY, 2022)

4.1.3 Manuka as a Viable Alternative

Another relative newcomer when it comes to marginal land use is Manuka plantation with the dual purpose of Manuka honey production and carbon sequestration. To understand why this is now being undertaken on a reasonable scale we first need to understand the Manuka honey industry.

Manuka Honey is recognised worldwide as a unique health food with benefits in both topical applications for wound care and general skin health as well as an oral application for throat and gut health. It has achieved prominence for this purpose, especially in the Asian and U.S markets and can now demand upwards of $1,000 per kg in retail markets. Successful marketing of Manuka honey has now created a very successful honey industry in New Zealand, with export demand driving demand. Off the back of Manuka honey and its high prices, the total value of honey exported from New Zealand has risen from $23 million in 2004 to $480 million in 2022, a nearly 2000% increase in only 18 years.

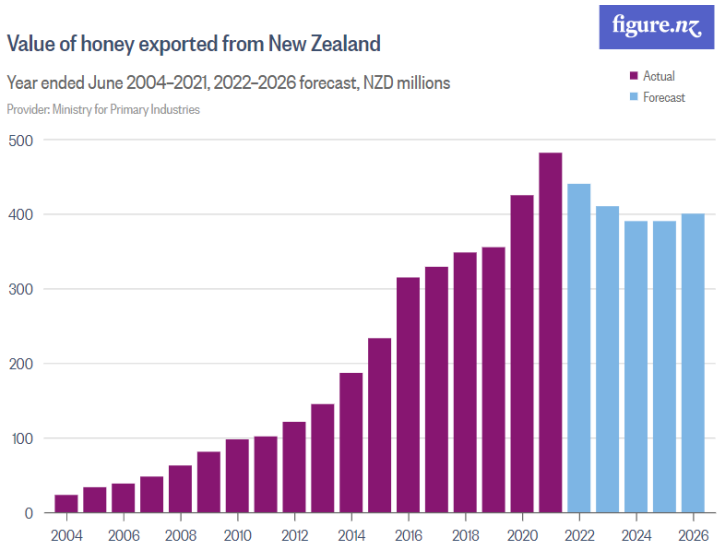

Figure 5: Change in Honey Export Value over time (Figure. NZ June 2022)

As interest in this product has grown, so has the appetite for large-scale plantations of Manuka to provide a consistent supply of the raw product. Both individuals and apiary businesses are now planting native and improved cultivars to replace a natural population that in many areas is losing its effectiveness as it ages. This now creates an opportunity for landowners with marginal country that has a propensity towards growing this scrub to stop paying to try to minimise its spread and start harnessing its economic benefit. “Ironically although we have spent many decades trying to control Manuka in our hill country pastures, now we are actively trying to grow Manuka…farmers are now planting those manuka cultivars into hill-country land” (Massey University, n.d)

Landowners do not need to be beekeepers to benefit from this industry. While Beekeepers have purchased high-performing Manuka properties the vast majority of Manuka honey in New Zealand is still harvested by beekeepers in partnership with landowning farmers or Iwi.

Wholesale prices for Manuka honey from 2014 – 2020 ranged from $4.50 - $130.00 per kg depending on the quality produced with an average per hive figure of 27.1kg per hive in the North Island (MPI, 2020). Allowing for a more common range of Manuka honey, an average price of $55/kg is consistently achievable, and an oft-used stocking rate figure is one hive per hectare. Per hive total costs are around $450 (commercial beekeeper, Personal Communication, August 18th, 2022). Using

this assumption, we can model an average per hectare income net profit of $1,040.50 ($55 x 27.1Kg-$450).

Again, from the same large-scale commercial beekeeper, we have found that agreements for large-scale properties (200 hectares of manuka +) are often modelled on a 50/50 profit share basis. This would provide a landowner a per hectare profit of $520.25 per hectare from Manuka honey, a 179% increase in profitability. Owners of marginal country can simply stop control measures of Manuka in place to allow it to regenerate and they would be achieving these figures within 5-6 years.

An alternative option would be to plant Manuka seedlings under their initiative, or partner with an apiculture business to do so. Since the Manuka honey boom began there have been several studies done on Manuka to increase performance such as the High-Performance Manuka Plantations PGP Programme carried out by the Manuka Research Partnership & Massey University. The key findings of this report (Douglas. B et al, April 2019 pg. 5-6) for a successful plantation were:

- A plantation needs to be a minimum of 100 hectares to ensure domination over other nectar sources
- The Manuka provenance must be matched with local weather and site conditions such as soil type and altitude
- An improved cultivar variety will produce nectar rich in DHA (the active ingredient) as its home location – the timing of flowering needs to be matched to local climatic conditions
- Quality seedlings should not be underestimated
- Excellent establishment, management and apiary practices are needed to ensure successful harvests

For landowners, there are currently apiary companies seeking to acquire land for this purpose and they are willing to pay to do so. $400 per hectare for five years, to cover the costs before the Manuka gets to the age it will provide a commercial crop of honey) & 50% of any carbon credit value from the Manuka is an offer currently in the marketplace with Comvita NZ Ltd per their 'Native Forest Partnership' leaflet. This is a zero-cost model for landowners with any fencing, tracking, pest control and plantation establishment and maintenance costs being the responsibility of the company.

Alternately landowners can source seed stock from nurseries and plant the land themselves. The cost to establish Manuka is between $2000-3200 per hectare with operating costs of $20-$45 per hectare a year. (Waikato Regional Council, n.d) and a contract beekeeper would be required to then provide the beehives, harvest the crop and extract the honey and would take a share of the harvest to cover their costs.

The carbon sequestration ability of Manuka is significantly less then *radiata* at 242.2 tons per ha over 28 years and 323.4 at 50 (MPI, July 2017 pg. 40) but again, at today's price this still equates to a potential per hectare income of $27,165 ($970.02/yr) over 50 years or $20,344 ($726.57/yr) over 28 providing a 421% improvement versus traditional sheep and beef farming on marginal country just for the carbon value. There is currently work being undertaken on native carbon with potential increased value in the voluntary emissions space which could increase values on a per unit basis above *radiata* so this is a space to watch.

The international honey market is forecast to grow at a rate of 5.2% per year from 2022 until 2030 increasing its total value from NZ $14.34 Billion to $22.68 Billion in that time (Grand View Research 2022). Extrapolating that growth until 2052 would have a total industry value of $65.62 billion. If Manuka honey retains market share then the market will increase from $447 million (MPI, June

2022) to $2.045 billion in value or 11,833 to 52,883 tons. To support such a huge increase in production significant Manuka plantation effort would be required. Even allowing for an increase in productivity to 50kgs/ha on plantation this would need 821,000 hectares of Manuka to harvest nectar from, a number almost impossible to reach. This would suggest that supply would be incapable of outstripping demand in the long term, supporting strong honey prices for plantations already established

4.2 Marginal Land Use Change and Its Environmental Impacts

There is more to consider with land use in marginal country than just the economics. Marginal country is this class in a large part due to environment. Steep, poor soils, prone to slippage and damage, these factors all influence the economic return on this land. As such we must also look at the current environmental pros & cons of the land use choices and the long-term impacts these can have on the land.

4.2.1 Pasture and its Environmental Impact

Pastoral farming in marginal country has certainly altered the environment. Clear felling forests for their timber and to make way for pasture was widespread in New Zealand through the late 1800 – mid 1900s most recently in the 1950s during the wool boom (MfE, Oct 1997). While not as damaging as the intensive farming of class 1-3 with its increased use of fertilizer and high stocking rates with associated runoff, the sheer scale of the marginal country under lighter management creates issues of its own. The MfE environmental report goes on to say, “because this sort of farming is often located on hilly terrain where the soils are naturally more susceptible to erosion and nutrient depletion, it has caused accelerated erosion in many areas and sedimentation of streams and rivers”.

Hill country erosion is the most obvious environmental impact, and this flows through into the freshwater impacts due to sedimentation. Hill country erosion and its effects such as loss of soil and nutrients, loss of production, and damage to houses and roads and waterways are estimated to cost New Zealand between $250 - $350 million yearly (MPI, March 2022). This impact is only increasing due to the frequency of severity of flooding and rainfall events tied to climate change.

Figure 6: Multiple slips in Manawatu following a 2004 storm (NZ Farm Forestry Association)

Significant areas of monoculture grass also have a corresponding negative effect on the biodiversity of the land itself with its lack of habitat. There is also the impact on freshwater species and water health due to runoff of chemicals and fertilizer as well as the sedimentation build-up mentioned earlier. Almost 2,500 native land-based and freshwater species are currently listed as threatened in New Zealand (MfE, Dec 2007), and it needs to be acknowledged that the worsening state of our marginal land is having an impact on that.

4.2.2 *radiata* and our Environment: the Good, the Bad & the Ugly

Rotational forestry has a serious problem of its own regarding debris control and the effects of heavy rain events on its forests. Forestry harvesting can result in large volumes of slash/harvest residue with the potential to move into rivers during high rainfall events, often resulting in significant damage downstream (Visser, R et al July 2018). This was made all too evident in a June 2018 storm which saw huge amounts of forestry waste and debris being washed from the Uawa forest down rivers and streams to the coast. This saw over 400,000 cubic metres of woody debris spread across the Uawa catchment and the coast at Tolaga bay. It also saw the prosecution of and fines of over $1 million for 5 forestry companies who had failed to follow effective management processes (Sharpe. M, August 2022)

Figure 7: Forestry debris for the Uawa forests, 2018 (Sharpe. M August 2022)

Monoculture Radiata forests also hurt the ecology of an area. These forests both harbour significant numbers of pest species such as goats, possums, hares, rabbits, and deer and deter populations of natives that require the mixed vegetation of the native forest. While invasive pests that influence seedling development are usually controlled in planted forests during the establishment stage, once the seedlings reach an age where this effect is negligible then this operation ceases for economic reasons.

In a study carried out in the Gisborne region it was found that *radiata* forests had a negative effect on populations of Kaka, Long Tailed Bats, Tomtit & Rifleman, Tui, Bellbird, Kereru, North Island Robin and Native Mistletoe, Wood Rose and Orchids (BDO Gisborne Ltd, July 2021). This is due to both the pressure from pest species such as possums and stoats, and the lack of appropriate nutrition and habitat within these forests.

Radiata is not all bad news environmentally and we also need to acknowledge this. Apart from its explained benefits in carbon sequestration, which is hugely important, it does also offer significant advantages in erosion control. This can be seen anecdotally in figure 7 where we see an area of *Radiata* forest unaffected by the slippage that is prevalent around it, and in studies around its benefits for this purpose, especially with permanent forest.

Radiata compares favourably to Douglas Fir & Poplar the two other mainstays of hill country erosion protection when their root biomass and tensile strength are compared (Knowles. L, Feb 2006). When you consider their common stem/ha stocking rate as well: Poplar is usually planted at 50 stems/ ha, Douglas Fir at 1250, and *radiata* at 1200, in a given hectare of country Radiata will stack up very well for erosion control as long as it is left in the ground.

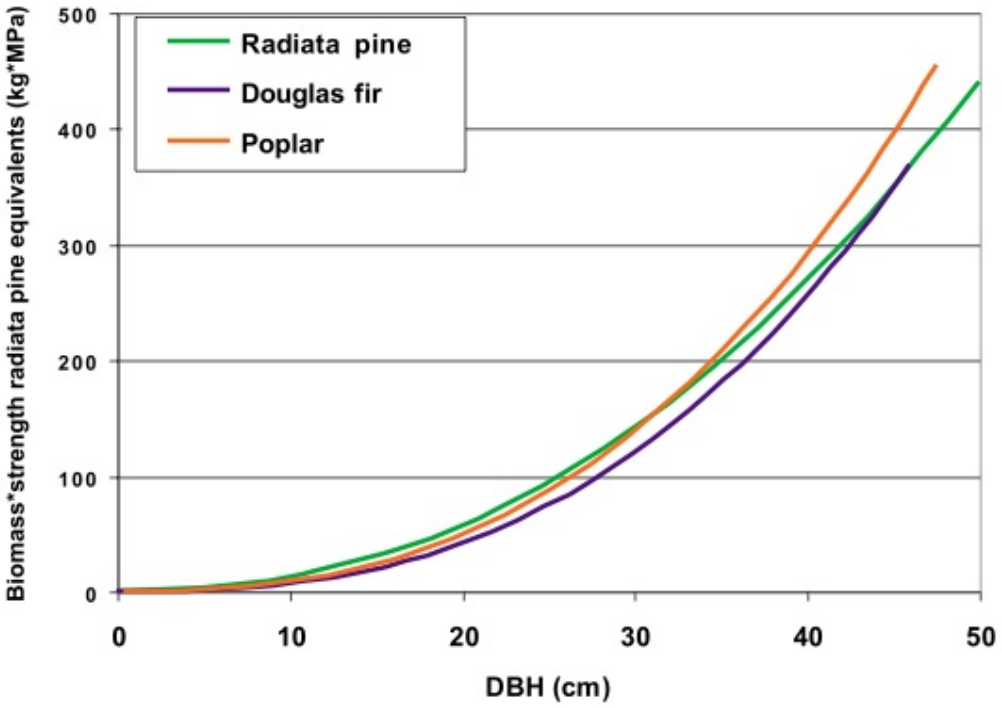

Figure 8: Root Biomass multiplied by tensile strength relative to Radiata (Knowles. L, Feb 2006)

The issue is that often Radiata is not left in the ground, and this can have consequences for rotational forestry. Knowles goes on to explain that the half-life of Radiata is 15 months once it has been harvested. This means that 30 months post-harvest the soil holding ability will be 25% of what it was prior to felling. He uses a figure of 30tonnes/ha of root biomass for effective erosion control and explains there is an 8-year gap from harvest until the next rotation will have sufficient biomass to pass this figure. Using our 28-year rotation figure would suggest that over a third of the forest's life is not achieving suitable erosion control, a matter of concern when we consider the amount of land currently under this regime.

4.2.3 Manuka as the Native Solution

Being the native choice, Manuka is probably considered the most environmentally friendly option and when the information is considered this appears to be borne out. Manuka has several benefits, the most telling being its support role as a nursery crop for slow-growing native hardwoods, its ability to improve water quality, and its low-impact erosion protection.

Manuka is considered a colonising species in that it "functions as an intermediate stage in the reforestation of bare land. As they grow larger, Manuka and Kanuka provide canopy cover which helps to prevent invasive weeds from growing and creates a safer environment for our slower growing native plants such as Rimu, Totara, Kauri, Puriri and Kowhai to flourish" (Manukaessentials.com, n.d). While this means that without ongoing management Manuka plantation has a limited lifespan from a honey production point of view (35-50 years), it does mean that planting marginal land in Manuka will eventually revert to the canopy cover nature intended it to have.

The restoration of Manuka especially along waterways and riparian strips is also of value to the environment. Nutrients (nitrogen and phosphates in particular), sediment and pathogens via livestock waste are having very detrimental effects on our rivers and lakes. In a report by the Ministry for the Environment, our freshwater (2017), it was found that:

- Half of the river sites monitored in the past two decades have increased their nitrogen content
- Only 34% of the lakes monitored are in a good state
- Compared to rivers running through native ecosystems our rural waterways have levels of E-Coli 10 to 20 times higher
- As a result, 72% of native fish, 34% of native invertebrates & 31% of aquatic native plants are threatened with or at risk of extinction

Manuka has proven to be a very competent filter in helping alleviate the effects of this runoff into our water system and can significantly change the nitrogen system. The total amount of nitrate leached under Manuka is just one-third of that under pasture, when urea is added to the soil it is 25 times less than under *Radiata*. (Gines. M et al, Dec 2017)

Manuka has also been successful in erosion control, especially in the steep marginal country of the North Island. Manuka establishes roots to a depth of 0.5 – 1m and when planted or propagated at rates of above 1200 stems/ha it provides an average of 25tonnes/ha of root biomass. While this number is lower than the 30 tonne/ha of *Radiata* it provides superior slippage control due to the weight of the canopy being magnitudes lighter and the tensile strength of the root itself is higher in Manuka (Watson. A & O'Loughlin. C, Nov 1985)

4.3 Land Use Change – Our Rural Communities' Future

The changes to marginal country aren't just confined to the land itself. It also greatly impacts how rural communities in these areas are made up, and some would suggest threatening their survival and way of life through loss of employment opportunities and environmental shifts. We also need to consider how the current predominant land use, as well as the changes, are viewed in the context of te ao Māori.

4.3.1 Land Use Change and its Impact on Rural Communities

The main concern raised by opponents to land change is around the loss of employment associated with land going out of grazing and into trees, and the loss of opportunity for support industries in the region such as contractors, mechanics, fertilizer companies etc. The loss of these jobs and people out of the area is having a flow on effect to communities with rural school roles and a general feeling of camaraderie with the neighbours now having less staff due to land use change, or out of the area altogether having sold up to foresters. The truth (or not) of this concept is more nuanced and has been the subject of a PWC report 'Economic Impact of Forestry in New Zealand' where they look at both the direct and indirect impact of forestry vs sheep and beef farming.

When we look at the economic impacts of forestry and sheep and beef value chains the numbers appear to be quite stark. Forestry currently provides $7.93b through its value chain and supports 64,889 full-time equivalent roles (FTEs), while Sheep and Beef contribute $12.78b and has 124,500 FTE associated with its value chain. (BDO, May 2020, Table 1 Pg 5). This would suggest that Sheep and Beef farming is significantly more beneficial for rural communities than forestry. However, when viewed on a per 1000 basis this changes the equation drastically.

	Direct	Indirect	Induced	Total
Forestry value chain				
Value-add ($m)	1.7	1.8	1.1	4.6
FTEs	11	18	9	38
Sheep and beef value chain				
Value-add ($m)	0.7	0.6	0.5	1.7
FTEs	7	6	4	17

Note: There may be small discrepancies due to rounding

Table 3: Annual Economic impacts – Forestry and Sheep and Beef per 1000ha (PWC, May 2020 Pg5)

When viewed on a like-for-like basis Forestry adds over 2.5 times more dollars of value and twice the FTEs per hectare as sheep and beef. This data is however the key piece of information about where these jobs are based. While shepherd and farm worker roles are in the community, it is fair to assume that a lot of forestry worker roles are not. It also needs to be broken down into rotational forest and permanent forestry categories to see the full picture, especially as over the next 30 years the vast majority of land use change in the marginal country under discussion will be for permanent forestry.

	Plantation forestry	Permanent carbon forestry	Sheep and beef farming	Plantation forestry integrated into sheep and beef farming	Permanent carbon forestry integrated into sheep and beef farming
Value-add ($m)	4.6	0.8	1.7	2.2	1.8
FTE	38	2	17	20	17

Note: There may be small discrepancies due to rounding

Table 4: Annual total value chain economic impacts per 1,000ha – by land use (PWC, May 2020 pg7)

Here the true picture begins to emerge, and we see why lobby groups such as 50 Shades of Green are seeing support in our rural communities. Permanent forestry contributes 15 fewer jobs per 1000 hectares than sheep and beef farming. When we look at the actual effects this is having in communities that are predominately located in marginal country in the North Island, we see that the largest permanent forestry company in New Zealand, NZ Carbon Farming, has potentially removed 1,500 jobs from these communities with its 100,000 hectares of forest planted according to its website.

Some forecasts suggest that there will need to be a total of around 1.5 million hectares of new planting between 2020 – 2050 to ensure that New Zealand meets its carbon targets (Vivid Economics, July 2018 pg. 24). Making a generous assumption that only 50% of this occurred as stand-alone permanent forestry this would mean the loss of 22,500 jobs (or 18% of the current FTEs) in the sheep and beef value chain, the majority of these being 'coal face' positions on-farm and in our rural communities.

Manuka forest establishment is an area with little or no research available around its impacts on employment in rural communities source?. Most beekeeping operations, and certainly those of scale enough to be pursuing large-scale forest establishment, are often based near population centres to provide a larger labour pool of beekeepers. It can be surmised that they would require the same amount of employment for the establishment, although tracking and fencing work would be more

than permanent forestry as the forest requires constant access to manage the hives. Pest Control activity is also carried out for a longer period of 3-5 years.

Longer term there could be options for local employment for management of the forest if selective thinning or replanting is carried out. Also, on a per 1000-hectare basis this would require 3 FTE beekeepers to service so I suspect the impact would be less than that of permanent forestry but not by a significant amount.

4.3.2 Marginal Land in the Context of te ao Māori

'Te toto o te Tangata, he kai, te oranga o te Tangata, he whenua', While food provides the blood in our veins, our health is drawn from the land. Iwi has a very special relationship with the land all over New Zealand. As a group Māori are the second largest landowning behind the government/crown with 10,214,912 hectares on the north island alone (Kingi. T, n.d pg. 132). Due to colonisation and the sale or confiscation of the most fertile land during the 1800s, Māori are also overrepresented as the holders of marginal land on the North Island.

Māori's relationship with land ownership differs greatly than the majority of European New Zealanders with it held in collective ownership pre-Treaty of Waitangi in 1840. At this stage, Māori land was brought under the land court and acts such as the Māori Land Court Act, New Zealand Settlements Act and Native Land Act broke the customary areas that remained in Māori ownership into titled blocks with ownership reverting to a share basis along iwi or hapu lines (Kingi. T, Pg 137).

Private sale of these parcels of land is almost impossible due to the requirement that unless the purchaser has affiliations with the titleholders then 75 of the shareholders and the Māori Land Court must approve the transfer. Financing using the property as collateral is also very difficult as all owners must act together to make this possible, Kingi goes on to point out that with an average size of 59 hectares and 73 shareholders, achieving consensus can be extremely difficult.

The result of this is Māori are left as owners of a significant amount of marginal land with poor prospects for utilisation, little chance of raising capital to make improvements and trying to balance Kaitiakitanga and multi-generational thinking with making it economically viable.

This tension has best been exhibited in the reaction of some parts of Maoridom to the proposed changes to the Emissions Trading Scheme excluding exotic forests moving forward. While most agree that native forests are, environmentally and culturally, the most suitable choice it is also very clear that removing the opportunity for landowners to plant exotic forests for carbon benefit disproportionally affect Māori who has much fewer land use options than their European counterparts.

In the Stuff.co.nz article 'Why the pine tree might land the government in court' these two sides are put to paper. Te Kapunga Dewes – Chief Executive of forestry and horticulture organisation Whenua Oho and chair of Nga Pou a Tane said "The is going to have a huge economic and social impact for Māori landowners…there's a huge gap between the economics of pine and natives, its an order of magnitude" (Wanna. O, May 2022). She further quotes Scion native forestry expert Ramona Radford, "When the crown is making a decision about native afforestation, they cannot make that decision on their own…. when you disturb the possession, you severe future generations from the full enjoyment, expression, understand and rights to be kaitiaki of the forest". Land researcher for Hikurangi Enterprises Manu Caddie also points out that "article two (of the treaty) in protecting taonga (In the form of native trees) that are not allowed to regenerate because pine have been incentivised to take over land that could otherwise have those taonga that are protected, and that Māori have the right to protect" (McCaull. A, August 2022)

Manuka honey has been a boon for Māori landowners over the last decade as large parts of their land have been historically underutilised which has resulted in large amounts of Manuka growth. This has seen Māori setting up successful apiary businesses such as Kai Ora honey and the purchase of one of the largest Manuka exporters in the country Watson & Son's but Ngai Tahu in 2016. Manuka ties into Kaitiakitanga through the environmental benefits discussed earlier in this report plus the fact that Māori have utilized Manuka for health benefits long before the honey industry took off. Its light touch on the land and the employment opportunities available through beekeeping as well as potential economic value make it a more attractive proposition to Māori than grazing leases.

'Whatungarongaro te tangata toitu te whenua', as man disappears from sight, the land remains.

5.0 Findings & Discussion

This research report has provided analysis of both pastoral farming on marginal country and the various afforestation options. The economic reality of these land use options, their environmental impacts and the cultural considerations have been analysed through comparative analysis of available literature on these topics. The key findings of this report are summarised below.

The indicative results of the report support the hypothesis that traditional pastoral farming in this marginal country no longer stacks up economically against traditional rotational forestry, carbon forestry and to a lesser extent Manuka Forest intended for honey production & carbon benefit. And that to make the most of this country in both an economic and environmental sense landowners will have to adapt to this new reality and diversify to some degree.

The economic variation was expected but not to the extent that was found. It was surprising in the first instance to see just how marginal this land is from an economic point of view, with a sub $190 per hectare of profit for traditional pastoral farming confirming the premise that there must be a better use for this land type. If we compare that result against even the next two land classes 4 & 5 the profit margin is only 57% of what this land has achieved over the last 10 years (Beef & Lamb, 2020). The information available about financial results was of impressive scope and availability especially that provided by surveys completed by Beef & Lamb New Zealand's members, and it shows that the industry does have a firm understanding of the knife edge they are balancing on with marginal country farming. It helps explain why afforestation options are being adopted at a quickening rate, and why every farm of this type needs to be including afforestation options from a financial perspective.

The difference in the potential economic gains was an interesting output of this report and should provide both landowners and foresters with some food for thought. Pastoral farming on marginal land is financially outperformed by rotational forestry by 657% (West. G, 2019), carbon forestry by 974% (Woodford. K, 2021), and even Manuka forestry by 346% when considering both production and carbon benefit. One might assume the only impediment for landowners to implement these changes would be the capital outlay required for plantation and maintenance but in all cases, there are partnership options with zero outlay options and returns that still dwarf what can be achieved by grazing. The real question that I am left with after reviewing these details is how New Zealand will manage to retain enough land for food production as even finishing farms cannot come close to the possible revenue of afforestation. Even these farms, the best of our grazing country have only managed an average of $542 ha profit over the last three years (Beef & Lamb, 2020).

As an interesting aside, the findings would also suggest that traditional rotational forestry might be in for a tough time over the next decade. The competition for land from permanent forestry interests will be stiff and the lower impact of permanent forestry will appeal to a wide range of landowners.

From an environmental standpoint, I think it is generally agreed that grass and animals are not the best answer for marginal country with their steep slopes and poor soils (MPI, 2022) when we compare it to the alternatives of afforestation especially Manuka evolving into native forest (Gines. M et al, Dec 2017) & (Watson. A & O'Loughlin. C, Nov 1985). It is responsible for significant erosion of marginal land that comes with an impact on profitability due to maintenance issues on tracking and fencing, as well as being a major contributor to freshwater quality issues due to nitrogen and phosphate leeching as well as sediment build-up due to the aforementioned erosion. Pasture also does not support biodiversity due to its monoculture nature not being suitable for the majority of the North Island's native species.

This was confirmed with the review of literature that supports afforestation as a solution to hill country erosion and poor water quality. The analysis shows that Manuka offers the best results from a biodiversity and water quality aspect as well as very good erosion control if planted at a sufficient stem per hectare rate. The big benefit of Manuka over radiata is its behaviour as a colonising species, acting as a nursery for slow-growing tall tree natives such as Totara and Kauri (MfE & Stats NZ, 2017). Manuka also acts as a very competent filter around waterways regarding nitrates, significantly outperforming pasture and also radiata in some circumstances (Gines. M et al, Dec 2017)

Radiata has its pros and cons as expected. In rotational form, it causes serious issues with waste products if not managed, as seen in the East Coast floods of 2018, and it also has a lag period of eight years from planting until it performs suitably for erosion control. It has also been found to have negative effects on biodiversity as shown in BDO's report where Radiata forest had negative effects on 11 native species of flora and fauna (BDO, July 2021).

While permanent *radiata* forest has better characteristics for erosion control due to their permanent nature and lack of logging-waste products, their effects on biodiversity are the same. Also, *radiata* has an expected life of 80-90 years (Wollens, R.C & Manley. B, Nov 2011), while native species such as Kauri and totara have a lifespan of over 1000 years. (Wassilleff. M, Sept 2022). Where this leaves the country in 100 years is a question that needs further exploration. With another 1.5 million ha of planting potentially required (Vivid Economics, July 2018) there is the very real risk that we could end up with a landscape of dead and dying forests with associated fire and environmental concerns but no economic way to harvest due to their nature of planting and the carbon value now locked up in them. However, we also must acknowledge the ability of radiata to support New Zealand's drive towards Carbon neutrality due to its fast-growing characteristics and accept that with the climate change we are seeing and forecasting to see that this is a necessity.

Carbon is a theme that has woven itself throughout this report from both an economic and environmental aspect. And in actuality through the popular literature, it is the common theme that drives the profitability of afforestation, and therefore is most responsible for the land use change we are seeing in marginal country and is likely to continue to do so if the projections this report as referenced hold to be true. While the reality of this might be concerning and uncomfortable for those farming the North Island's marginal country traditionally, the research shows that there are huge benefits both financially and environmentally to adaptation, and I would recommend this be explored by any landowner of marginal land who reads this report.

We have also explored the facts behind the rallying cry of those opposed to afforestation that it is destroying the social fabric and culture of our rural communities servicing this marginal land through the removal of opportunity. In some instances, this has proven to not be the case, with rotational forestry providing twice the FTE's per a given hectarage than grazing and permanent forest integrated into grazing not effecting FTE numbers at all (PWC, May 2020), although this certainly is a valid point when we look at stand alone permanent forestry as again shown in PWC's report.

What we failed to find, and what is a hole in the research we have gathered for this report, is where exactly these jobs are located. Replacing one job on-farm that then takes two kids out of the rural school and replacing it with four jobs in the nearest provincial town is potentially not seen as a positive by our rural communities. While it is an economic benefit to the country, it is also depopulating areas and leaving those left behind even more isolated.

The stand-out land use that is contrary to this pattern was permanent forestry and the potential opportunity loss for large areas of land being converted into this. The management of these forests post establishment has been found to be effectively nil, and this is supported by the PWC reports findings that as a stand-alone operation it contributes only 11% of the FTE that grazing does. This is a huge variation and raises questions about the actual economic benefit and where this ends up. Does it benefit our rural communities when wealth creation is removed from 89% of the population and concentrated in the hands of landowners or corporate interests? It is interesting to see that permanent forestry integrated with sheep and beef provides 18% more FTE than sheep and beef alone (PWC, May 2020), and I would suggest this should be the preferred method of plantation.

We also researched the perspective of Māori on the changing landscape of our marginal land, as per Te Tiriti o Waitangi we are required to do when considering our environment in New Zealand. The results on the surface were somewhat surprising as one could assume that Maoridom as a whole would be against the wholesale plantation of exotic trees in this country. This however is not the case with divergent opinions expressed throughout the literature as seen in the differing quotes in the stuff.co.nz article referenced (Wannan. O, May 2022).

Once explored, the reason for this became abundantly clear, Māori in many cases simply do not have another choice. Through historical injustices and marginalisation, the land that many Māori are left as owners of is just not suitable for other more productive uses. This has left Māori in the unenviable position of choosing between economic progression and the benefits for their landowners this provides (as many are doing throughout the North Island) and holding true to their role as Kaitiakitanga and foregoing this economic advancement.

This is the crux of the report for not just Māori. Do landowners pursue economic advancement and turn away from what we have already done, or stick to the tried and true and continue to hope for the best? Hopefully, the research carried out in this report assists in helping make that decision and supports the requirement for innovation to continue the optimization of our marginal land.

My conclusions that have resulted from the research I have undertaken on this topic are as follows:

- There is a very clear case that from an economic standpoint, afforestation in all its forms is a more profitable alternative to grazing on marginal country in the North Island regions explored, with permanent forestry forecast to far outstrip the alternatives over the next 30 years
- Environmentally Manuka plantation reverting to native forest over time is the clear front runner. Both rotation and permanent forestry have their downsides from a biodiversity perspective and concern about long-term impact but this is no different than what we

currently have with monoculture pasture for grazing on the same land. *Radiata* forestry does offer the benefit of erosion control that pasture does not.

- While afforestation of land does affect opportunity in rural communities it does offer significant economic benefits for the country as a whole. While Rotational forestry does provide a substantial increase in FTE roles over traditional grazing, the location of these roles is unlikely to benefit all rural communities that experience afforestation growth.
- There is no current incentive for pursuing large-scale native planting even though environmentally this is the superior option. The opportunity to plant any land class in fast-growing exotics has such a huge economic advantage that this is unlikely to change.
- Afforestationon is not an all-or-nothing proposition. There is a significant opportunity for landowners of marginal country to incorporate the practice in any or varied form into their current operation and achieve a superior outcome economically and for the environment. This path needs to be encouraged and supported by the central government with support for those choosing the native path as well as easing entry into the ETS for individuals.

6.0 Recommendations

As a result of the findings in this research, the following actions are recommended.

- ✓ Central and local government need to support the establishment of native forests with the benefits that they entail, significant subsidies need to be put in place to incentivise this form of afforestation

- ✓ Government support of permanent exotic forestry via subsidies and entry into the ETS needs to be limited to class 6 & 7 land only, and proper site analysis undertaken to ensure soil types and contour is suitable for this purpose to slow the change of productive land from pasture into permanent forests

- ✓ MPI should increase the threshold for land that is registerable under the MPI lookup table to a minimum of 200ha to streamline the process and minimise the cost for landowners looking to establish forestry on class 6 & 7 land

- ✓ Landowners on marginal land need to isolate and establish accurate profitability information regarding their class 6 & 7 land and confirm a baseline, then environmental and cultural considerations need to be carried out by the landowner. This will help in establishing the best option for them

- ✓ Investigation into potential afforestation options needs to occur on a case-by-case basis via communication with commercial rotational, permanent and Manuka forestry providers. Afforestation of marginal country is in most cases the most sensible outcome in any of its current forms, landowners need to establish what options are available in their circumstance and establish a cost/benefit model for each of these.

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