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PROGRAMME

The Impact of Exotic Carbon Forestry on Rural Aotearoa New Zealand

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Craig Fellowes

I wish to thank the Kellogg Programme Investing Partners for their continued support.

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1 Executive Summary

"We are not anti-forestry - exotic plantings can be integrated where appropriate – but it is about planting the right tree in the right place" (Sam McIvor B+LNZ Chief Executive, 2021).

With Aotearoa New Zealand's commitment to the Paris Agreement of a reduction in emissions to net zero by 2050 the practice of planting faster growing, quicker carbon sequestering trees (Pinus radiata) has boomed. The continued rise in the Aotearoa New Zealand Units (NZUs) price and Government's lack of regulations around permanent exotic carbon forestry have further contributed to planting more exotic forests on productive land where previously the land value would have been too high to be considered for forestry. The new permanent forestry category will be added to the New Zealand Emissions Trading Scheme (NZ ETS) on the 1st of January 2023. This applies to both exotic and native forests that will not be clear-felled for fifty years. Forests must be planted post-1989 to qualify, any trees planted or established pre-1989 do not qualify for entry into the NZ ETS.

Aotearoa New Zealand's land area is 26.8 million hectares of which 8 million hectares is native and indigenous forests and 2.1 million hectares are exotic forests, mainly Pinus radiata. Only 333,000 hectares of post-1989 plantings are registered into the NZ ETS, leaving a vast portion of pre-1989 forests excluded from the NZ ETS, all of which are still holding and continuing to sequester carbon.

Key findings of the research around the potential effects of exotic carbon forestry on rural Aotearoa New Zealand are as follows:

- As the NZU price rises (currently $77) stockholders will be able to out-compete farmers for productive farmland sales.
- Returns on investment for permanent exotic forests far outweigh relative competing land uses and native trees.
- Large-scale permanent exotic forests would allow Aotearoa New Zealand to meet their emissions targets and at a lower direct economic cost.
- To reach our 2050 goal, the area needed for planting exotic trees would be less than if native trees were planted.
- Higher economic returns due to the faster sequestration rate of exotic trees.
- Higher economic returns on marginal to steep land compared to traditional farming in these areas.
- Long-term damage to the biodiversity and ecology of the land.
- Increased pest burden, risk of wildfires and spread of wilding pines.
- Direct financial impact through job losses on farms and indirect financial impacts on rural towns and businesses.

- The short-term fix of planting permanent exotic forestry will become a long-term problem for future generations.

Key recommendations from this research are as follows:

- Government should be encouraging industry to reduce emissions rather than taking the easy option of offsetting them.
- MPI allowing pre-1989 native forests and natural carbon sinks (Fiordland) into the NZ ETS.
- Research into alternative ways to sequester carbon such as the use of our oceans and seaweed to sequester carbon.
- Power companies should be increasing investment into alternative power sources such as wind turbines, building more hydro lakes and harnessing geothermal energy.
- The Ministry for the Environment and local councils encouraging partial farm plantings which will improve profitability on marginal land and will have environmental benefits on-farm if waterways and marshy areas are locked up and left in native plants.

2 Acknowledgements

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Thank you to Dr Patrick Aldwell for all your time and knowledge sharing on how to write reports. Dr Scott Champion for your leadership, time, and facilitation throughout the course. Lisa Rogers and Annie Chant thank you for all the organising you have done for us around the venues, accommodation, and PG Cert registration and Chris Parsons for your continued support of the Rural Leaders Program.

Thank you to my family and in particular my wife Jen for your support and encouragement throughout the last six months.

To Cohort 46 thank you for making this an enjoyable experience. I wish you all the best in your respective futures.

3 Introduction

A vast majority of the rhetoric surrounding planting exotic trees, in particular Pinus radiata, for permanent carbon forests has cast a negative light on this practice. Headlines such as
"The Unpopular Tree Sucking Carbon from Our Air", or "The Burning Irony of our Climate Fix", are all casting a negative light around permanent exotic carbon forestry.

Been a dairy farmer from North Otago the impact of permanent exotic carbon forestry has had very little if any impact on me so why would I choose this topic as my research report topic. The answer is because it involves rural Aotearoa New Zealand and the impact of productive land been lost to trees. My concern is that as the NZU price rises so will the demand for land required to plant these forests which will in turn drive the sale of whole farm conversions to permanent exotic forests. The impact of the sale of sheep and beef farms up the valley will soon filter down to us. How would this impact our rural communities and towns? What is the knock-on effect?

In my research I considered both sides of the debate and tried to remain unbiased. I wanted to understand who the winners and losers are. Have we put in place a short-term fix without considering the long-term impact? What will be the legacy we leave our grandchildren? There can be no debating that we need to do something, but the question remains, has Aotearoa New Zealand rushed into fixing a problem but naively created a far greater one?

A key part of my research was to gain a better understanding of our commitments, (Paris Agreement) regulations, (or lack thereof), legislation around the NZ ETS, and how the NZU market works. This has given me a framework as to why the establishment of permanent exotic carbon forests have seen a boom.

It was also important for me to establish the difference between whole farm planting of trees and partial farm planting. These two different practices despite achieving the same end goal, differ vastly on their impacts on rural Aotearoa New Zealand.

4 Background

4.1 Aotearoa New Zealand's Climate Change Obligations

The below section provides an overview of Aotearoa New Zealand's protracted response to climate change which first began in 1990 triggered by a report from the United Nations Intergovernmental Panel on Climate Change (IPCC). The Labour

Government of the time released a climate change response strategy which set a target of a 20 per cent reduction in the 1990 carbon dioxide emissions by 2005. In 1994, Aotearoa New Zealand was one of 197 nations to sign and ratify the United Nations Framework Convention on Climate Change, however the realization that more stringent measures were required prompted the development of a subsidiary agreement which was negotiated in 1997 and then ratified in 2002. This agreement, known as the Kyoto Protocol, meant that Aotearoa New Zealand was required to reduce its net greenhouse gas emissions (GHG) to 1990 levels by 2012 (Knight, 2018). To further strengthen and accelerate the progress, parties to the United Nations Convention reached agreement in 2015 and in 2016 ratified the Paris Agreement which saw a commitment by Aotearoa New Zealand to reducing the country's net GHG emissions to 11 percent below 1990 levels and to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels (MfE, 2021).

The purpose of the Paris Agreement is to:

- keep the global temperature well below 2 degrees Celsius above pre-industrial levels, while pursuing efforts to limit the temperature increase to 1.5 degrees Celsius
- strengthen the ability of countries to deal with the impacts of climate change
- make sure that financial flows support the development of low-carbon and climate-resilient economies.

By ratifying the agreement Aotearoa New Zealand has committed to having an emissions reduction target and regularly updating it.

According to Ministry for the Environment (2018), ratification also commits Aotearoa New Zealand to:

- continue to regularly report on our emissions and how we are tracking towards meeting our target
- continue to provide financial support to assist developing countries mitigation and adaptation efforts
- plan for adaptation

Aotearoa New Zealand has since made a further amendment to the Act. The Climate Change Response (Zero Carbon) Amendment Act 2019 (MfE, 2021).

The changes do four key things:

- set a new domestic greenhouse gas emissions reduction target for Aotearoa New Zealand to:
    - reduce net emissions of all greenhouse gases (except biogenic methane) to zero by 2050

    - reduce emissions of biogenic methane to 24 – 47 percent below 2017 levels by 2050, including to 10 percent below 2017 levels by 2030
- establish a system of emissions budgets to act as steppingstones towards the long-term target
- require the Government to develop and implement policies for climate change adaptation and mitigation
- establish a new independent Climate Change Commission to provide expert advice and monitoring to help keep successive governments on track to meeting long term goals.

This gives us an outline of what Aotearoa New Zealand's commitments are.

4.2 The Emissions Trading Scheme in NZ

With the National Party coming into power in late 1990s saw Simon Upton being appointed Minister for the Environment. Despite an earlier failed attempt in 1994 to introduce a low-level carbon charge, Upton set up a public and private sector policy working group which several years later went on to publish a set of recommendations, central to which was an emissions trading scheme (ETS). Pressure from industry at the time resulted in the government holding off on any decision-making on the proposed ETS ahead of the climate change negotiations in Kyoto Japan. In 2001, the concept of a carbon charge was again reconsidered under Helen Clark's Labour Government. Once again this saw strong opposition from industry. The commissioning of a report by the Greenhouse Policy Coalition suggesting the charge would reduce the national gross domestic product by $1 billion resulted in a further postponement of the introduction of a carbon charge. Under the Climate Change Response Act, enacted in 2002, a national inventory agency was established to facilitate the recording of greenhouse gas emissions. In late 2006 an emissions trading scheme gained favour over a carbon tax and following a year of development under the then Minster of Climate Change David Parker, was introduced and designed in such a way that would see it operating within the Kyoto Protocol emission credit market and eventually covering greenhouse gases across all sectors of the economy including agriculture, a world first. Forestry was the first sector to be introduced in 2008 whilst agriculture was later delayed indefinitely (Knight, 2018).

Between 2008 and mid-2015, the New Zealand Emissions Trading Scheme (NZ ETS) operated within the international Kyoto Protocol cap as opposed to within a cap on domestic emissions (Leining & Kerr, 2016).

Pricing GHG emissions has been for over a decade been thought to be an important tool with which to mitigate climate change. According to Leining & Kerr (2016, p. 2), "an ETS transforms a regulatory limit on emissions into an emission price

set by the marketplace, enabling and creating economic incentives for producers, consumers, and investors to choose lower-emission alternatives".

4.3 Carbon Forestry in Aotearoa New Zealand

In 2009 the first forest carbon transactions took place following the enactment of NZ Emissions Trading Scheme (NZ ETS) legislation in 2008. Carbon sequestration is the natural process by which growing plants remove carbon dioxide from the atmosphere and store it in their tissues. Each unit of sequestered carbon dioxide credits a corresponding unit of emissions elsewhere, making carbon forestry through carbon sequestration an effective means of avoiding emissions of greenhouse gases. According to the NZ Agricultural Greenhouse Gas Research Centre (2021), to qualify for the NZ ETS, forests must be:

- established post-1989
- 30 metres in width
- 5 metres in height
- 30 per cent average cover per hectare
- contain eligible species

5 Aims and Objectives

The aim of my project is to find out more about the impact of exotic carbon forestry on rural Aotearoa New Zealand focusing on the below topics.

- Fire risk
- Pest risk
- Impact on food production
- Impact on jobs
- Land use change
- Pinus radiata vs natives
- Profitability of carbon forestry vs farming
- Māori owned land

My objective is to provide an unbiased report on the subject. The desired outcome is to determine if rural Aotearoa New Zealand is under threat from exotic carbon forestry and if so, what can be suggested to nullify this. Doing nothing is not an option.

6 Methodology

The methodology used in writing this report was a literature review of relevant documentation, including newspaper articles, journals, reports, and Aotearoa New Zealand legislation surrounding permanent exotic forestry in Aotearoa New Zealand. The main research was done around factors I believe will impact rural

Aotearoa New Zealand in the years to come. I have attempted through an extensive review of the literature available to gain a knowledge of potential pitfalls and wins from permanent exotic carbon forestry. All findings and recommendations were deduced from these sources.

7 Literature Review

To better understand the positives and negatives around permanent exotic carbon forestry the following topics have been researched and analysed to give a clear view of the subject of this project.

7.1 The Risk of Wildfires

According to a report by BDO Gisborne Limited commissioned by the Tairāwhiti Economic Action Plan (TEAP) Operations Group (2021, p. 38),

> The National Policy Statement for Plantation Forests currently does not address fire or non-harvest plantations. In the absence of adequate fire risk mitigation, the costs of fire risk management potentially fall on the wider community including, FENZ, forest neighbours and the environment.

According to the National Institute of Water and Atmospheric Research (NIWA), 2021 was the warmest year on record with temperatures 1 degree Celcuis above the 1981 – 2010 average.

Based on findings included in the IPCC 5th Assessment report, NIWA is predicting increases in mean summer and winter temperatures by the end of the 21st and increases in wind speeds of up to 10 per cent over Coastal Canterbury and Otago (NIWA, n.d.). These predicted changes are illustrated in figures 1, 2 and 3 below.

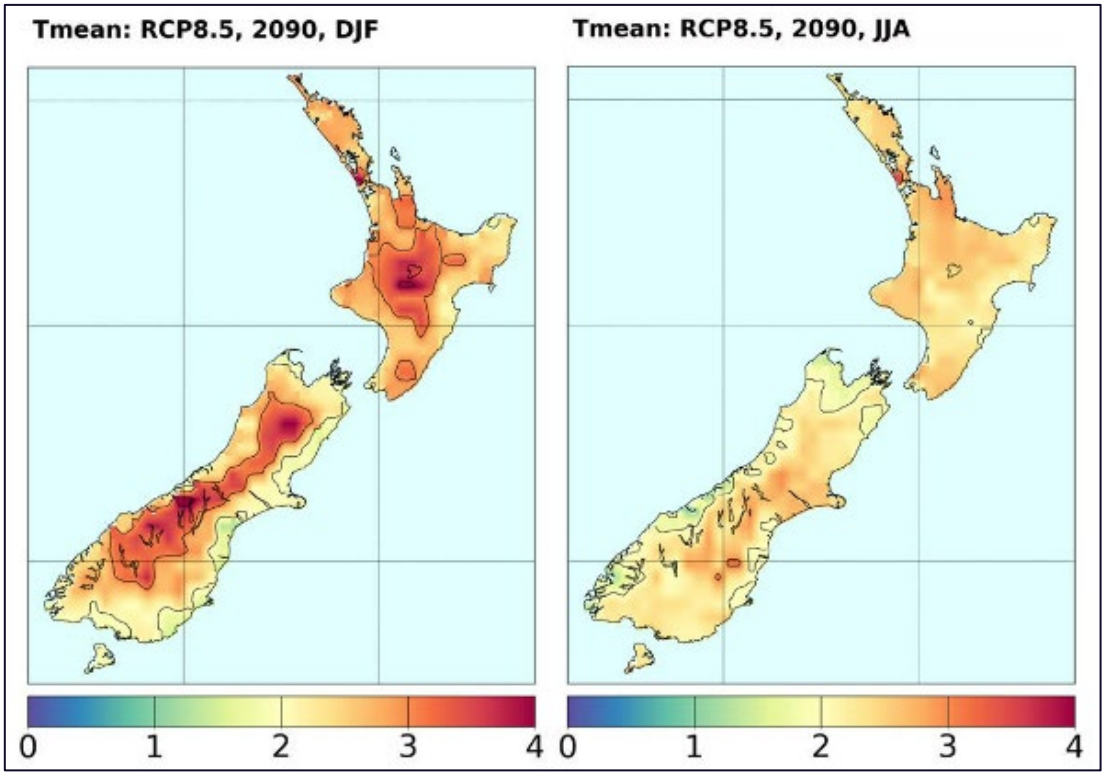


Figure 1 and 2: Projected changes in mean temperature (in degrees Celsius) for summer and winter by the end of the 21st century (Source: NIWA, n.d.)

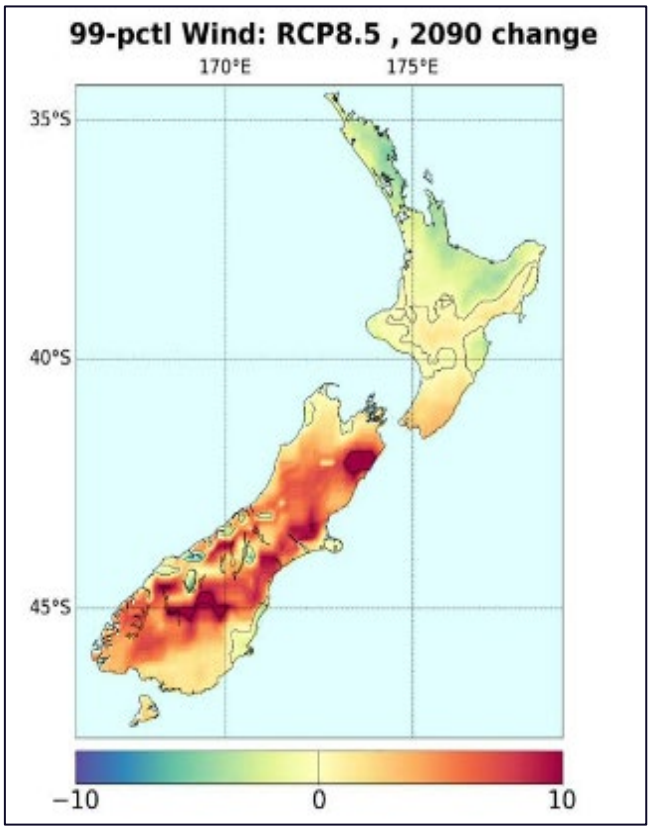


Figure 3: Projected changes in extreme daily wind speeds (%) by the end of the 21st century (Source: NIWA, n.d.)

When combining these two factors, an increase in wildfire risk is highly probable.

Are we inadvertently creating the perfect conditions for serious wildfires in Aotearoa New Zealand? Wildfires are not new to forestry; however, the major difference is in a commercial forest each plantation has its own fire risk profile for which the owner or manager needs to tailor an appropriate risk management approach. The Forest Risk Management Guidelines outline the steps to be taken to mitigate wildfires and give forest owners a clear outline of what is expected of them in this process. These guidelines give forest owners, large and small, the opportunity to assist FENZ in meeting its obligations under the Fire and Emergency NZ Act 2017 (NZ Forest Owners Association, 2018).

The threat from plant and leave forestry blocks, permanent carbon forestry, is that they are unregulated from an environmental perspective. (Yule, 2022). Controlling wildfires in these types of forests is exacerbated by the fact that they are neither managed nor maintained. There is often no access into the forest due to lack of roads, no green belts to help act as firebreaks, and no pruning or clearing of undergrowth. It essentially leaves the first point of defence as the forests neighbour. In the Australian wildfires of 2020, it is estimated that 350 million tonnes of carbon dioxide were released into the atmosphere which equates to two thirds of the nation's normal annual industrial emissions budget (Newsroom, 2020).

As our climate becomes hotter and drier, wildfires are burning with more vigour and there are now fears that the fires will burn down into the soil and begin to affect the Carbon Sink.

7.2 Pest Risk

BDO's Tairāwhiti Economic Action Plan report (2021) found that in the initial stages of establishing plantations, steps are taken to protect the seedlings from pests. This is to protect the capital investment of the young seedlings. Deer and goats will graze young seedlings effectively killing them. However once established the trees become less desirable and very little if any pest control is carried out. In addition, carbon forests are planted at a higher density than commercial forests making it very difficult for effective pest control to be carried out. There is therefore a risk that these forests will become reservoirs for deer, goats and pigs which will have a negative impact on ecological systems and freshwater ecosystems. Furthermore, these forests can provide sheltered and favourable sites for other pest species such as possum, stoats, weasel, feral cats, hedgehogs, hare, and rabbits. The impact on native species and trees would be catastrophic if pest populations were able to thrive unchecked. These negative effects could also extend beyond the forest boundaries onto neighbouring farmland. An example of this is the loss of crop or pasture as a deer will consume 6 to 8 percent of its body weight in a day. So, a 68 kg deer will consume 5.4kgs of green foliage a day.

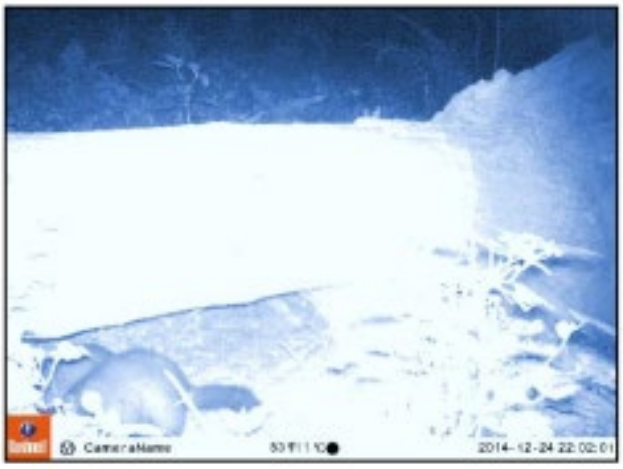


Image 1: Possums eating falcon eggs
(Source: BDO, 2021, p. 34)

Image 2: Feral goats
(Source: BDO, 2021, p. 34)

The above images are examples of pests in our forests.

Image 3: Pinus radiata blocking waterways after significant slippage in Tutamoe, Gisborne. A range of species and freshwater habits will be impacted downstream (Source: BDO, 2021, p. 33)

The above image shows the potential damage of unmanaged forests and their impact on waterways.

7.3 Threat to Endemic Species

Our endemic species in Aotearoa New Zealand have evolved over millions of years and have adapted to surviving in native forest stands and open tussock grasslands. The removal of these habitats will put many species at risk of becoming extinct.

Whilst certain species have adapted to Pinus radiata forests and appear to be thriving, other species have vanished from these exotic forests. Examples of this is the disappearance of the whio, commonly known as blue duck, and the brown kiwi in the Gisborne area within the last a decade. Extensive surveying using remote, spectral sonograph acoustic recording technology conducted by Ecoworks NZ staff has shown no sign of these species.

Other species under threat in the area as listed in the report by BDO Gisborne Limited (2021) are as follows:

- North Island Kaka: although Kaka have been discovered in Pinus radiata forests, these forests do not contain the optimal food species that indigenous forests provide, for example: honeydew, nectar, fruit and seed material, and the invertebrates that indigenous forests provide. Nor do they provide the mature hollow trees required for nesting.
- Long Tailed Bats: these bats are ranked as 'Nationally Vulnerable' by The Department of Conservation and IUCN (International Union for Conservation of Nature). Although the bat is found in Pinus radiata plantations within Tairāwhiti, they only appear to occur close to native forest remnants. These native trees provide suitable breeding sites for the bats which need mature podocarp or beech cavity bearing trees.
- North Island Tomtit and Rifleman: North Island Tomtits can be found in low numbers throughout Pinus radiata forests in Tairāwhiti with the harvesting of trees at 30/35 years having reduced their numbers. North Island Tomtits are found in larger numbers in protected indigenous hardwood forests. Rifleman have been recorded in Pinus radiata forests in the Tairāwhiti region. This bird can only be found in predator protected areas such as Motu. However even in predator protected areas such as at Hawkes Bay the Rifleman is not found in Pinus radiata forests.
- Tui, Bellbird and Kereru: Numbers found in Pinus radiata plantations are very low and these species remain reliant on nearby native forest for food. Mixed forest type with low pest numbers is required for these species to thrive. Radiata monocultures are not sufficient to protect and sustain robust populations of these three key species.
- North Island Robin: This species should be abundant in the Tairāwhiti region, but it is now range restricted. No North Island Robins have ever been recorded within Pinus radiata forests in Tairāwhiti. It would appear that the robin will only live in indigenous forests.
- Native Mistletoe,' Wood Rose' and Orchids: Both red and green mistletoe do not survive on Pinus radiata. Red mistletoe will only survive on indigenous beech trees. Green mistletoe needs kohuhu, mahoe and other broad leafed native species to survive. Wood rose (Dactylanthus), an ancient plant indigenous to Aotearoa New Zealand forests, will also not survive on Pinus

radiata roots and most orchid species found in indigenous forests will also not use Pinus radiata as a host tree.

- Striped Skink: This endangered species is found in the Tairāwhiti region. It was first discovered in 2018 (Ecoworks NZ Ltd) and is extremely rare. The Department of Conservation (DOC) has a species recovery taxon plan for the skink. The species has not been recorded in Pinus radiata monoculture forest areas and it is highly unlikely that Pinus radiata would provide the necessary habitat required for this specialist climbing skink to survive.

All the above species will face further risk from an increased pest burden in Pinus radiata forests where pest control is not implemented.

Between 2012 and 2014, there was an estimated 4000-hectare reduction in indigenous scrub/shrubland because of exotic afforestation (MPI, 2022).

7.4 Impact on Food Production

A recent report by Orme and Associates Limited (2021) commissioned by B+LNZ, estimates that 800,000 stock units have been lost to the sale of farms intended for conversion to carbon forestry. Currently there is very little research into the actual threat of food production been negatively impacted by carbon forestry, although often referred to in reports as a 'potential threat' there is not much in the way of an actual impact been felt at present. However, if left unchecked and if more productive food producing land is lost, an impact on food production could be felt. In the event of this occurring, stock numbers may have to be increased in certain areas which would in turn have a negative impact on the environment. The continued loss of productive farmland is highlighted by B+LNZ following an independent report by Orme and Associates (2021) that found in the first six months of 2021, 14,219 hectares of sheep and beef farmland were purchased with the intention of being planted into trees, 11,585 hectares of exotic planting and 2,634 hectares of planting of natives for honey. Over 80% of whole farms sold into forestry were in clear pasture, compared with 65.7% sold between 2017 – 2020 period. Of concern to B+LNZ is the increase in land sold in low to moderate Erosion Susceptibly Classifications (ESC).

Recent analysis by B+LNZ on farm sales data shows that the number of land sales for forestry conversion in 2021 would exceed those in 2019, which reached 36,824 hectares. These figures show that the amount of exotic planting will far exceed what the Climate Change Commission (CCC) has projected as a sustainable amount which is 25,000 hectares per annum.

> "Our sheep and beef farms are already home to 1.4 million hectares of native woody vegetation – and land-use changes over the past 30 years have added two million hectares to the country's conservation estate, the largest private

sector contribution to biodiversity in New Zealand" (B+LNZ Chief Executive, Sam McIvor, 2021).

To mitigate the undesirable conversion of whole farms into carbon forestry, planting only on marginal to steep land could be a solution as this should not impact overall food production but instead it will serve as an extra source of income for farms. In some areas it could also help control erosion and storm sediment and run-off rates Reducing livestock units on steep land could help farmers to focus on maximising the benefits from productive land.

As part of a NZ Landcare Trust Sustainable Farming Fund project in 2011 carried out on a 376-hectare sheep and beef farm in Waiotira Central Northland grazing 4000 stock units, PA Handford and Associates Ltd together with AgFirst found that planting 54 hectares of steep land with forestry would see a reduction of 320 stock units, allowing for more focused management on productive land. An outcome of which would be an increase in the performance of the flock and associated profitability of up to $220/ha. Furthermore, planting trees on marginal land would also give the farm a source of income through carbon credits on what was previously unproductive land. This investment would guarantee an income during tough economic times such as drought or market downturn which would normally have a negative impact on the farming operations (PA Handford & Associates, AgFirst, 2011).

The below Table 1 shows the effect ground contour will have on pasture and animal production.

Table 1: Ground contour effect on pasture and animal production. (Source: PA Handford & Associates, AgFirst, 2011)

Contour	Pasture Production (kgDM/ha/yr)	Adjust to actual 85% Utilisation (kgDM/ha/yr)	SU/ha	Product/ha (kg)	Gross Margin[2] c/kgDM	Gross Margin $/ha[3]	Farm Working Expenses $/ha[4]	Net Profit ($/ha)[5]
Easy	9425	8011[1]	14	325	14	$1,122	$450	$672
Easy/ Moderate	8338	7087	12	288	13	$921	$425	$496
Moderate	7250	6193	11	250	12	$740	$400	$340
Steep	4350	3698	6	150	10	$370	$350	$20

[1] Cage measurement overestimates actual availability and consumption, estimated utilisation is 85% of cage measurement.
[2] As slope increases potential gross margin / kg DM decreases for example it is difficult to finish beef or lamb on steep land
[3] Gross margin/ha = kgDM/ha x GM/kg DM
[4] Farm Working Expenses, based on industry average, adjusted for maintenance fertiliser by 1.8kgP/ha/SU, excludes wages to management, tax, interest on mortgage, depreciation and capital expenditure
[5] Net profit/ha = gross margin less farm working expenses.

Table 2: Investment and returns for steep land for different land use options (Source: PA Handford & Associates, AgFirst, 2011)

	Livestock	Timber	Timber + carbon ($20/NZU)	Timber + carbon ($30/NZU)
Investment ($/ha)	$600[1]	$2,850	$2,850	$2,850
Average Profit/year over 30 years ($/ha)	$20	$537	$785	$908
Internal rate of return over 30 years	2.9%	6.7%	18.5%	26%

The above table shows the different investment returns for various land use options on steep land.

7.5 Impact on Jobs

Permanent carbon forestry produces 0.6 full-time equivalent (FTE) direct jobs per 1,000 hectares from the year of planting onwards compared to exotic production at 2.2 FTE (Non-Harvest) and 5.1FTE (Including Harvest) and livestock farming which produces 7.4 FTE over the same area per annum leaving a difference of 6.4 FTE per 1000 hectares. From the BDO Gisborne Limited study (2021) done for the Tairāwhiti region as many as 2,914 FTE jobs could be lost to permanent carbon forestry.

The loss of 6.4 FTE per 1,000 hectares is significant but the impact of this reaches further into other industries in the rural sector. 2020 Australian and New Zealand Standard Industrial Classification (ANZIC) data showed a further 293 jobs involved in wood product manufacturing and 267 jobs in meat and meat product manufacturing with a further 535 linked to road transport) which brings the potential total loss of jobs to over 4,000 or 18% of the total regional jobs.

Table 3: Comparative analysis of direct spend and local employment of a Wairoa sheep and beef farm versus varying forest options (Source: BDO Gisborne Limited, 2021, p. 19)

Metric	Sheep and beef farm	Forest options		
		Excluding Harvest	*Including Harvest*	*Carbon Farming*
Direct spend, $/1,000 ha*	315,988	107,283	246,723	27,417
Employment, no. labour units/1,000 ha*	7.4	2.2	5.1	0.6

The above table highlights annual direct spend for sheep and beef farms versus varying forestry options and their local employment impact.

Table 4: Type of jobs included in the FTE figures by type of impact (Source: PricewaterhouseCoopers, 2020, p.15)

Industry	Direct	Indirect	Induced
Forestry and logging	Forestry and logging workers Forest managers	Forestry consultants Port service workers	Chefs of restaurants in rural forestry hubs
Processed wood product manufacturing	Wood processing workers	Builders Carpenters Truck drivers	Retail assistants in shops in rural centres
Pulp, paper, and converted paper product manufacturing	Pulp and papermill operators	Port service workers Truck drivers	Checkout operators in supermarkets in rural centres
Meat and meat product manufacturing	Farmers Shepherds Abattoir workers	Veterinary workers Agricultural scientist Agricultural consultants Shearers	Baristas at the local café

A forestry economic impact assessment report by PricewaterhouseCoopers (2020) for Te Uru Rākau- New Zealand Forest Service, found that the loss of sheep and beef farms will not only have a direct impact on farm staff numbers but will also have a flow on effect into other sectors, such as:

- shearing gangs
- livestock agents
- veterinarians
- local co-ops
- local shops
- stock trucking companies
- schools
- meat works
- agricultural dealerships including farm machinery service agents
- local pubs
- fencing contractors

The loss of production in the production forestry sector would impact similar local businesses, for example:

- sawmills
- log trucking companies
- pest control companies
- builders
- log imports
- local contractors (road works, fire dam construction, harvest teams, pruning teams, planting teams)

Although forests planted for lock up and leave carbon credits will have an initial positive impact on the local economy, once the planting is done the work is finished. There is no further maintenance or silviculture work required.

The below graph shows a comparison of the value chains for permanent forestry and production forestry.

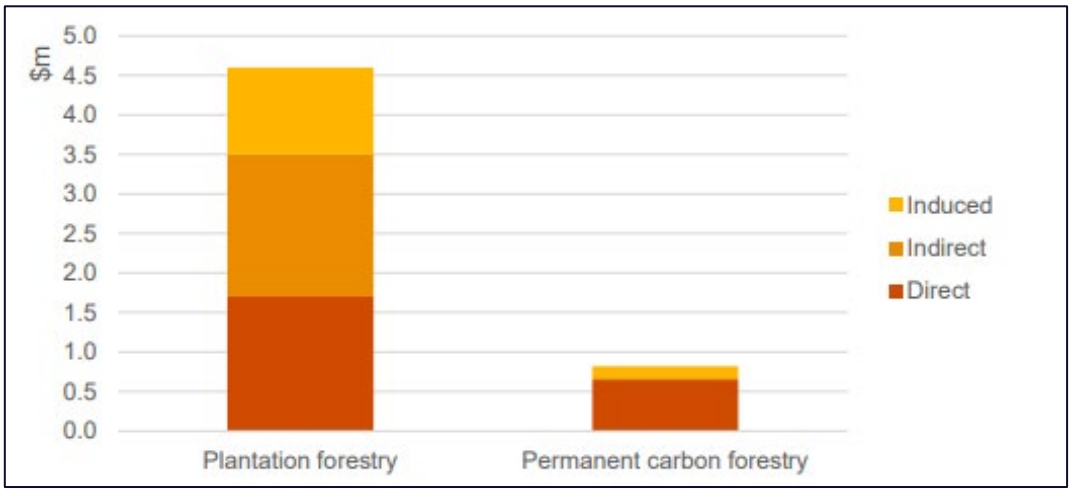


Figure 4: Permanent carbon forestry and plantation forestry value chains (Source: PricewaterhouseCoopers, 2020, p.21)

The option of planting Pinus radiata carbon forests on marginal land and maintaining livestock farming on productive land, will ensure job security and the wellbeing of local business and the community. Marginal land should be deemed unsuitable for carrying livestock and instead should be planted out to trees as this will improve the value of this type of land. It is worth noting that Pinus radiata may be the most profitable tree to plant when compared to native species, but as discussed under 7.3, they may not be the best tree species for the region's biodiversity.

Figure 5 below shows that permanent carbon forestry adds the lowest value when compared with other land uses, whilst figure 6 clearly illustrates the significantly lower FTEs required for permanent carbon forestry.

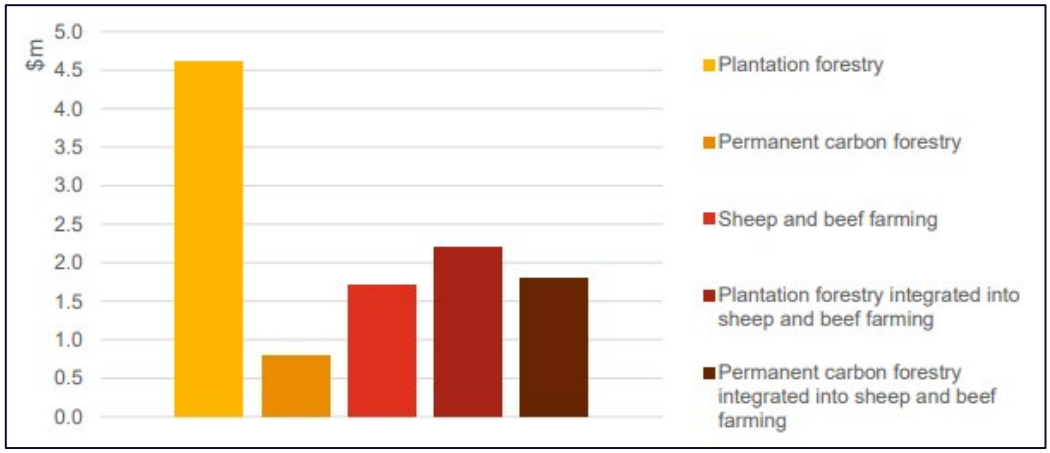


Figure 5: Annual total value chain impact per 1,000 hectares – value add by land- use (Source: PricewaterhouseCoopers, 2020, p. 6).

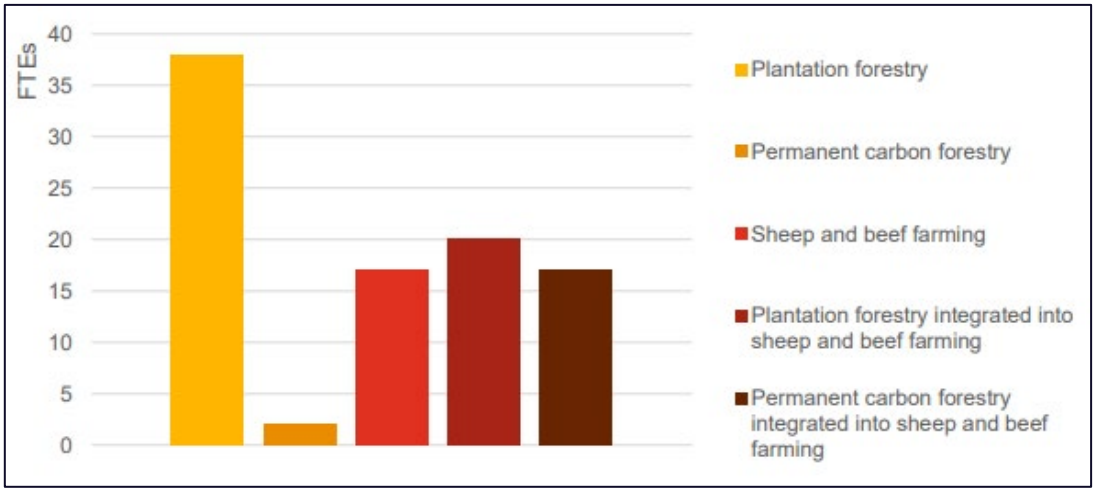


Figure 6: Annual total value chain impact per 1,000 hectares – FTEs by land-use (Source: PricewaterhouseCoopers, 2020, p. 6)

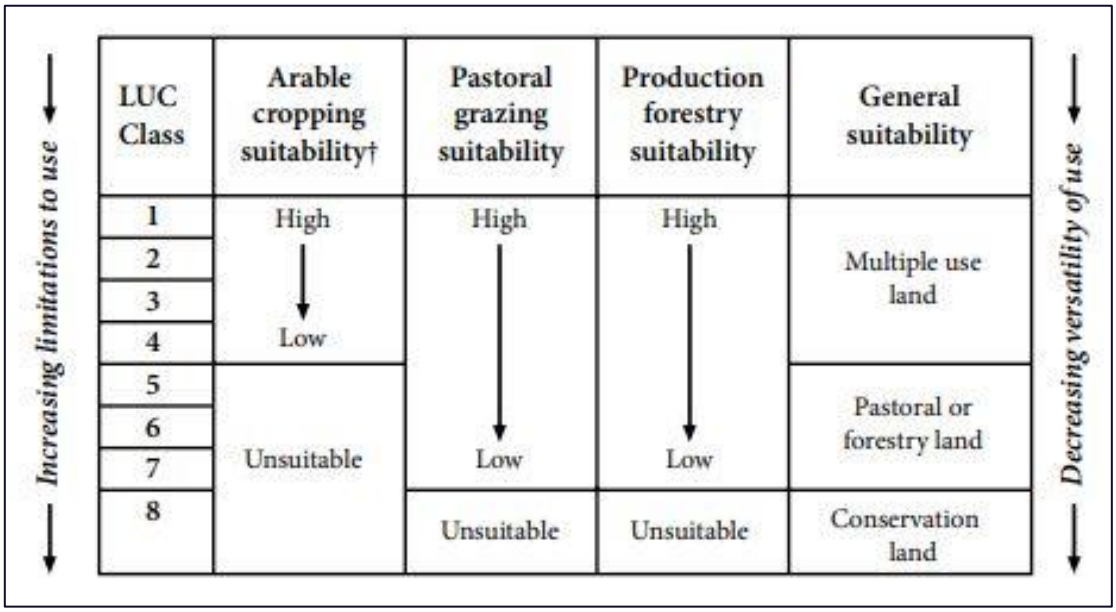
7.6 Land Use Change

Land Use Capability (LUC) classification is used in Aotearoa New Zealand to determine land's capability for use. It considers both the physical limitations and versatility required to sustain production. The LUC was first established in Aotearoa New Zealand in the 1950s to help achieve sustainable development and farm management.

All rural land in Aotearoa New Zealand is broken down into classes 1 to 8. Class 1 is deemed the most versatile and is open to a wide range of potential land uses. Class 8 land is on the other end of the scale with physical limitations such as steepness, high erodibility and is therefore unsuitable for arable, pastoral, or commercial forestry use (Hawkes Bay Regional Council, 2022).

The below table demonstrates the LUC classification system and indicates that an LUC of between 5 and 7 is still considered suitable for forestry or pastoral uses, but not suitable for arable farming.

Table 5: Limitations of use and decreasing versatility of use LUC Class 1 to LUC Class 8 (Source: Orme & Orme, 2021, p. 16)



The below table shows the number of hectares per LUC band purchased for forestry conversion.

Table 6: LUC areas purchased for conversion to forestry (Source: Orme & Orme, 2021, p. 10)

Region	Land Use Classification (LUC) Band								Grand Total
	2	3	4	5	6	7	8	Other	
North Auckland	0	0	55	0	171	109	0	0	**334**
South Auckland	32	44	125	0	2634	680	9	0	**3524**
Hawkes Bay	52	182	154	0	3529	856	0	0	**4774**
Wellington	0	187	236	0	3582	968	7	1	**4980**
Marlborough	0	16	31	0	1775	507	25	1	**2354**
Nelson	0	0	0	0	462	389	0	0	**852**
Canterbury	0	0	57	0	562	659	0	0	**1278**
Otago	0	53	622	0	3612	15	0	0	**4302**
Southland	23	126	89	0	417	0	0	0	**655**
Grand Total	**107**	**608**	**1368**	**0**	**16743**	**4182**	**41**	**3**	**23052**
% of Total	0.5%	2.6%	5.9%	0.0%	72.6%	18.1%	0.2%	0.0%	**100.0%**
% 2017-2020	0.1%	3.1%	5.4%	0.9%	52.0%	36.7%	1.7%	0.1%	**100.0%**

The Erosion Susceptibility Class (ESC) is used in Aotearoa New Zealand to determine the susceptibility of land erosion. It is a tool used by councils to provide a threshold test to implement the National Environmental Standard for Plantation Forestry (NES-PF) regulations according to the erosion risk profile of different landscapes over the eight forestry activities regulated under the NES-PF (MPI, 2017).

The 2021 Orme & Associates report found that there was an increase in the percentage of land with medium to low ESC ratings purchased for large-scale forestry in the first half of 2021 when compared to 2020.

Table 7: Erosion Susceptibility Classification summary. Land purchased spread over the four main ESC classes (Source: Orme and Associates Limited, 2021, p. 6)

ESC Class	1/1/2021 to 30/6/2021	1/1/2020 to 31/12/2020
Low	42.4%	28.2%
Medium	43.7%	35.8%
High	13.3%	26.0%
Very High	0.6%	9.9%

Historically plantation forestry in Aotearoa New Zealand has only occurred on steeper land given its unsuitability to beef or lamb farming. However more recently there has been a marked increase in the area of viable pastoral land that is being sold to carbon forestry as a result of the higher carbon price which has meant that potential buyers can now easily out-compete traditional farmers in the sale of land.

The steeper the land the higher the production cost is when compared to generating the same farming output on less steep land that falls within lower LUC and ESC classes. This further supports the argument that areas such as these would be better suited to permanent carbon forests. Due to the topography of lower-class LUC areas, establishment costs may be higher which could deter buyers.

The increase in the price of carbon has also seen farmers taking this opportunity to sell whole farms to carbon forestry. Increased regulations, staffing pressures, succession issues and volatile markets are a few contributing factors. With the Overseas Investment Office (OIO) regulations in place it has become very hard for overseas investors to purchase farmland for farming whereas if overseas investors wish to purchase land for carbon forestry there are currently no regulation stopping them from doing so.

Traditionally production forestry was seen as being economically viable when planted within 200kms from the closest port (Orme & Orme 2021). This has meant that high country stations have been out of forestry's focus. With the introduction of permanent carbon forests this is no longer the case. Further to the increase in carbon pricing as previously mentioned these investors can now out compete farmers for any land that becomes available in these areas. Commercial forestry is also being impacted as land within the 200km from port area is being lost to

permanent forests. Approximately 50 per cent of Aotearoa New Zealand's timber is exported and the rest is used in local markets, (Orme $ Orme 2021) particularly within the building industry. Of the land sold for planting between the start of 2017 and the end of 2020 26,547 hectares was sold to companies that intended to utilise this land for permanent carbon exotic forestry. Although these companies have the option to harvest the trees further down the line, the ever-increasing price of carbon makes these options less and less attractive. It is estimated that 139,500 hectares of land has been planted or will be planted to permanent exotic forestry thereby removing this land from beef and sheep production (Orme & Orme 2021).

A report compiled by Lawrence Yule (2022) and more commonly referred to as the Green Paper, uses the B+LNZ Benchmarking Tool to analyse the returns from different land uses. During 2019, 2020, and 2021 farm profit before interest, tax, and rent was $300 per hectare for hard hill country, $450 per hectare for hill country, and $700 per hectare for finishing country. An equivalent analysis carried out on a pruned production forest regime incorporating carbon averaging calculated that the return generated is $2,000 per hectare per annum for the first rotation of trees. This is further illustrated in the graph below.

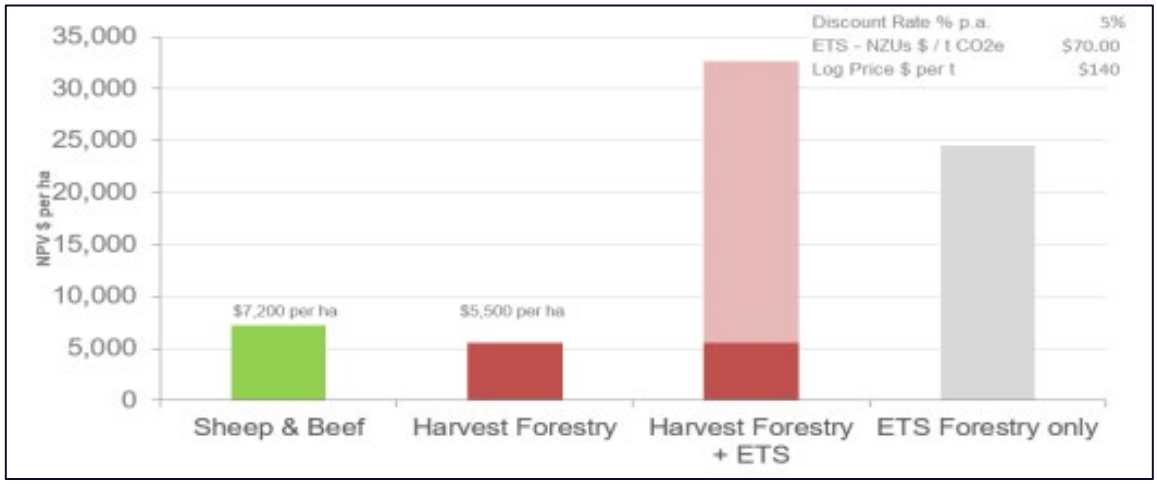


Figure 7: Class 4 North Island Hill Country (NPV 30 years - $ per hectare) (Source: Yule, 2022, p. 6)

It can also be seen that the benefit of combining NZ ETS carbon forestry into current farming operations can have a significantly positive impact on farm income as shown in the graph below.

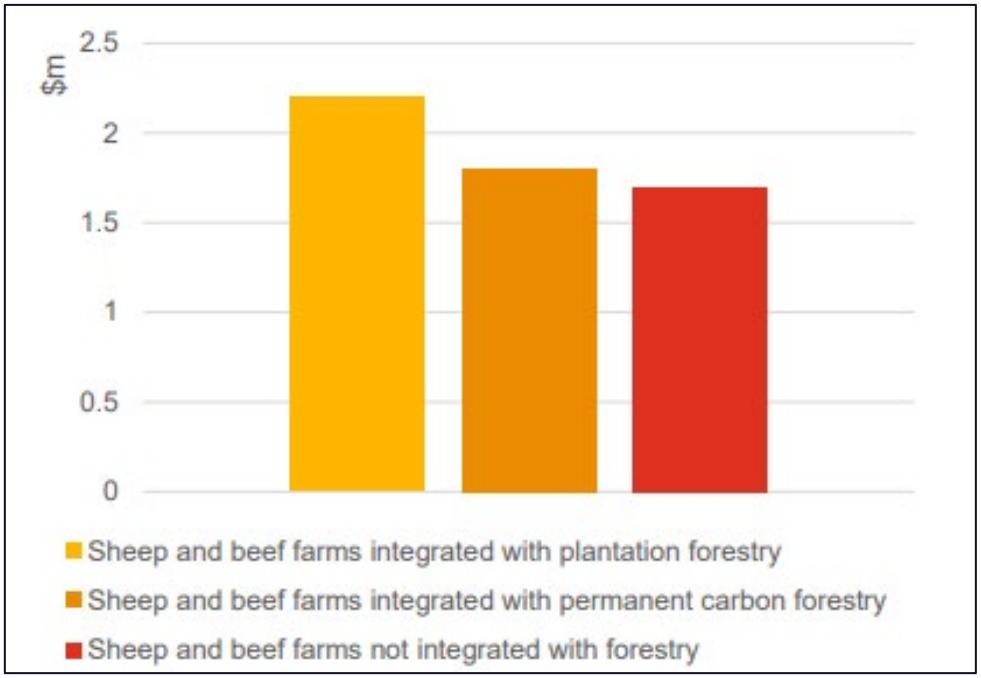


Figure 8: Value added impact ($m) per 1,000 hectares - forestry integrated into a sheep and beef operation (Source: PricewaterhouseCoopers, 2020, p. 25)

7.7 Pinus Radiata versus Natives

Pinus radiata is the chosen exotic tree species for permanent exotic carbon forestry due to its ability to grow quickly which means it begins to sequester carbon an early age. Native trees are far slower growing and take longer to begin sequestering carbon. A 27-year-old stand of Pinus radiata will on average have sequestered 488 tonnes of carbon dioxide per hectare.

If we take the same aged stand in a fast-growing region such as Gisborne this figure jumps to 779 tonnes of carbon dioxide per hectare. When this is compared to a 50-year-old native forest, on average 323.4 tonnes per hectare of carbon dioxide stored, the Pinus radiata stand would have stored double the amount of carbon dioxide per hectare as shown in the below graph (Gibson, 2020).

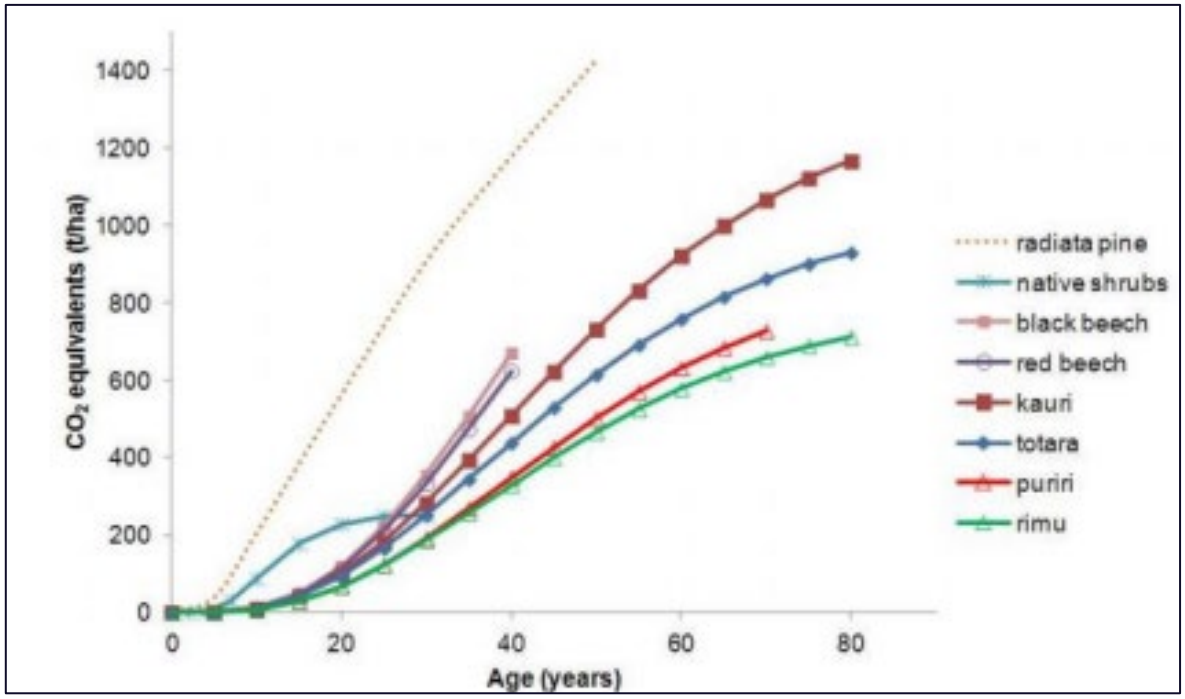


Figure 9: Predicted carbon sequestration rates of pine and native forest types on average sites in Aotearoa New Zealand (BDO Gisborne Limited, 2021, p. 14)

Due to its fast-growing nature and superior rate of carbon sequestration Pinus radiata is the obvious choice if Aotearoa New Zealand is going to achieve it Paris Agreement reduction targets by 2030 and 2050.

For a forest to qualify into the NZ ETS it must meet certain criteria as required by Te Uru Rākau – The New Zealand Forest Service. A forest should be:

- 1 ha in area
- 30 meters in width
- 5 meters in height

Furthermore, the forest should:

- have a 30 per cent average canopy cover per hectare
- contain eligible species
- be established after 1989

Trees not eligible for the ETS include:

- fruit trees
- cropping and horticulture species
- non-woody species such as flax and toetoe
- native nursery crops such as gorse
- certain invasive species and tree weeds

Certain trees such as manuka, may reach a height of 5 metres in certain areas, but may not in extremely exposed sights. The importance of 'the right tree in the right place' needs to be considered. A forest canopy of 30% cover achieved over a reasonable period is another stipulation of entry into the NZ ETS. This may mean planting trees at a much higher rate per hectare which will in turn influence establishment costs. It is worth noting that native seedings are more expensive than exotic seedlings (CarbonCrop, 2021).

Area and terrain will have a major impact on what tree species is most suited to grow in an area. Certain aspects need to be considered when deciding between exotic and native tree species as listed below (CarbonCrop, 2021).

- Erosion prone areas if planted to Pinus radiata can cause problems further down the line as when these trees die or fall over, debris could block waterways and cause log jams further downstream. If the plantation was to be harvested in the future once the carbon cycle has run out, then further soil instability could occur. In addition, the nature of these areas makes for extremely unsafe working conditions for logging crews. It would be better practice to plant these areas in native species which would help anchor the soil and increase the biodiversity of the area. The less external interference on these erosion prone areas, the better.
- Snowfall prone areas are not ideal for Pinus radiata but instead are better suited to a different exotic tree species namely the Douglas fir. On the other hand, native species which grow naturally in these areas would flourish.
- Swampy land is not ideal for Pinus radiata. Native coniferous species such as Kahikatea grow well in wet areas.
- Chalky, stony, or sandy soils especially if long dry spells are the norm will not suit native trees.
- Weed potential must be a consideration when planting exotics such as Pinus radiata. Wilding conifers also known as wilding pines are a massive problem in certain parts of Aotearoa New Zealand and controlling the spread of these trees comes at a significant cost.
- Weather events can also have big implications for exotic forest species. Wind fall and increase fire risk must be considered.

The difference in establishment costs between pine seedlings and native seedlings cannot be overlooked. Native plantings cost on average $4,000 per hectare compared to exotic plantings which cost on average $1,500 per hectare (thisNZlife, n.d.). As noted in 7.2, native species are at greater risk of pest damage and therefore require regular pest control to ensure the successful establishment of these trees. For short-term gain exotics outperform native trees, however in the long-term this gain may well be detrimental to our ecology and biodiversification.

The issue of what will become of these Pinus radiata plantations in 50 years once their carbon cycle has been completed remains a big question, particularly those plantations owned by overseas investors who may not have the same concerns as local New Zealanders who will likely be left with the burden of these unmanaged and unmaintained forests.

The below image is a good example of the result of poor management post felling. Trash left behind has been washed downstream and now litters the beach. The same scenarios may well occur in unmanaged permanent carbon forests from trees that have died or been knocked over by wind.

Image 4: Tolaga Bay: A beach covered in forestry slash (Source: Stuff, 2019)

7.8 Profitability of Carbon Forestry and the NZUs Market

Currently the carbon price is sitting at around $77 (carbonnews, 2022). With the ever-increasing price of carbon, traditional farming is struggling to keep up. In the past the forestry sector would target marginal to hard land. With the increase in carbon pricing and even higher forecast prices predicted, carbon forestry companies can now look to compete on more arable sections of land and in many cases full farm purchases. This is further exacerbated by the fact that Aotearoa New Zealand is the only country to allow 100 per cent of an emitters' emissions to be offset by forestry. With no limits on OIO applicants for the purchase of land intended for planting to forests, more overseas companies are pushing to buy land in Aotearoa New Zealand and are outcompeting local farmers for arable land.

Although concerning to locals this does have a positive financial impact on land prices and farm equity. The downside is that any new farmers wishing to purchase their first farm could effectively be excluded from the market.

Proposed changes to the NZ ETS accounting rules are to be introduced on 1st January 2023 and include: the removal of the saw tooth accounting methodology for all new entrants into the NZ ETS, the introduction of a new Permanent Post – 1989 Forest (PPF) category, and 'Averaging'. Averaging accounting is compulsory for all new post-1989 forests from 2023 onwards unless they are registered as permanent forests. The PPF category is for post -1989 forests that will not be clear-felled for a minimum of 50 years after been registered with the NZ ETS. Permanent forests will be placed on the stock change accounting approach. Units will be earned for as long as they are in the ground and the carbon stock is increasing. These units will be tagged as coming from permanent forestry (Yule, 2022).

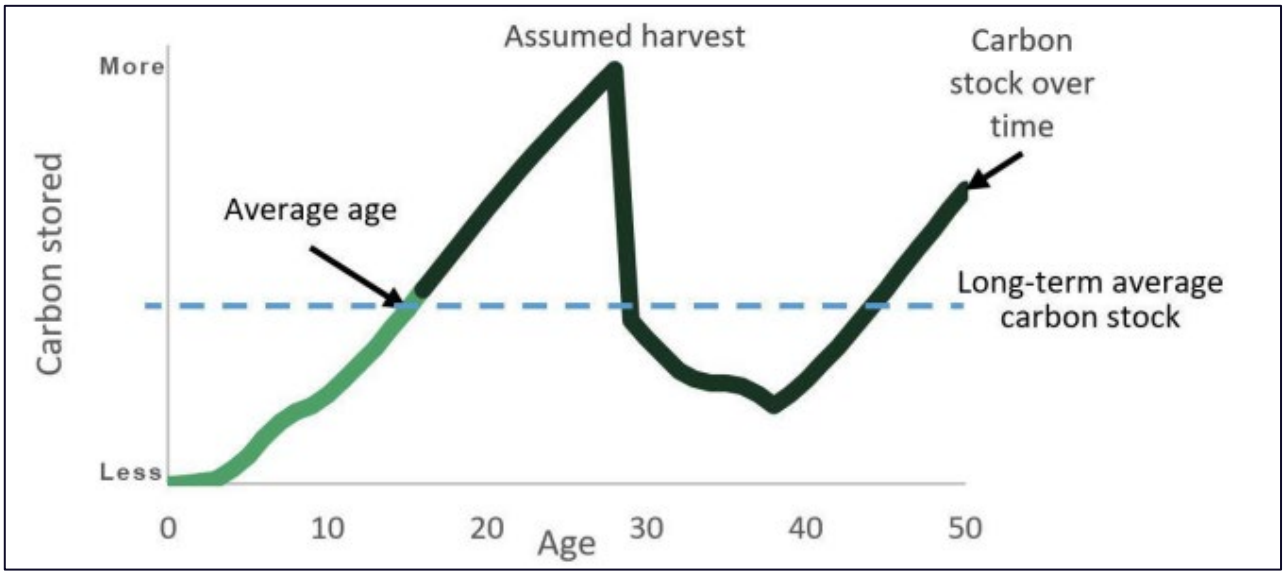


Figure 10: Pinus radiata forest over time and the average carbon stock of that forest (Source: Yule, 2022, p. 15)

The above figure illustrates the concept of averaging accounting. A forest that has never been harvested before, will earn carbon credits until its long-term average carbon stock is reached as shown by the blue line on the above graph. The long-term average carbon stock equals the average amount of carbon stored in the forest over several growth cycles. The black line indicates the actual carbon stock of the forest. Whilst growing and earning carbon these forests are of high value to the owner. An obvious choice due its fast rate of growth and carbon sequestering capability, would be Pinus radiata planted at high stocking rates. Fast forward 50 years with no silviculture having taken place and the allowable carbon credits claimed, could see possible absentee owners who have no further use for the trees simply walking away. The effect of this could cause the land value to be significantly reduced or become negative (Yule, 2022).

The economic analysis by BDO Gisborne Limited on behalf of the TEAP Operations Group in 2021 lists the economic impacts that would be felt from exotic carbon forestry in the Te Tairāwhiti region.

- As carbon prices increase the return from permanent exotic carbon farming is significantly higher than returns from production forestry and livestock farming up until forest reaches maturity.
- Pinus radiata is the dominant species chosen for permanent carbon forests due to cost, ease of establishment, and financial returns. The financial are far higher than returns from native forests.
- Cash flow returns will be higher from exotic permanent carbon farming for current generations however once forest maturity is reached this will incur negative returns for future generations.
- Negative cash flow returns for future generations will mean they will not be able to meet annual overheads.
- The sale value of the land could be rendered worthless as the NZ ETS liability attached to the land would far exceed the land value which in turn would mean rates and other creditors of the landowner may not get paid.
- As the landowners of these permanent exotic carbon forests are often companies this would mean individuals could not be pursued to reclaim debt especially if they were not directors at the time of distributions.
- Due to the significant cost in the NZ ETS of transitioning exotic forests to native forests this practice is unlikely to happen.
- There are financial incentives for the establishment of native forests at present, but these do not offset the financial incentives in the NZ ETS for exotic forests.
- Government and taxpayers would incur significant liability at an international level if it were to allow forestry participants to transition exotic forests to native without a cost.
- Exotic forestry participants would receive the revenue and taxpayers the liability if they were allowed to transition to natives with no attached cost making this unlikely to happen.

A report by ANZ Agricultural Economist, Susan Kilsby (2022) explains that the Aotearoa New Zealand carbon market is independent of international markets. Prices vary from country to country. At the 2021 COP-26 summit in Glasgow the global carbon market was developed. In Aotearoa New Zealand there are varied carbon markets. Firstly, there are New Zealand Units (NZUs) which are released by the Government and sold quarterly at auctions. The secondary market for NZUs in circulation is traded bilaterally. It is from these trades between buyers and sellers that we get the term 'carbon price'. The third is the voluntary market which exists outside of the Government regulated carbon market. In the voluntary market there

is a range of standards and credits available. Businesses in the voluntary market look to offset their emissions by investing in projects that reduce GHG emissions such as planting trees. Pricing in the voluntary market tends to be privately negotiated, so it may vary between projects and the deals are facilitated by a broker or a company. NZUs can be created by the Government as they see fit. To establish market certainty the Government has a provisional budget of NZUs it will release at its quarterly auctions. The provisional budget for 2021-2025 was to be announced at the end of 2021 but has been pushed out to May 2022.

In the secondary market companies that can prove they have sequestered carbon, for example through planting trees, are entitled to receive NZUs. These units may either be offered to the market, or the owner may hold onto them to offset future emissions, or they may expect a higher return on them later. Due to changes in the rules with the introduction of 'averaging' (less units earned but not liable to repay NZUs if they replant areas of land harvested) pine trees can provide an income for 16 years.

At present there is a large supply of NZUs in circulation which could have a negative impact on future prices.

Some of the other factors based on this reports research which could impact the profitability of NZUs are listed below.

- If He Waka Eke Noa fails which would see agriculture included into the ETS with a price placed on methane emissions from livestock and fertilizer.
- Financial returns from alternative land uses – Price of logs which impact the harvesting of forests.
- Forestry registrations post-1989. At present around 400,000 hectares or 54 per cent of post-1989 forests are not registered. If this changes the units on offer could be doubled.
- An oversupply of NZUs in circulation. As of 30th June 2021, there were 138.4 million NZUs held of which 40 million units are in demand meaning that there is a massive buffer of units in the forecast which may have a negative impact on the price of NZUs
- Changes in regulations remains the biggest threat with possible changes to be announced mid-2022. Changes to the ETS rules around solely offsetting emissions from credits obtained from Pine radiata plantings, could mean that emitters may be forced to reduce emissions not just offset them. OIO rules around the purchase of land for carbon forestry may be altered, sequestration rates of natives relative to pines may be reviewed and the planting of trees could be limited to high class land.

- International market prices. An international market for units would result in emissions reductions occurring in regions where it is the cheapest to do so. Massive planting of trees could occur in developing countries as it would be inexpensive and possibly unregulated. This increases the risk that wealthier countries will not change their polluting ways as they can buy cheap credits to offset their emissions. Existing carbon forests in New Zealand may no longer be attractive to overseas owners which could see owners walking away, leaving the forests "forgotten".

If Aotearoa New Zealand joins the global carbon trading market this may put downward pressure on the NZ carbon price as it would open the door for Aotearoa New Zealand companies to purchase international units which are cheaper than NZ units. The average carbon price in twenty of the largest economies is just below four Euro, the equivalent of approximately seven NZD. In contrast, if Aotearoa New Zealand joins the European Union ETS, the New Zealand carbon price could see an upturn given the EU ETS has a higher carbon price.

There is no certainty going forward that the carbon price will continue to increase although general expectation is that it will continue to rise. It is however worth noting that in the future carbon prices will fall to zero as emissions are mitigated and the need to offset them is no longer required.

Of the 2500 companies currently registered in the NZ ETS, 90% of these are involved in forestry, and only 10% in industries that emit GHGs.

The carbon market is a new market and still relatively immature with changes to the regulatory environment continually evolving. At present, the market is unregulated and pricing forecasts released in 2021 predict that if Aotearoa New Zealand is to meet its climate change obligations of reducing warming by 1.5 degrees Celsius by 2050, carbon prices could reach 138 NZD per tonne by 2030 and 250 NZD per tonne by 2050.

The quarterly auctions run by Government launched in March 2021, have both a ceiling price and a price floor. There is also an undisclosed reserve price to avoid market manipulation. If the price ceiling is exceeded then extra units are released, this is known as a 'cost containment reserve'. In 2021/2022 7 million units were released. To ensure all units are sold at the same price, the highest priced bids receive the available units and buyers will pay the price offered by the lowest successful bidder. A total of 19 million NZUs were sold across the quarterly auctions in 2021. When combined with the additional 7 million units from the cost containment reserve, the total NZUs sold was 26 million. There appears to be major players involved in the auction system as seen in September 2021 where all the

available NZUs were purchased by just two participants. At the start of 2022 Government announced there would be a gradual increase in the auction floor price of NZUs and additionally the ceiling price would also be increased.

The below table shows NZ ETS auction results from 17th March 2021 through to the 1st of December 2021. The set pricing can be seen for auctions 16th March 2022 to 7TH December 2022.

Table 8: NZ ETS carbon auctions 2021 (Source: Kilsby, 2022)

Auction date	Volume of NZUs available*	NZU floor price	NZU ceiling price	Clearing price	Participants	Successful participants
17 March 2021	4.75m	$20.00	$50.00	$36.00	40	30
23 June 2021	4.75m	$20.00	$50.00	$41.70	37	16
1 September 2021	4.75m + 7m	$20.00	$50.00	$53.85	43	31
1 December 2021	4.75m	$20.00	$50.00	$68.00	26	18
16 March 2022	4.825m	$30.00	$70.00			
15 June 2022	4.825m	$30.00	$70.00			
7 September 2022	4.825m	$30.00	$70.00			
7 December 2022	4.825m	$30.00	$70.00			

The secondary market operates with trading taking place directly between companies and often with the help of brokers to match buyers and sellers. Trading is normally on spot contract (immediate delivery) or a forward contract (units traded at a specific price on a future date). As stated earlier the pricing information obtained from the secondary market is commonly referred to as "the carbon price".

The below graph highlights the steep climb of the carbon spot price.

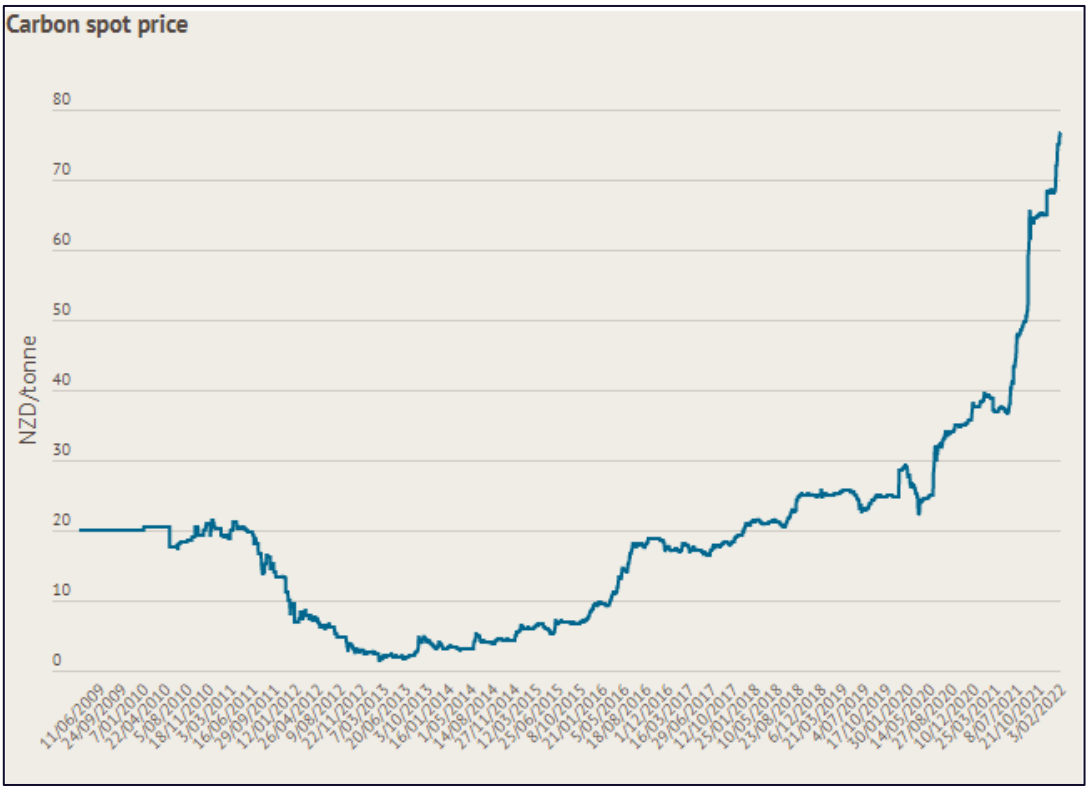


Figure 11: Carbon spot price (Source: Kilsby, 2022)

Overall, the price of NZUs is likely to continue to rise but the potential changes in Government regulations and rules surrounding carbon forestry, could see a level of market volatility in the future (Kilsby, 2022).

7.9 Māori and Carbon Forestry

Of Aotearoa New Zealand's 27 million hectares, Māori own 1.6 million hectares and of this 80 per cent falls into the 6 to 8 LUC classification, deeming this land unprofitable for food production.

"The scale only goes to 8, and 8 is the worst classification and 80% of Māori's 1.6 million hectares is in category 6-8" (Nga Pou a Tane National Māori Forest Association chair Te Kapunga Dewes, 1News, 2022).

With around 800,000 hectares of the land under Māori ownership being marginal to steep, forests are an excellent option. Government estimates are that if this land was to be planted to Pinus radiata for entry into the NZ ETS for credits, Māori could stand to make $40 billion. The other option is to plant these areas to natives which as shown earlier in this report are more expensive and far harder to establish (Kowhai, 2022).

Approximately 230,000 hectares of Māori owned land has been identified as being suited to forestry that qualifies for the NZ ETS. Of these 146,000 hectares is regarded as marginal for production forestry due to its remoteness and distance from port. This land would be well suited for permanent carbon forests (MPI, 2022).

The risk of the 'plant and leave scenario' for Māori landowners is that once the forest has reached maturity there is a risk of negative economic returns. There will be no income for future generations off this land unless significant money is spent to reclaim the land. The planting of natives would although to start with generate a lower return due to slow growth rates be a better investment for future generations and the future of the biodiversity of the land.

The opportunity for Māori to gain significant financial gain from carbon forests must not be overlooked. Pinus radiata would generate the most income in the shortest space of time but the long-term impacts for future generations should also be considered. Māori currently make up 40 per cent of the forestry workforce but with the increase in permanent exotic carbon forests, this workforce may be placed under threat.

Māori proverb "Whatungarongaro te tangata, toitu te whenua" – as man disappears from sight, the land remains (1News, 2022).

8 An Overview of Aotearoa New Zealand's Climate Action Framework

In 2019 the Government set about ensuring that the necessary policy framework was in place to ensure that Aotearoa meets its climate change obligations. To achieve these amendments to the Climate Change Response Act 2002 were made through the Climate Change Response (Zero Carbon) Amendment Act 2019. According the MfE, the amendments would allow for four important changes to the existing legislation including the establishment of an independent crown entity to provide advice and to assist future governments to meet Aotearoa's long-term climate change goals (MfE, 2021).

He Pou a Rangi Climate Change Commission was formed in 2019 with its core purpose being the provision of ongoing research-based advice around the various factors affecting emissions as well as potential impacts and effects of climate change on Aotearoa New Zealand. Part of this process was the development and release at the end of January 2021 of a draft advice report upon which consultation was sought during the months of February and March 2021.

More than 15,000 submissions were received. Following the consideration of these submissions, changes were made, and a finalised report was released in May 2021; Ināia tonu nei: a low emissions future for Aotearoa. Ināia tonu nei meaning 'the time is now'.
The report highlights the important but varying roles that native and exotic forests will play as Aotearoa strives towards not only meeting its 2050 emissions reductions targets but also maintaining net zero beyond 2050. It considers the concerns raised by submitters regarding the potential impacts that associated land conversions could have on rural communities and the wider agricultural sector, including the lack of economic benefits that permanent pine forests would provide and the long-term management and associated environmental risks that could be posed. Of the thirty-three recommendations included in the report, two are of relevance to my report.

Recommendation 1 looks at the introduction of three emissions budgets covering the following timeframes: Emissions budget 1 (2022 – 2025), Emissions budget 2 (2026 – 2030), and Emissions budget 3 (2031 – 2035), with each consecutive budget seeing progressively increased emissions reductions based on GWP_{100} values from the IPCC's Fifth Assessment Report (AR5) – see below Figure 12.

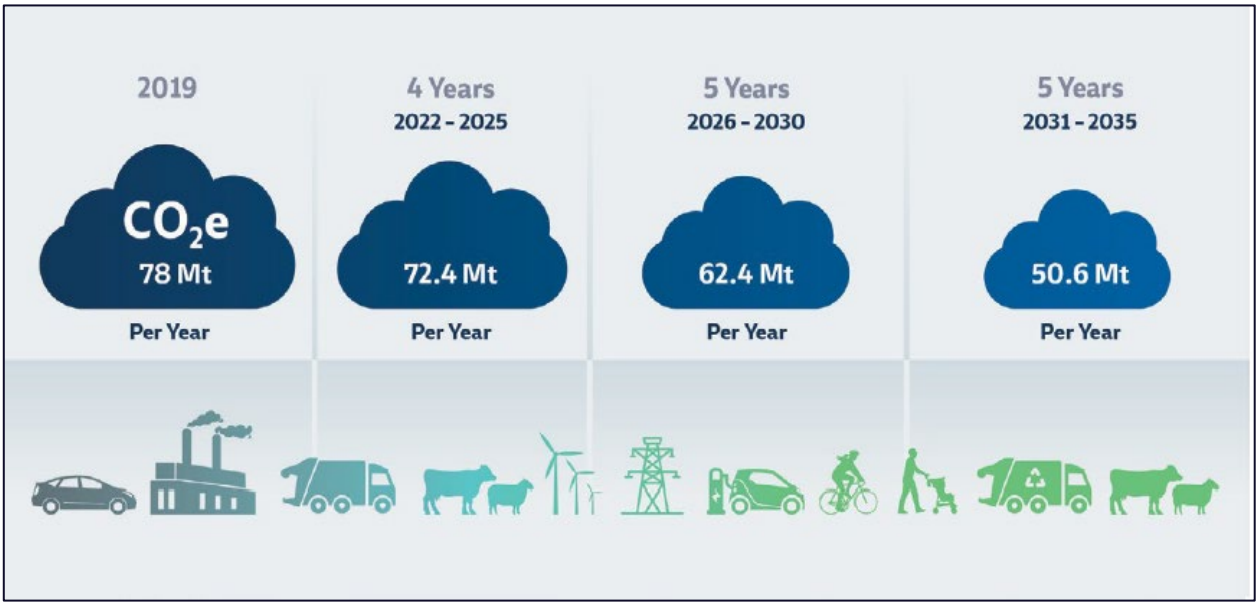


Figure 12: Emissions budgets 2022 – 2035 (AR5) annual average emissions (Source: He Pou a Rangi Climate Change Commission, 2021, p. 12)

Recommendation 25 (refer to below boxes) proposes that the Government commit to "Developing a framework of actions to deliver a mix of exotic and native forest sinks, and manage these and other carbon stocks, to provide flexibility to meet emissions budgets and targets" (He Pou a Rangi Climate Change Commission Recommendations Summary, 2021, p. 15).

Recommendation 25 – Manage forests to provide a long-term carbon sink.

1. Establishing a long-term carbon sink through a comprehensive national programme to incentivise the reversion and planting of new native forests to maintain net zero long-lived greenhouse gas emissions beyond 2050.
2. Designing a package of policies to reduce reliance on forestry removals and manage the impacts of afforestation including:
    a. Amendments to the NZ ETS to manage the amount of exotic forest planting driven by the scheme
    b. A clear position on the role and desirability of different types of permanent exotic forests as carbon sinks and amending the NZ ETS and other policies accordingly.
    c. Land-use planning, direction, and tools to help local government manage afforestation, mitigate localised impacts of afforestation and to achieve environmental co-benefits.
3. Managing pests in an integrated way, to ensure forests are successfully established and all forests are maintained long term.
4. Considering ways to allow more flexibility for Māori-collectives with pre-1990 forest on their whenua, to give them more scope to manage their whenua in alignment with the intergenerational aspirations of their members. This could include, for example, assisting capital-constrained Māori-collectives to offset deforestation on pre-1990 forest land.
5. Maintaining and increasing other carbon stocks through:
    a. Improving and enforcing measures to reduce deforestation of pre-1990 native forests.
    b. Noting that emissions and carbon dioxide removals may not currently be reliably quantifiable or accounted for in targets, taking steps to:
        i. Protect and increase the carbon stocks of pre-1990 forests through activities such as pest and fire control, and enrichment planting.
        ii. Encourage carbon removals by new and additional small blocks of trees and vegetation.
        iii. Preventing further loss of carbon from organic soils, particularly due to the degradation of drained peatlands and the destruction of wetlands.

Recommendation 25 - Provisional progress indicators

1. Government to have, by 31 December 2022, developed proposals for incentives for native forests and for managing the amount of exotic forest planting driven by the NZ ETS, with amendments to be effective by 31 December 2024.
2. Government to report, from 31 December 2022, on the hectares of exotic and native forest that are afforested and deforested at least annually.
3. Government to report at least annually, from 31 December 2022, on a suite of indicators including information on labour, nurseries, land purchases, pest eradication data (area to which 1080 has been applied or farm management plans).

The report also looks at various long-term scenarios to 2050 and what actions are required to meet the 2050 targets.

Of relevance to this project are the following insights.

- Steep, less productive land could be used to establish new native forests which would act as long-term carbon sinks
- Exotic production forestry would continue to be used in the interim until native afforestation ramps up

However, the report notes that "relying too much on forests will not lock in net zero" (He Pou a Rangi Climate Change Commission Recommendations Summary, 2021, p. 91). One scenario looked at unconstrained carbon removals by forests and the undesirable effect that this would have in terms of an increasing emissions price which would in turn result in much higher rates of exotic forestry being planted and therefore ongoing reliance on planting of forests post 2050. To illustrate this, the below figure shows that net emissions would rise above zero by 2065 as the temporary exotic forest carbon sink declines.

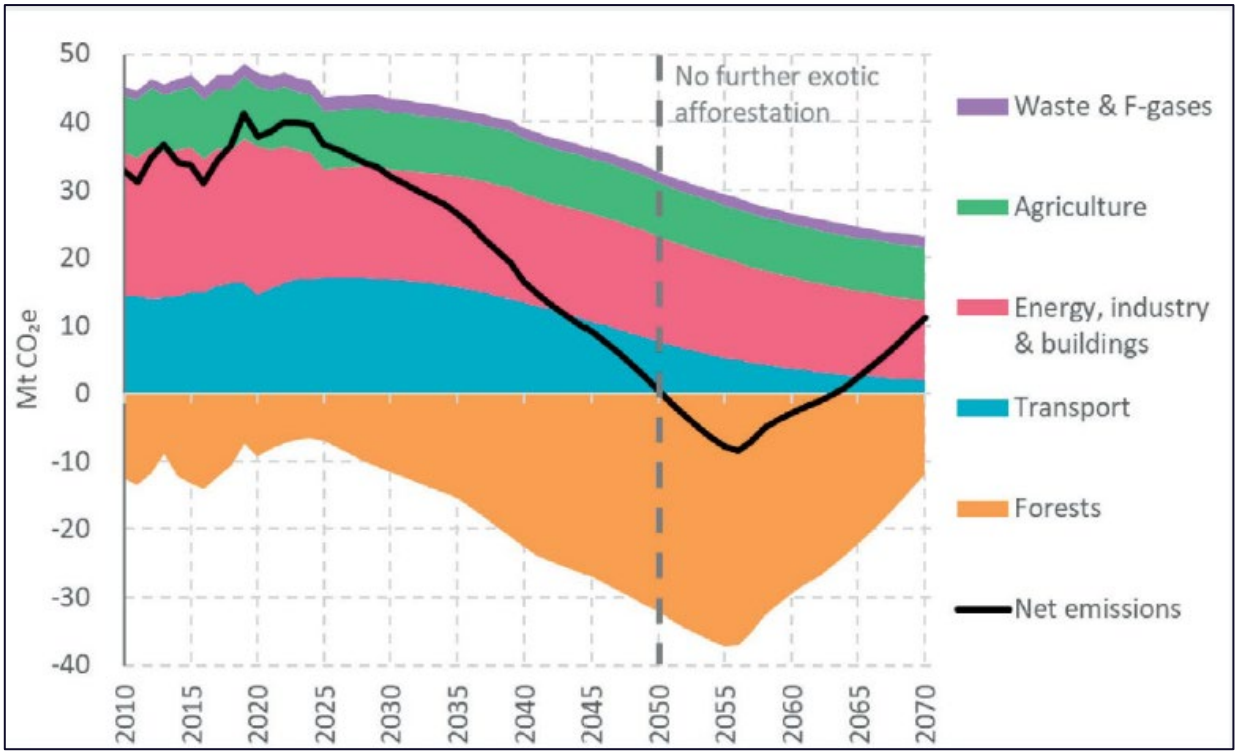


Figure 13: Long-lived GHG emissions in the 'unconstrained removals' scenario (Source: He Pou a Rangi Climate Change Commission, 2021, p. 92)

Based on the findings from the long-term scenario analyses, the report looks at 'demonstration paths' for each sector including the actions required in order to deliver the three recommended emissions budgets. An increase in the establishment of new native forests on marginal land through active planting and reversion of land to native forests would provide long-term carbon sinks for long-lived greenhouse gas emissions.

According to the report the Ministry for Primary Industries (MPI) had anticipated around 12,000 ha of new native forests to be planted in 2021. The proposed

demonstration path would see this number being increased to 25,000 per year by 2030 and by 2035, an estimated 300,000ha of new native forests established – see figure 14 below.

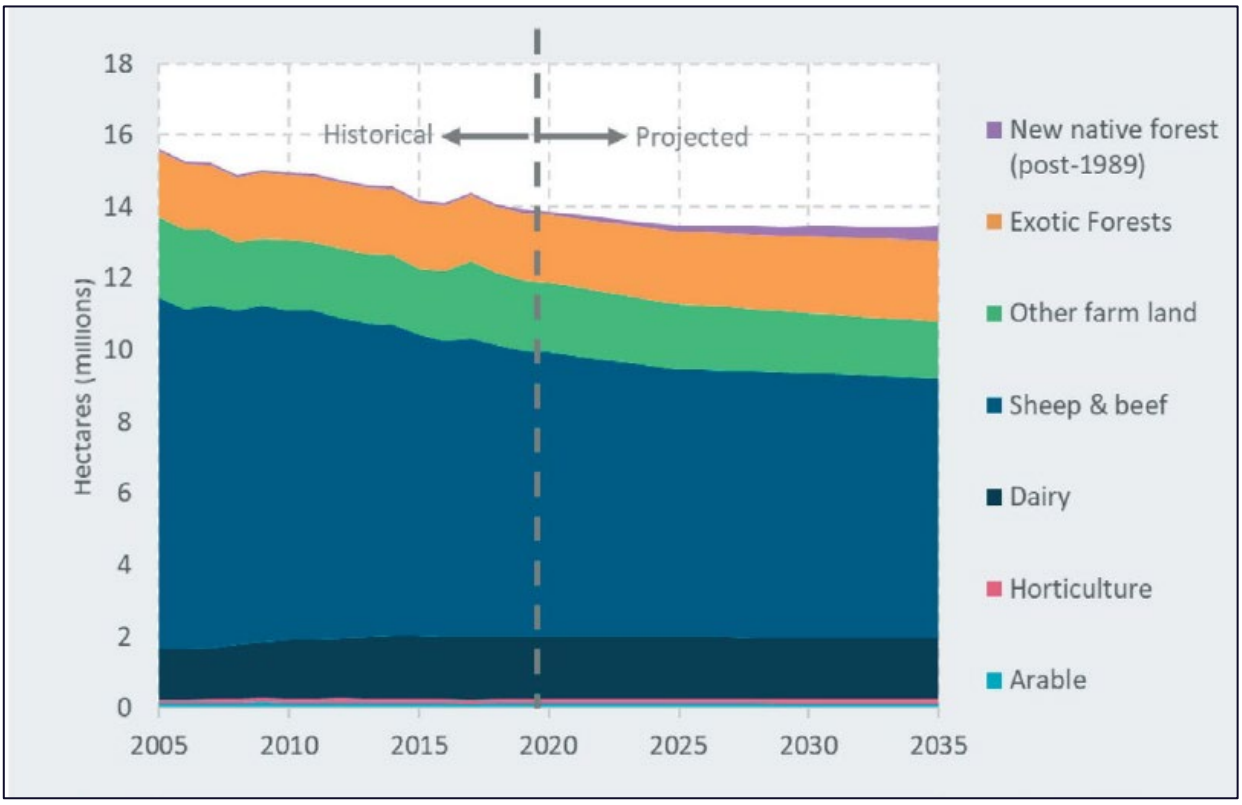


Figure 14: Land use for agriculture and forestry in the demonstration path (Source: He Pou a Rangi Climate Change Commission, 2021, p. 119)

Furthermore, the report suggests that between 1,200,000ha and 1,400,000ha of marginal land is suitable for forestry conversion, including 740,000ha which could revert to native forests naturally. It is highlighted that permanent native forests would be best suited to most of this land given the steepness and proneness to erosion.

In contrast, exotic forestry planting would continue at the anticipated rate of approximately 25,000ha per year to 2030, thereafter the rate of exotic forestry planting for carbon removals would decrease. Between 2021 and 2035, a total of 380,000ha would be established. The report states that planting over and above the anticipated 25,000ha per year is not required in order to reach the 2050 targets. The reports anticipates that the proposed demonstration path would see a reduction in deforestation which in itself is a contributor to Aotearoa New Zealand greenhouse gas emissions, and that beyond 2025 there should be no further native deforestation, as illustrated in the figure below.

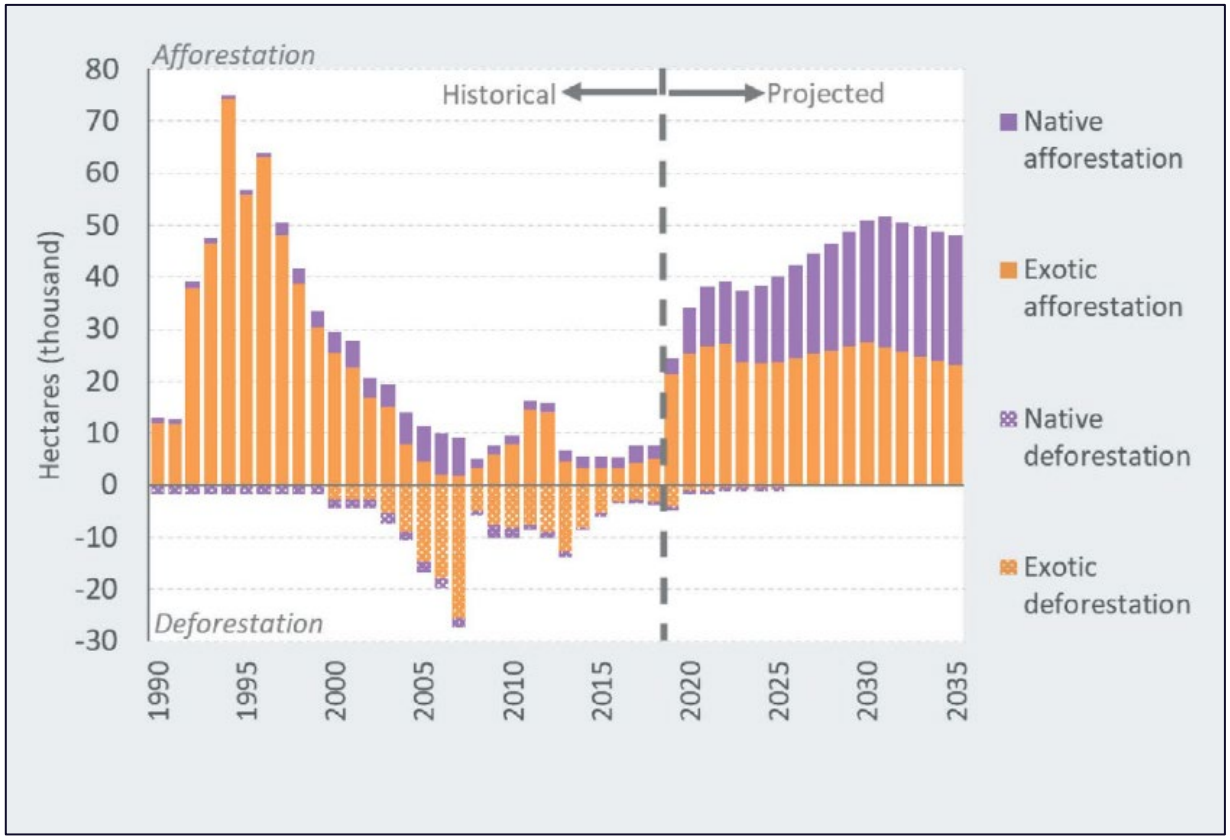


Figure 15: Afforestation and deforestation by year in the demonstration path (Source: He Pou a Rangi Climate Change Commission, 2021, p. 121)

Chapter 18 of the report provides policy direction for forests and other carbon stocks. It acknowledges that in Aotearoa New Zealand, 'forests are the only option available now for removing carbon dioxide from the atmosphere at scale' (p. 314). The overarching advice of the Climate Change Commission however is to stop greenhouse gas emissions at the source and managing them in such a way to provide a long-term carbon sink for Aotearoa New Zealand as opposed to using them as a means to meet the 2050 emissions reductions targets.

Moving Forward – Government's First Emissions Reduction Plan

After considering the independent advice of He Pou a Rangi Climate Change Commission, Government published an emissions reduction plan on 16 May 2022. The plan outlines policies and strategies to achieve the first of three emissions budgets (2022 – 2025, 2026 – 2030, 2031 – 2035).

The below table illustrates the overall 2.3 per cent lower Government's emissions budgets versus the Climate Change Commission's proposed budgets. Budgets are expressed in mega tonnes of carbon dioxide equivalent (Mt CO_2e).

Table 9: Comparative analysis of the first three emissions budgets – adapted (Source: MfE, 2022).

Budget period	2022-25		2026-30		2031-35	
	Government	Climate Change Commission	Government	Climate Change Commission	Government	Climate Change Commission
All gases, net	290 Mt CO_2e	290 Mt CO_2e	305 Mt CO_2e	312 Mt CO_2e	240 Mt CO_2e	253 Mt CO_2e
Annual average	72.5 Mt CO_2e	72.4 Mt CO_2e	61 Mt CO_2e	62.4 Mt CO_2e	48 Mt CO_2e	50.6 Mt CO_2e

In line with the Climate Change Commission's final advice, the plan acknowledges the importance of native afforestation in terms of not only improving biodiversity, but also as long-term carbon sinks (MfE, 2022).

9 Findings and Discussion

To meet our commitment to the Paris Agreement, Aotearoa New Zealand has in a way forced itself into a corner. The literature suggests that the only realistic way to achieve our commitments is to plant the fastest carbon sequestering tree available, this happens to be Pinus radiata.

This is no need for concern as pines have been used in production forestry for many years in Aotearoa New Zealand. The production pine plantations are a good source of income and provide many jobs for New Zealanders. Historically these plantations have been sighted on marginal agricultural land with very little if any impact on food producing land. Pinus radiata was first introduced into Aotearoa New Zealand in the 1850s and by the planting boom of the 1920s and 1930s it had established itself as the species of choice (Berg, 2008).

The problem is that with the increase in carbon unit pricing and the open gate policy of the OIO towards the purchase of land intended for planting to carbon forests, the agricultural land which previously was not under threat from forestry now is. As the carbon unit price continues to climb this threat grows larger and seeing large areas of productive land been lost to carbon forestry.

The impact of losing productive land to forestry is having a definitive effect on Rural Aotearoa New Zealand some positive but unfortunately negative as well.

The positive impact is that farmland which is marginal and relatively unproductive can now become a valued source of income for the landowner. Due to the low establishment of Pinus Radiata vs native trees, pines will be generally chosen. The

return on carbon credits is far quicker from pines as compared to natives due to their faster growth rate.

For farmers wishing to sell land for various reason such as wanting to move on, no natural succession and retirement, permanent carbon forest sales have helped them make the move whereas previously the farm may have sat dormant on the market for years. It has offered an out for many farmers. As farming margins become tighter and regulations increase on farming practices more farmers may see going into or selling out to exotic permanent carbon forests as an easier option. Investment returns from permanent exotic forestry at the current spot price (Averaging between $70-$80) sits around $30,000 per hectare. Investment returns sheep and beef per hectare are $4,500 and for production forestry $20,000 per hectare (MfE, 2022). The return on investment for permanent exotic carbon forests will continue to rise as the NZU price rises over time.

As this rise in return continues it will become harder for farmers to justify not selling up. The financial gain may well begin to outweigh the emotional attachment to the land. MPI estimates 645,000 hectares of exotic afforestation will occur over the next decade driven by the NZ ETS. Around half of this afforestation by 2030 (350,000 hectares) will be in permanent carbon forestry.

There is a fear Aotearoa New Zealand has put all its eggs in one basket and is relying solely on trees to reach our emissions targets. A quick fix with not much thought to the future and the impact these plantations will have in 50 years' time. There is also the concern over the extensive use of Pinus radiata. The main concern been the loss of biodiversity for future generations.

The heightened risk of wildfires, spread of wilding pines, threat to endemic species and an increased pest burden are all environmental factors leaning against permanent pine forests.

Loss of jobs in the rural sector is another fear as more whole farm conversions to permanent exotic forestry occur. The knock-on effect to rural towns and communities have already been felt in areas such as Te Tairawhiti region (BDO Gisborne Limited, 2021). Job loss in the production forestry industries and agriculture sectors will have roll on effects into all secondary industries and suppliers of these sectors.

The risk to food production at the present is minimal although it is estimated that 800,000 stock units have been lost to whole farm sales for permanent carbon forestry (B+LNZ, 2021). The planting of marginal to unsuitable production land may in fact be beneficial to livestock farmers as they can concentrate their efforts on getting

better returns from their higher producing lands and improve their stock quality through better selection and genetics.

The impact of permanent pine forests may also have an impact on our waterways and water quality. Harley, as cited by BDO Gisborne Limited (2021, pp. 26 – 27) "waterways from undisturbed native forests and mature undisturbed exotic plantation forests contain lower bacteria counts, fewer suspended solids and lower concentrations of nutrients". Water availability will see an impact from permanent carbon forests if unregulated planting is allowed to continue in catchment sensitive areas which will impact water runoff from rainfall. Runoff from Pinus radiata compared to pasture is approximately 160-260mm per year less. Runoff from Pinus radiata versus natives is also less by 100mm per year. This disruption in flow will impact direct users of the water and the aquatic ecosystem. There are two positives due to less runoff. Erosion will be less severe and the P loss into the water ways will be reduced.

Aotearoa New Zealand's continued reliance on fossil fuels is contributing to our emissions, last year 2021 we imported more coal than we ever have before. In 2020 we imported 1 million tonnes, 800,000 tonnes of this been used to generate electricity. In the first quarter of 2021 we burnt more than half the total amount coal used for electricity in 2020. The energy sector is aware of their large contribution to emissions and are looking at ways to reduce these emissions through renewable projects such as geothermal and wind sources. This unfortunately will take time but does show a positive move to improve rather just offset emissions (Bond, 2021).

The option of partial farm plantings will be of benefit to both national carbon targets and environmental benefits. The two Government initiatives into this system have been well received by farmers. They are The Crown Joint Venture Forest plantings adapted in 2017 and the One Billion Trees Programme. The benefits of these systems of planting within the farm boundary are:

- Add value through improved cash flow
- Reduction in net farm emissions
- Reduce risk associated with emissions that a farm might incur going forward

These systems of allowing partial farm plantings to be included into the NZ ETS will reduce the sale of farms for whole farm plantings (Orme & Orme, 2021).

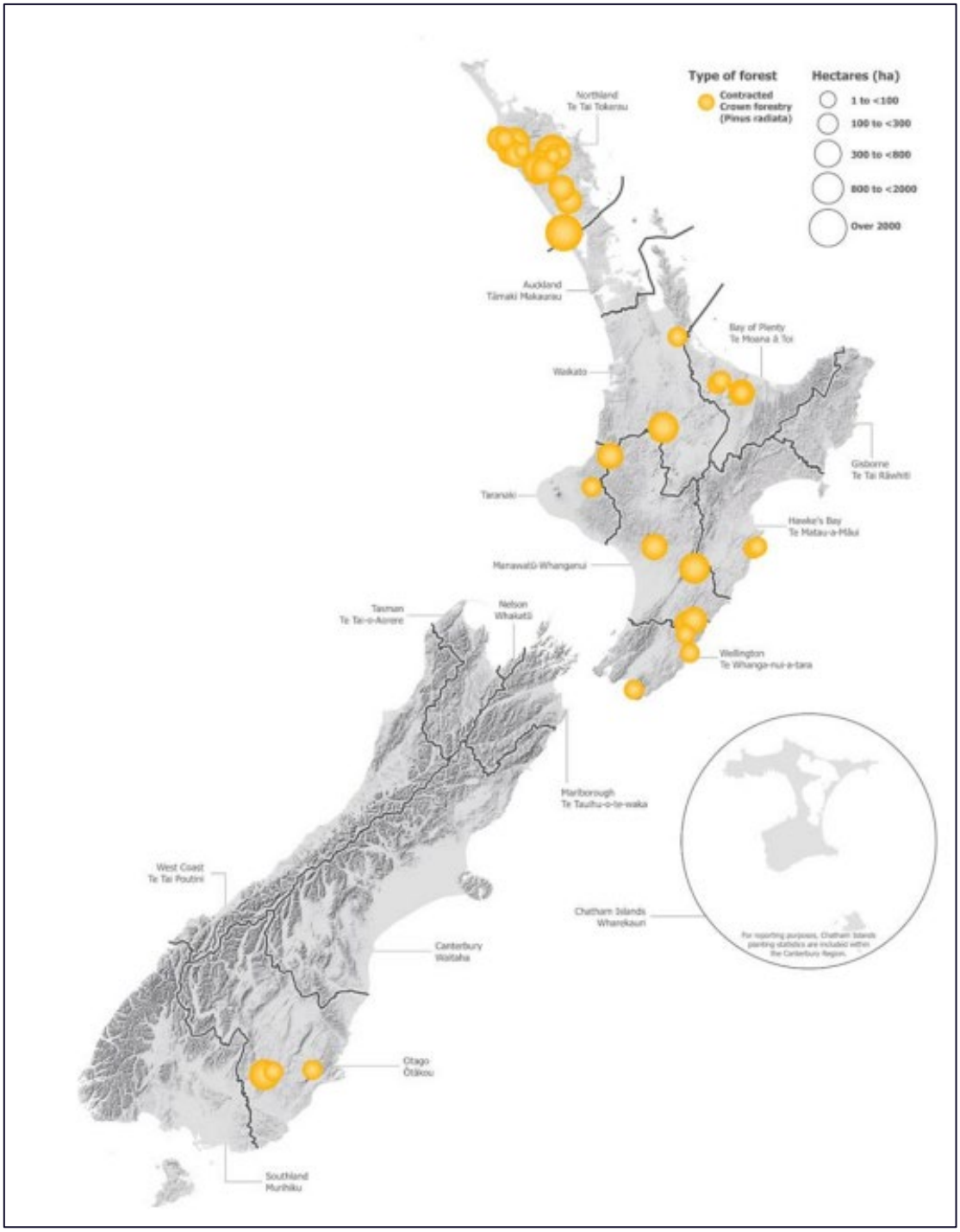


Figure 16: Crown Joint Venture Plantings (Source: Orme & Orme, 2021, p. 27)

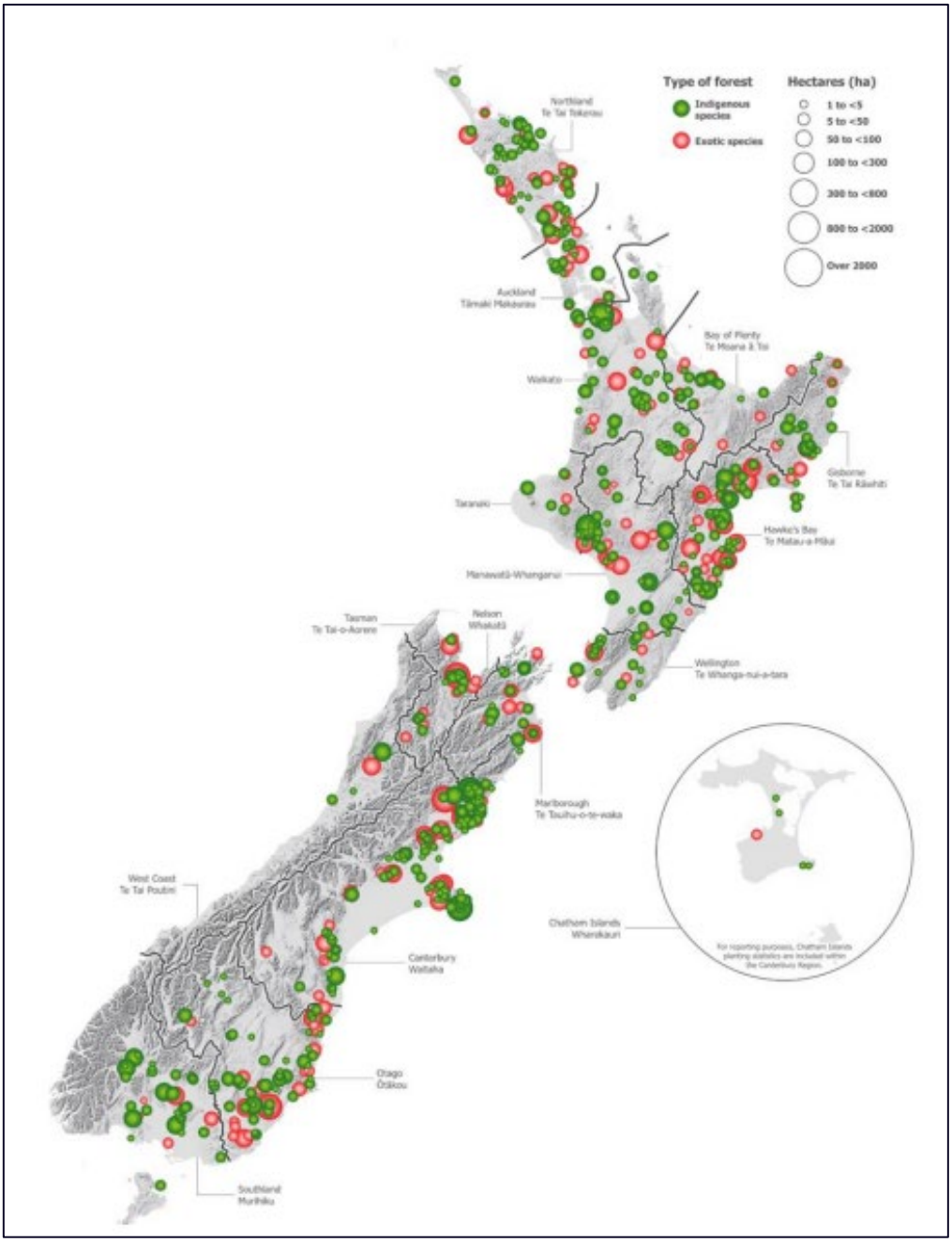


Figure 17: Approved 1BT grants (Source: Orme & Orme, 2021, p. 28)

On completion of the research and literature review the impacts of permanent exotic carbon forestry on rural Aotearoa New Zealand are both negative and positive. The positive aspect would appear to have a definitive short-term impact of reaching our goal of being carbon neutral by 2050 but past 2050 this impact turns to a negative in terms of the impact on our biodiversity, ecology, and future generations. The following conclusions and recommendations stem from this project.

10Conclusion

There can be very little doubt that permanent exotic forestry possesses greater risk to rural Aotearoa New Zealand than it does good. Although in the short term the financial benefits along with carbon absorbed from these trees will prove very attractive the impact for future generations will not be as beneficial due to the impact on the biodiversity and possible negative land value.

The initial plan of planting the faster growing, higher carbon absorbing Pinus radiata species seems to have been rushed into without taking the full impact these single mono-culture exotic species will have on the Aotearoa New Zealand landscape. The quick fix solution will allow us to meet our obligations to the Paris Agreement, however if we do achieve our carbon neutral status by 2050 what will become of these forests. The option of felling them for logs could be expensive as these forests are unmaintained with no access roads. Distance from port would be an issue due to their remoteness. The impact of felling these trees could cause further erosion in steep areas, slash build up in waterways and destroy any native regeneration that has occurred in the forest. Would the forest owners be prepared to put up the finances for these operations to occur or would they leave the forests as they stand and walk away. If these forests are to be felled once carbon neutral status is achieved, then most of the carbon that was stored in these trees will be released into the atmosphere meaning we are back at square one and does this mean we have to now keep the cycle going of planting more exotic pine trees to get us back to carbon neutral status. Native trees store carbon for hundreds of years so for our long term gain they must be the solution.

All industries that emit carbon must be held accountable for their part in trying to cut emissions rather than simply carrying on normal operandum. The practice of offsetting emissions is an easy out for industry now and this needs to change. By cutting emissions we would have to plant less permanent exotic forests and thus reduce the land area needed for this. Agriculture is one of the very few industries that has reduced its emissions (methane), a reduction of 30% since the 1990s through better management practices and advancing technology (NIWA, n.d.).

- breeding low-emitting animals
- planting low-emitting crops and using low-emitting feed additives
- methane vaccination to reduce methane production
- methane inhibitors to suppress the methane producing microbes in an animal's gut.
- Alternative manure management treatments to capture or reduce methane from effluent

If it comes to the point of forest owners walking away the Aotearoa New Zealand taxpayer may well be left with the task of paying for the clean-up of these forests from wilding pine control, wildfires, and pest control.

11 Recommendations

The recommendations from this project are listed below.

Government agencies recommendations.

- The OIO to begin restricting overseas purchases of whole farms for conversion into permanent exotic carbon forests.
- MPI to allow Pre 1989 Native forests to join the ETS.
- MPI ensuring further research is done on existing native forests to realize their full carbon sequestering potential.
- MPI introducing natural carbon sinks (Fiordland) into the ETS.
- MPI allowing on farm plantings pre 1989 be allowed into the ETS and encourage new plantings on marginal land and around waterways.
- MPI promoting planting the right tree in the right place.
- MPI encouraging the increased plantings of natives.
- MPI to investigate alternative means of carbon sequestration such as the use of seaweed.
- MPI encouragement for partial farm plantings on marginal and unproductive land.
- MPI reintroduction of grants (1BT fund) to encourage native plantings.
- MPI recognizing the 1.4 million hectares of woody vegetation already found on sheep and beef farms as carbon sequestering rich areas.
- MPI implementing regulations around the planting of permanent exotic carbon forests. Particularly around the planting near or around sensitive water sources, biodiverse sensitive areas, and the management of these forests (what is the forest owner's responsibility with regard pest, fire control and best forest management practises).

Business and Industry recommendations.

- Business and industry reducing emissions from Aotearoa New Zealand industry and agriculture by better practices in these areas.
- Encourage industries to reduce emissions through better practices rather than carrying on as normal and relying on offsetting emissions as the easy way out.

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Addendum - New Rules Proposed for Carbon Farming of Exotic Forests in the Future

On the 3rd of March 2022 the Honourable Stuart Nash (Forestry Minister) and the Honourable James Shaw (Climate Change Minister) released a media release stating that they are considering making changes to the planting of exotic forests like radiata pine for use in the ETS. Public submissions can be made from 14th March until 22nd April 2022.

Key Proposed Changes

The new permanent forest category of the NZ ETS, which comes into force on 1 January 2023, permits exotic species including radiata pine as well indigenous forestry to be registered in the scheme and earn Aotearoa New Zealand Units (NZU).

The Government has listened to submissions and confirmed the risk that the new permanent forest category and high NZU prices could accelerate the establishment of new permanent exotic forests which are not intended for harvest.

To manage this risk, the proposed changes include restricting exotic forests from registering in the permanent post-1989 category in the Emissions Trading Scheme, which will remove the NZ ETS incentive to plant permanent exotic forests.

The Government is also consulting on a proposal to adjust how the new carbon accounting method (averaging accounting) applies to remote and marginal land for harvesting. (Minister Stuart Nash, 2022)