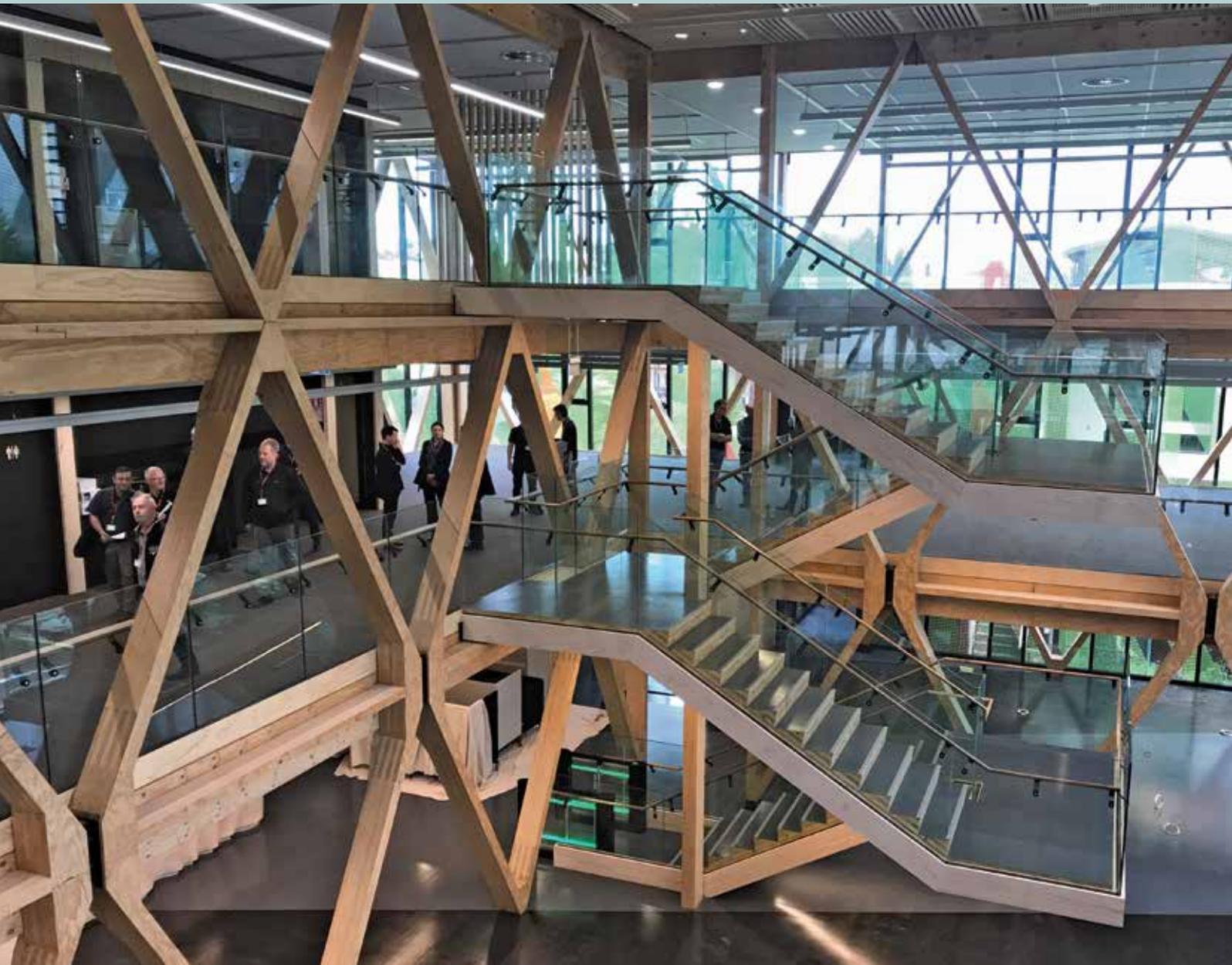


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Update on forest regulation
Tane's Tree Trust vision
Carbon economics of natural regeneration at scale
Forest Growers Research R&D programmes



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Front cover photo: Scion Innovation Hub in Rotorua. Photo courtesy of Andrew Hewitt

Back cover photo: Hudson Clearwood pruning machine undergoing field trials. Photo courtesy of Paul Adams

Tim Thorpe

This issue of the *New Zealand Journal of Forestry* includes five papers from the NZIF conference held in Auckland in September last year, plus two professional papers. They cover, as the saying goes, a broad church. From someone whose career has included tropical, exotic and indigenous forest management, as well as wood utilisation, it is a pleasure to read papers that cover such a wide spectrum of topics. That's what forestry is about.

First up, Andrew Hewitt (Red Stag) provides an update on mass timber adoption in New Zealand. The market has started from a small base, but interest has been growing in recent years. Different forms of mass timbers include GLT (glue laminated timber or glulam), CLT (cross laminated timber) and LVL (laminated veneer lumber). There are increasingly more options, but architects, designers and builders need education about how to use them. Production, distribution and construction also need to be integrated in new ways. At the same time, standards and regulations need review.

Heidi Dungey (Scion) et al. ask the question about whether we can make planting native forests cheaper by growing seedlings in smaller pots. Based on the results of a one-year planting trial of different species and sites near Rotorua, the short answer is yes. The simple fact of needing less media in each pot reduces cost, as well as impacting on distribution and handling costs. The longer answer is more complicated and is site and species dependent, along with other factors such as availability of skilled labour. I look forward to the second-year results in a future issue of the journal.

David Raudkivi (Russell McVeagh) provides a background and useful commentary on the Log Traders and Forestry Advisers legislation and the Forests (Legal Harvest Assurance) Amendment Bill. Things are happening so fast that even since this paper was presented at the conference in September further consultation on the Log Traders regulations has already been announced. As David himself says, 'watch this space'.

Paul Adams (R&D Director, Forest Growers Research Ltd) has provided an update on three research and development programmes managed by FGR – Automation and Robotics (commenced in 2019), Speciality Wood Products (officially completed December 2022) and Precision Silviculture (launched

in May 2022). Paul's paper outlines in detail the activities undertaken in each programme. FGR also publish a regular newsletter and hold an annual conference which is always worth attending.

Malcolm Paterson (Tumumaki/Chief Executive) takes us on the journey of Ngā Maunga Whakakī o Kaipara's (NMWoK) management of the Woodhill Forest estate, including a block of Riverhead Forest, since Ngāti Whātua o Kaipara's Treaty settlement with the Crown in 2013. Some issues are common to all large forest owners, such as dealing with recreational users and fire prevention, and others are linked to the hapu's cultural aspirations and long-term vision. Malcolm wrote this for all of us to understand their journey, but also as a potential guide to other iwi going through their own Treaty settlement processes involving forested land.

The first of the professional papers is by Jacqui Aimers and David Bergin (Forestry Scientists and trustees, Tāne's Tree Trust (TTT)), who provide an introduction to TTT. Established as a nationwide charitable trust in 1999, TTT has attracted funding from a range of sources and, drawing on a nationwide resurgence of interest in our indigenous forest, has built its momentum accordingly. TTT's vision is, 'seeing landowners successfully establishing and managing native forest for multi-purposes'. How TTT go about this, including the resources they have produced and other achievements to date, are covered in this paper.

The final paper (and the third paper in this journal relating to indigenous forests) is by Sean Weaver, founder and CEO of consultancy company Ekos, based in Christchurch who has written about the economics of managing natural forest for carbon at scale (>100,000 ha). Sean is a lover of indigenous forests, but a pragmatist when it comes to its role in climate change mitigation. He has analysed four scenarios in detail involving indigenous forests on their own or in combination with exotic forests. It will come as no surprise that it is the mixtures of exotic and indigenous forests that provide the greatest carbon and financial advantages. Read on.

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Mass timber adoption in New Zealand

Andrew Hewitt



Figure 1: Cathedral Grammar School, Christchurch

Abstract

Mass timber adoption has recently witnessed significant growth. It is increasingly being used as the structural material of choice for a wide range of construction and infrastructure projects across New Zealand. This paper explores some of the industry changes that have contributed to this growth and looks at some of the external influences that have been playing a role in promoting the uptake of mass timber. It provides an overview of how manufacturing is moving to meet the growing demand and gives

viewpoints on various topics related to manufacturing, supply chain and wider industry factors. Mass timber has an important future, where plenty of opportunity exists, and will have an essential part to play in our low carbon future.

Overview of recent growth

There has been a major increase in the use of mass timber products such as glulam (GLT), cross-laminated timber (CLT) and laminated veneer lumber (LVL), as structural materials for construction and

infrastructure projects in New Zealand since 2019 (see Figures 1, 3 and 4). This is a trend which looks to continue for several years yet.

What had been (up to 2019) a steady (and, in comparison, slowly growing) mass timber industry has seen a notable increase in the demand for these products across all construction sectors. This is a trend which is also mirrored globally, particularly in North America, Europe and closer to home in Australia. Where mass timber had previously been used for highly bespoke projects, or in projects only as feature elements, it is now being widely adopted as a material of choice for full structural solutions on an increasing range of building types.

Of course, buildings do not happen overnight, and as a precursor to this demand on the building site a notable increase was seen in 2016–2017 of the number of design consultants wanting to incorporate mass timber into their designs. Until that point, the mass timber design community in New Zealand was quite small and the design work required for mass timber, particularly from a structural design viewpoint, was considered highly specialised.

Sustainability credentials

During this same period, conversations around climate change and global warming were becoming very much mainstream topics, which through a form of social responsibility led to many organisations incorporating carbon reduction policies across their building activities.

With this increase in consultants and public awareness of climate change, mass timbers benefits – such as its sustainability credentials (decarbonising construction, carbon sequestration), speed of construction, biophilic design, architectural expression of structure and the ability to perform well seismically – came into the spotlight.

Growing interest

Industry bodies, technical groups, Primary Growth Partnership (PGP) programmes and content providers dedicated to mass timber have been evolving and growing in numbers, which has helped in the dissemination of information to a wider and growing audience. The Wood Products and Manufacturers Association (WPMA), the Timber Design Society (TDS) – a technical group of engineering New Zealand, the Timber Design Centre (TDC), Scion, Mid Rise Wood Construction and the annual WoodWorks conference are all successful platforms for propelling the adoption of mass timber in New Zealand.

An example of the notable increase in interest in learning about mass timber can be seen in Figure 2, showing attendance numbers at the annual WoodWorks conference for the last seven years. This illustrates a consistent level of interest from 2016–2019, with a growth period starting from the 2020

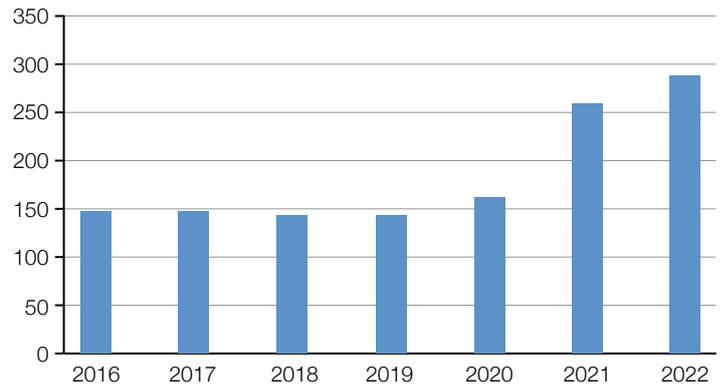


Figure 2: WoodWorks conference attendance 2016–2022

period. This would align with the timing of these first major buildings being constructed and people starting to notice more mass timber buildings entering the built environment around them.

ITP and EPD

The recent Industry Transformation Plan (ITP) published by the Ministry for Primary Industries (MPI) combines much of this knowledge and thinking around the benefits of using mass timber. The ITP puts out a clear message to the industry about how the Government sees the construction sector moving towards a more sustainable future.

An industry-wide Environmental Product Declaration (EPD) has also been compiled and published, allowing designs to better access the environmental aspects of the structures they are designing. Carbon accounting is becoming a standard measure on buildings and other environmental schemes are gaining popularity. More and more manufacturers have invested in environmental product information like V.O.C. testing and Declare labels to support Green Star and Living Building Challenge projects.

Supply to meet the demand – manufacturing capacity

RedStag TimberLab is a mass timber supplier in New Zealand, producing GLT, CLT, LVL and Frame and Truss across multiple plants in Auckland, Rotorua and Hamilton. Our goal is to lead the industry in the modern manufacturing of mass timber.

Manufacturing capacity in New Zealand, which for the past few decades has been growing at a rate in line with the market demand (as it was prior to 2019), has had to rapidly change its pace of growth to meet this increased demand. Manufacturing growth took several years to come to fruition because new building materials and equipment from overseas (typically Europe) were required to meaningfully increase capacity.

Having witnessed this demand increase on the horizon, RedStag TimberLab has put plans in place

to grow capacity and capability across our mass timber-focused operations. Operations have grown substantially over this period, with the first stages of these plans (a purpose-built CLT plant in Rotorua and an extension to the Auckland GLT plant) being completed and already creating additional capacity for the market. We remain committed to supporting the uptake of mass timber by growing local capacity and capability. Additional manufacturing equipment across multiple sites has already been purchased and is in transit to enable extra capacity through 2023.

Manufacturing growth is needed in two primary areas to ensure that the supply for this growing market keeps pace with demand, the first being commodity production for 'off the shelf' solutions and secondly bespoke production for custom-made and prefabricated solutions.

Increasing capacity for commodity production is a simpler equation, and with capital investment, time and raw materials this can (and has) been achieved with great results. Once operational, a facility designed for commodity production can often turn capacity up or down to meet the market due to the repetitive nature of the processes involved.

Manufacturing facilities for bespoke production are much more complex and take more time and investment to deliver supply to market. These facilities require everything that the commodity product does, plus a large amount of human resource (both upfront and ongoing), and specialist plant planning to provide capability and allow for flexibility in production.

Developing manufacturing facilities that cater for both forms of production is not the most efficient way to produce, but is often what is required with



Figure 3: Coastlands Aquatic Centre, Kapiti Coast



Figure 4: St Patrick's Church, Christchurch

a market size like New Zealand has to offer. The capital input to mirror what some of the European plants have in the way of automation for bespoke manufacturing is challenged by the market size here.

Increased workload on factory floor

Modern manufacturing (CAD, CAM and CNC), and a wider adoption of prefabricated and offsite solutions being incorporated into construction methodologies, has seen a notable increase in another part of the bespoke production model. Whereas in the past the process would be finished at the completion of the timber part(s), there are now a growing number of projects where post-manufacturing operations (such as multi-part assembly and module building) are

being incorporated. These tasks are being completed as part of the manufacturing process to enable the construction to be quicker and less disruptive to its surroundings.

This increased workload on the factory floor has required a rethink in the way we approach designing components and how we programme construction site works. Typically, with prefabricated products, the design needs to happen much earlier and to a more finite stage to allow for this work to be completed well ahead of when the construction starts. With a completely prefabricated structure, the build time can easily outpace the manufacturing time, so we need to move to a strategy where the building components are made and stored ready for construction before the building site needs them.

Completing this production ahead of the construction timeline, and taking into account the increased upfront design work both by the design consultants and the manufacturers, has meant a shift in the commercial arrangements required to make this work for all parties. There has been a move away from traditional tender models, which were very linear in time, to increasingly using early involvement forms of engagement where designers have direct contact with manufacturers throughout the design phases and the manufacturing companies can start the process of producing manufacturing information much earlier.

Software platforms like BIM 360, which enable the real-time sharing and combining of design work in 3D models from various sources, have aided a wider team of designers and manufacturers/suppliers to work together in this early engagement process.

Wider industry factors

Raw material supply has become a large focus for industry, with a general awareness that we need to be sending less logs offshore as unprocessed fibre and create more finished goods for both export and local use. There is a big opportunity to increase jobs, especially in the regions, and to increase our forestry export values when considering the export of finished goods.

With overseas governments providing subsidies to their industry to enable log purchases at higher rates, local manufacturing is paying the price. The price paid for logs by local mills must match what the export market will pay, meaning the raw material costs for local manufacturers are controlled by what these overseas buyers are doing. The result once the subsidies have been applied is that overseas producers can often produce products from New Zealand grown timber and ship them back to here at a cheaper rate than we can produce locally.

We need to encourage growth in our forests to meet future demand, and it is essential that our current forests do not decline in size and that the harvesting and replanting of these areas continues.

A large amount of research and product development is being undertaken in New Zealand by manufacturers/suppliers, higher education (the Auckland of University and the University of

Canterbury), as well as designers and developers looking to introduce and test proprietary solutions. This research, coupled with an increasing amount of case studies and post-construction testing for factors like acoustics, are increasing the knowledge around material properties and performance.

Constructors have risen to the occasion as well, with more and more building and construction companies increasing their knowledge of mass timber and understanding how to successfully incorporate these materials on-site. With a greater knowledge of moisture control, construction methodologies that incorporate prefab/CNC components and material handling for exposed structural elements, constructors are more able to help in achieving quality outcomes.

A greater utilisation of digital tools like 3D models, virtual reality (VR) and augmented reality (AR) are allowing site teams to harness the digital information provided by the design teams and relay it as built information back to designers and customers in real time.

Standards and regulations

A new design standard (NZS AS 1720.1) to replace our old NZS 3603 has just been released, which will bring us more in line with recent learnings and international standards. A greater awareness of international standards and verification methods is also allowing local designers to design mass timber in a more efficient and robust way.

Fire design and associated building compliance and insurance regulations are a heavy focus for industry. A large amount of resource has and continues to go into performance testing and specialist design knowledge to give confidence to building owners, regulators and emergency services.

A low carbon future

The mass timber industry in New Zealand has an exciting future where plenty of opportunity exists, and an essential part to play in our low carbon future.

Andrew Hewitt is General Manager of RedStag TimberLab based in Auckland. Email: andrew.hewitt@redstag.co.nz

Can we make establishing native forests cheaper by growing native plants in smaller pots?

Heidi Dungey, Craig Ford, Alex Lloyd and Kelly Turner

Abstract

Establishing forests over a large area, specifically to buy New Zealand time to adapt to climate change, is something new for this country. Establishing indigenous forests at small scales is already being done through reversion, augmentation and planting. Large-scale planting is very rare and not always successful. Planting native forests is often avoided due to the high costs involved. If we can adapt forestry growing methods to native trees, and use smaller plants that cost less, then a good proportion of costs can be removed from this equation. This paper discusses some recent work around Rotorua, in New Zealand’s Central North Island, to examine where and how using forestry-grade plants might work.

Introduction

In its recent report, the New Zealand Climate Change Commission (2021) recommended the establishment of 300,000 ha of native forests by 2035. This is a huge and audacious goal that has already seen considerable debate about how this might be possible. All types of forest establishment practices will be needed to meet this goal, including the use of passive forest reversion, augmented planting in a reverting forest, or planting on human-modified sites. One of the biggest barriers to establishing indigenous forests is how to obtain sufficient numbers of quality plants to successfully establish native forests at scale.

Native plants from nurseries commonly supplied for planting are often expensive compared with exotic forest plants and can take a lot longer to grow. Large-scale afforestation with native trees is seen as potentially too costly and logistically demanding (Forbes et al., 2019). While all approaches will be needed to reach the target area for afforestation (Forbes Ecology, 2022), there are alternatives to some of the more costly components of the establishment of native plants across the motu.

Forbes Ecology’s recent work (2022) to document the current costs of restoration planting gives some important insights into the complexity and levels of costs that can build into, at times, a very high price for forest restoration. Using the data collected, and 4,444 stems/ha, total cost of establishment was between \$22,314 and \$27,7425/ha. Within these cost estimates, however, some interesting comparisons can

be made (Table 1). Comparing the best- and worst-case scenarios from the evidence collected, the extremes could actually be very different (between \$6,100/ha and up to \$188,000/ha).

It is extremely unlikely that anyone would have found themselves with all the worst-case scenario costs, but this comparison is interesting to make in the context of what the native planting goals are. Estimated costs of establishing all of the 300,000 ha is therefore between \$1.83 billion and \$11.15 billion for the current average. It is not worth even considering the worst-case scenario in a practical context as no-one would choose it. The comparison does show, however, that there is an opportunity to test the current cost paradigm and work towards making the lower-cost options more available.

Forest establishment costs for the exotic species such as radiata pine are much lower. New Zealand Farm Forestry Association (2023) case studies suggest around \$846/ha and for Douglas-fir around \$1,300/ha. This would of course vary and tend further towards the \$1,000, given the quality of the genetics of radiata pine plants at establishment can also vary (e.g. \$515–\$725/1,000 from a New Zealand forest nursery catalogue).

These costs are based on 75 years of research and development, from seed orchards through to site preparation, planting and early silviculture.

Table 1: Average, low and high costs of native restoration plantings

| | Low | Current average | High | Aspirational forestry model |
|----------------------|-------|-----------------|---------|-----------------------------|
| Stems/ha | 1,100 | 4,444 | 10,000 | 1,100 |
| Cost/plant | 0.6 | 3.77 | 10.23 | 1.50 |
| Transport cost/plant | 3.5 | 2.26 | 5 | 1.00 |
| Planting cost/ha | 1,250 | 7,044 | 21,717 | 1,250 |
| Releasing | 40 | 2,649 | 12,500 | 40 |
| Blanking | 300 | 667 | 1,500 | 300 |
| Total/ha | 6,100 | 37,157 | 188,017 | \$4,340 |

Source: Forbes Ecology (2022)

Note: A breakdown of aspirational forestry-adapted operational costs is also given

An aspirational cost structure for native forest establishment using forestry-based techniques is suggested in Table 1. This is still much higher than for exotic species, but considerably lower than the current paradigm. With research, development and the rapid adaptation of knowledge from large-scale forestry and horticulture, an aspirational goal of establishing indigenous forests is achievable.

Why are native trees so much more expensive? Every step of the process is more costly, from seed production and germination, to growing as bare-root or smaller forestry-grade containers, and then more efficient packing, transport and even planting. One key example is pot size. Many restoration and afforestation projects use large plants, with either PB1 or PB2 planting stock (approximately 600 cm³ and up to 1,500 cm³ of soil, respectively). Forestry-grade plants can either be bare-root or containerised (usually 90–350 cm³). While only one factor, it affects all aspects of forest establishment post-germination where volume of media used, and space needed in the nursery and for transport, are critical factors.

This study, funded by Te Uru Rākau New Zealand Forest Service, attempted to take a preliminary look at the effect of container type on the establishment success of native plants in and around the Rotorua district.

Materials and methods

Twelve different species were tested in 10 different pots and planted across six sites around Rotorua. Year-one measurements on survival was measured and analysed. Details of species, pots and sites are given below.

Species

Twelve species were selected for trialling across different pot types/container systems (Table 2). With extremely high frost mortality on all sites and, across all container types, *Metrosideros excelsa* and *Vitex lucens* were also excluded from this analysis. All species,

other than *Melicytus ramiflorus* and *Kunzea ericoides*, were collected from the Whirinaki forest by our project partners, Minginui Nursery. The other two species were purchased commercially and supplied by our other nursery partner, Treeline Native Tree nursery.

Pot type

Ten different growing systems were tested in the trial (Table 3).

Field trials

There were six trial sites, each representing a replication. In each replication 1,774 trees were planted as randomised single tree plots. Single tree plots were completely randomised on the chosen site.

Table 2: Twelve selected species for the container system trial reporting

| Scientific name | Common name | Māori name |
|-------------------------------|------------------------|------------|
| <i>Aristotelia serrata</i> | Wineberry | Makomako |
| <i>Coprosma grandifolia</i> | Kanono | Raurēkau |
| <i>Coprosma robusta</i> | Karamū | Karamū |
| <i>Cordyline australis</i> | Cabbage tree | Ti kōuka |
| <i>Dodonaea viscosa</i> | Hopbush | Ake ake |
| <i>Hoheria angustifolia</i> | Narrow-leaved lacebark | Houhere |
| <i>Kunzea ericoides</i> | Kānuka | Kānuka |
| <i>Leptospermum scoparium</i> | Mānuka | Mānuka |
| <i>Melicytus ramiflorus</i> | Whiteywood | Māhoe |
| <i>Plagianthus regius</i> | Ribbonwood | Mānatu |
| <i>Podocarpus totara</i> | Tōtara | Tōtara |
| <i>Sophora microphylla</i> | Small-leaved kōwhai | Kōwhai |

Table 3: The 10 different growing systems included in this trial

| Grade | Volume (cm ³) | Description | Container type |
|---------------------------|---------------------------|-------------|---------------------------------------|
| Retail/revegetation grade | 1,200 | PB2 | PB2 plastic propagation bags |
| | 900 | P10 | 10 cm diameter Ellepot paper pots |
| | 700 | P8.0 | 8 cm diameter Ellepot paper pots |
| | 500 | T28 | pT28 propagation trays |
| Large forestry grade | 310 | V310 | Hiko V310 forestry tray |
| | 150 | V150 | Hiko V150 forestry tray |
| Standard forestry grade | 125 | P4.0 | 4 cm diameter Ellepot paper pots |
| | 125 | TS48 | Transplant systems TS48 forestry tray |
| | 90 | P3.5 | 3.5 cm diameter Ellepot paper pots |
| | 90 | TS45 | Transplant systems TS45 forestry tray |

The six trial sites were established within a 15 km radius of Rotorua (Table 4). Sites were arranged by Tipu Wai Trust who also assisted with site preparation and planting. Trees were planted at 1.5 x 1.5 m spacing. Sites were of varying quality and silvicultural intensity (Table 5).

All trials were established between June and September 2020. Scion staff transported plants to each establishment site and oversaw the trial establishment. Tipu Wai Trust, or other partnering landowners, arranged site preparation and planting crew, as well as release weeding when appropriate. Scion technicians returned to assess survival after about one year (in June and July 2021).

Analysis for treatment differences was completed using general analysis of variance, in R. The six sites were used as the blocking term (replication). Significant differences between species and treatments

were tested using the pairwise post-hoc analysis with Tukey's Honest Significant Difference test, comparing means at alpha = 0.05. A regression analysis was used to investigate site-specific container volume effects on survival and species-specific survival as a result of site and container volume.

Results

Site

Overall, we observed that the sites sit largely in three groups: high quality (E1 and E2), good quality (A and B) and poor quality (C and D). This classification was based on expert knowledge of the sites and their unique growing environment due to differences in altitude, exposure, soil quality and fertility, rates of browsing, local herbivorous species, weed species present and method of weed control (Tables 4 and 5). Sites E1 and E2 were also ex-pasture, which

Table 4: Site details of the six sites used for field planting

| Site reference | Site name | Description | Latitude | Longitude | Altitude (m) | Planting date |
|----------------|--------------------------------|---|------------|-------------|--------------|---------------|
| A | Okareka Loop Rd – Lake Okareka | Roadside native tree rehabilitation of exotic block | 38°10'08"S | 176°20'44"E | 355 | 26/06/2020 |
| B | Miller Road – Lake Okareka | Native forest rehabilitation on nature reserve | 38°09'42"S | 176°20'58"E | 347 | 24/07/2020 |
| C | Hemo Gorge | Riverine rehabilitation | 38°10'02"S | 176°14'50"E | 302 | 14/08/2020 |
| D | Horohoro – Roadside | Pasture revegetation on farm block | 38°13'52"S | 176°10'59" | 368 | 27/08/2020 |
| E1 | Kaharoa – Top | Pasture revegetation on farm block | 38°01'22"S | 176°13'16"E | 425 | 22/09/2020 |
| E2 | Kaharoa – Bottom | Pasture revegetation on farm block | 38°01'28"S | 176°12'59"E | 358 | 22/09/2020 |

Table 5: Site quality descriptions for the six sites used for field planting

| Site | Site name | Site description | Planting description | Weed species | Release | Overall site quality |
|------|--------------------------------|---|---------------------------------------|---|------------------------------|----------------------|
| A | Okareka Loop Rd – Lake Okareka | Good soil, frost pocket, gully | Paid unskilled labour | <i>Convolvulus</i> sp., grasses, blackberry | Yes, mechanical | Good |
| B | Miller Road – Lake Okareka | Good soil, frosty, lakeside | Semi-skilled volunteers | <i>Convolvulus</i> sp., grasses | Yes, chemical and mechanical | Good |
| C | Hemo Gorge | Good soil, gully, heavy browsing | Unskilled and semi-skilled volunteers | <i>Convolvulus</i> sp., Bracken sp., blackberry | Yes, chemical | Poor |
| D | Horohoro – Roadside | Poor, shallow, compacted (former roadside), xeric soil, council sprayed edge of trial | Unskilled volunteers | Grasses, thistles, gorse, blackberry at periphery | No, chemical drift | Poor |
| E1 | Kaharoa – Top | Former dairy pasture, dryer, exposed hilltop | Professional planting crew | <i>Achillea millefolium</i> (yarrow), grasses | No | High |
| E2 | Kaharoa – Bottom | Former dairy pasture, moist soil | Professional planting crew | <i>Achillea millefolium</i> (yarrow), <i>Phytolacca octandra</i> (Inkweed), grasses | No | High |

had no maintenance since planting. Sites C and D had received at least one agrichemical application to combat weeds. Sites A and B were mechanically weeded with a string trimmer.

Seedling survival was clearly affected by site (Figure 1). Sites E1 and E2 had the best survival at 91% and 90%, respectively. With excellent site preparation and an experienced planting crew, results indicated that container selection becomes less important for seedling survival (Sites E1 and E2, Figure 1). This is an observation supported in other systems (Dominguez-Lerena et al., 2006; Landis, 2011; McGilvray & Barnett, 1982; Pinto et al., 2011).

Container/pot-type performance

Average survival across container types ranged from 65% to 86% (Figure 2). Results suggest that any of the best containers might be suitable for native tree establishment. These included the PB2, the 8 cm and 10 cm paper pots and the Hiko V310 forestry tray. It was interesting to note that the paper pots tested were just as successful as any of the most successful pots across all trials. At almost half the plug volume compared with a PB2, the 8 cm diameter paper pots would be preferable if a large plant was required. A Hiko V310 would be preferable if a slightly lower survival across all site types was considered adequate (species dependent).

The challenge is to understand how to grow good planting stock using forestry-grade (smaller or larger, Figure 2) for good survival rates in the field and lower establishment costs. While there were no significant differences between the four smaller container types, seedling survival was lower than ideal for operational planting. The larger forestry-grade containers survived across sites relatively well, particularly given the lower survival on the poor sites (e.g. Site D, Figure 1). As all the seedlings had the same raising time of 10–13 months it is possible that at least some of the smaller plugs may have become root bound, which in turn may have impacted survival.

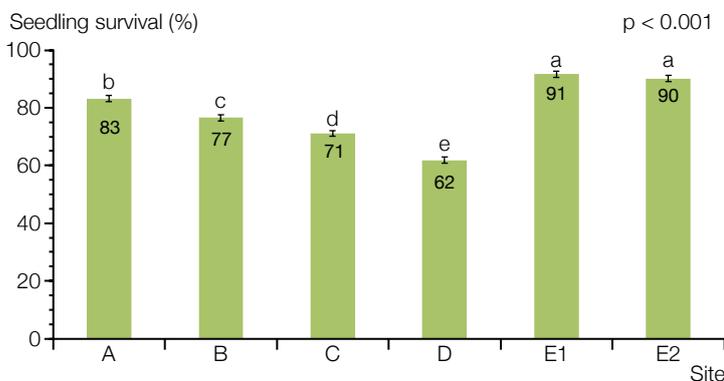


Figure 1: Seedling survival (%) across all six sites at one-year measurement

Note: Letters above bars represent significant differences between treatments using the pairwise post-hoc analysis with Tukey’s Honest Significant Difference test, comparing means compactly at alpha = 0.05. Where $P < 0.001$, differences between treatments are statistically highly significant

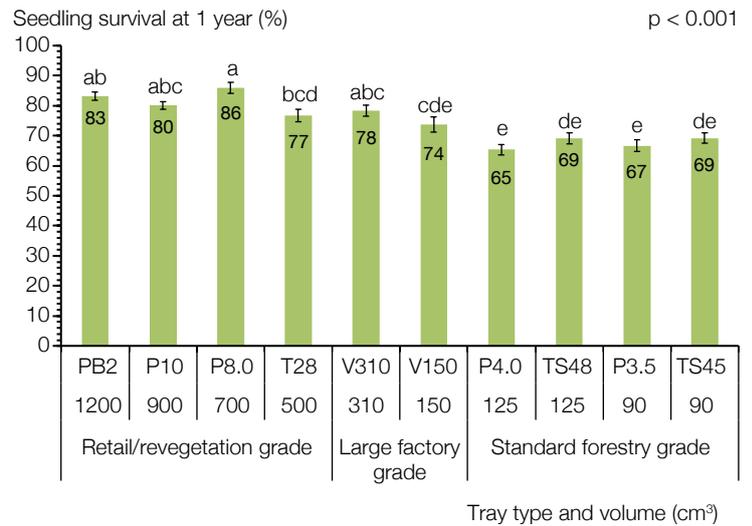


Figure 2: Seedling survival (%) by container type after one-year measurement

Note: Letters above bars represent significant differences between treatments using the pairwise post-hoc analysis with Tukey’s Honest Significant Difference test, comparing means compactly at alpha = 0.05. Where $P < 0.001$, differences between treatments are statistically highly significant

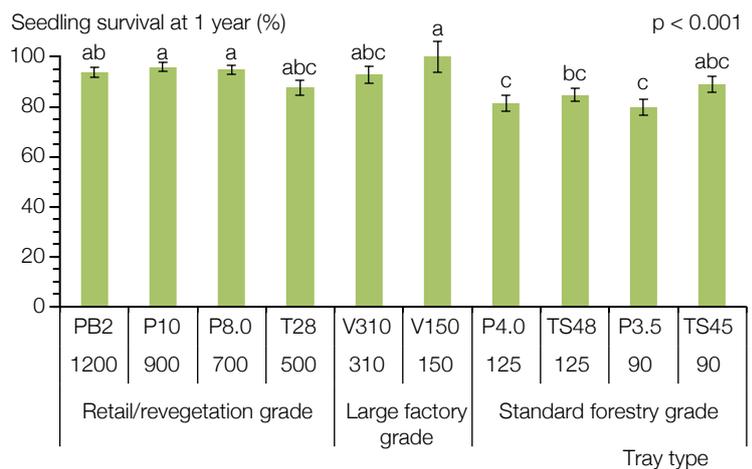


Figure 3: First-year seedling survival (%) in mānuka (*Leptospermum scoparium*) by container type

Note: Letters above bars represent significant differences between treatments using the pairwise post-hoc analysis with Tukey’s Honest Significant Difference test, comparing means compactly at alpha = 0.05. Where $P < 0.001$, differences between treatments are statistically highly significant

A severely bound root system at the time of planting will cause long-term growth complications (South & Mitchell, 2005), such as slow establishment, root circling and girdling (strangling) of the trunk. All of these factors can result in mechanical instability, poor anchorage and eventual mortality or wind throw (Mathers et al., 2007). An effective way to avoid this issue is to hold plant stock within the nurseries for the shortest period possible (though still achieving root plug consolidation), or to grow plants in containers with air-pruning or mechanical impediments (Amoroso et al., 2010), which encourage the growth of fibrous root systems.

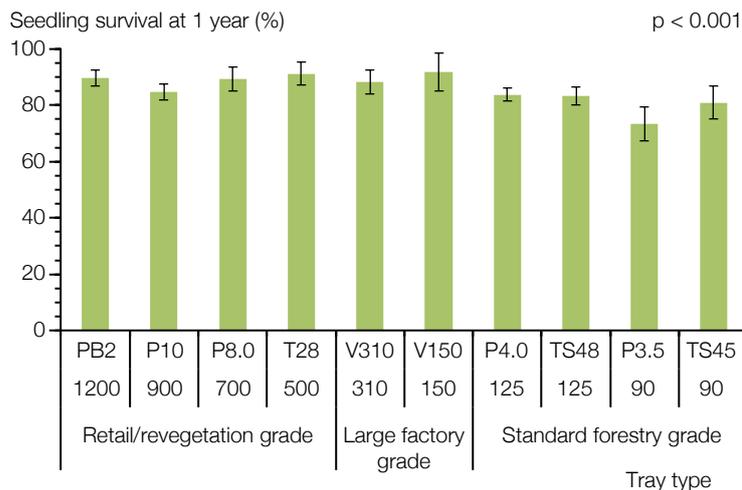


Figure 4: First-year seedling survival (%) in tōtara (*Podocarpus totara*) by container type

Note: Letters above bars represent significant differences between treatments using the pairwise post-hoc analysis with Tukey's Honest Significant Difference test, comparing means compactly at $\alpha = 0.05$. Where $P < 0.001$, differences between treatments are statistically highly significant

Some of the most encouraging results for individual species are for mānuka and tōtara (Figures 3 and 4, respectively). Survival of mānuka across all container types was 80% or above. The large forestry-grade container V150 was particularly successful, with 100% survival across all sites. This species is already being dispatched as a forestry-grade seedling across New Zealand, and the fact that these results are consistent is encouraging. Survival of tōtara was also remarkable (Figure 4), with the 3.5 cm paper pots surviving at 73% and all the other container types at 81% or above, and two containers above 90% (T28 and V150). Clearly, this species is amenable to successful establishment in forestry-grade containers above about 150 cm³.

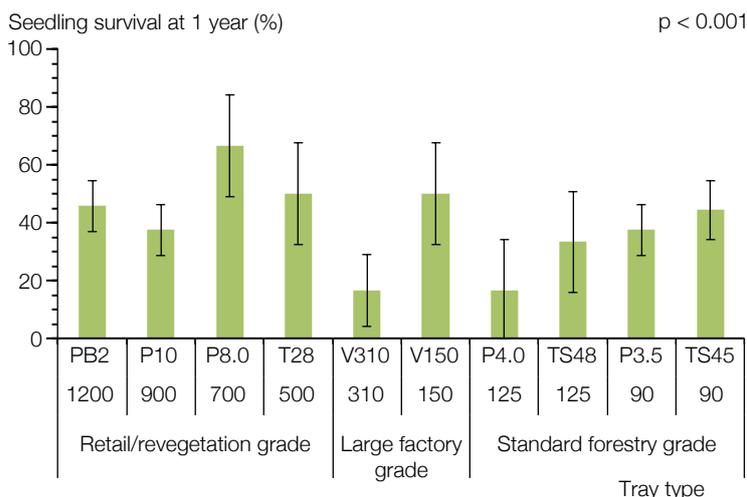


Figure 5: First-year seedling survival (%) in kōwhai (*Sophora microphylla*) by container type

Note: Letters above bars represent significant differences between treatments using the pairwise post-hoc analysis with Tukey's Honest Significant Difference test, comparing means compactly at $\alpha = 0.05$. Where $P < 0.001$, differences between treatments are statistically highly significant. $P = 0.430$ indicates that there are no significant differences between treatment means in this graph

One species that was not so successful was kōwhai (Figure 5). No container type resulted in successful establishment above 80%. All of the smaller container types were unsuccessful, whereas one of the larger forestry-grade pots (V150) survived to 50%. These levels of success are not suitable for large-scale planting of any type where the desire is to not have to go back to the site and replace dead plants. Clearly this species needs some more work before large-scale forest establishment will be possible.

The recommendation from these early year-one results is that on poor sites using larger plants will be more successful (PB2, P10, P8.0 and even V301). On good sites, we recommend at least testing some of the standard forestry grade. While we grew the 4 cm and 3.5 cm paper pots and had some success, a 5 cm version exists and this would be worth trying at scale, although initially on good sites. There is a clear relationship between species, site and container type, and we will be investigating this further as more results come to hand.

Why bother with new types of forestry-grade plants?

A simple and obvious comparison in the cost of forest establishment in different containerised production systems is the volume of soil required. This allows us to conceptually understand the relative cost of plants in the market without relying directly on a survey of nursery catalogues. Assuming media costs \$100/m³, and that media used in production is equivalent to the volume in pots used, significant savings in media alone could be made (Table 6). Although this is a very simplistic model, there are obvious advantages to at least testing some of the larger forestry-grade containers in any planting scheme, with the potential to save significantly on plant costs. This in turn means that planting costs at scale becomes more affordable, both for individual landowners and the country.

Table 6: Cost comparison among different pots based on media volume alone

| Grade | Volume (cm³) | Container type | Media cost per 1,000 plants |
|---------------------------|--------------|----------------|-----------------------------|
| Retail/revegetation grade | 1,200 | PB2 | \$12,000 |
| | 900 | P10 | \$9,000 |
| | 700 | P8.0 | \$7,000 |
| | 500 | T28 | \$5,000 |
| Large forestry grade | 310 | V310 | \$3,100 |
| | 150 | V150 | \$1,500 |
| Standard forestry grade | 125 | P4.0 | \$1,250 |
| | 125 | TS48 | \$1,250 |
| | 90 | P3.5 | \$900 |
| | 90 | TS45 | \$900 |

Note: Media was assumed to cost \$100/m³

Implications

The key result from this research was that for many species forestry-grade plants will survive at a level that is operationally acceptable, and equivalent in many cases to more traditional PB planting stock. Differences in survival across container grades can be relatively small. The influence of container size can be site- and species-specific, but can also be impacted by silvicultural practice.

In some cases, irrespective of container type or size, some species survived and grew consistently well during the first year when a container size of at least 90 cm³ was used (e.g. tōtara). As a result, we recommend:

- Using smaller grade containers for the establishment of more robust species, due to the add-on significant financial advantages of transporting and planting these smaller forestry-grade plants
- On poor sites, using at least an 8 cm paper pot, or (with an abundance of caution) a 10 cm paper pot.

Plant husbandry applies in all cases, as any species can be at risk of root binding, even in the larger pots. Trees that spend too much time in containers that are too small have an increased risk of becoming root bound, causing a detrimental effect on establishment, growth and development. Trees that do not have a bound pot also run the risk of excessive stress at planting. These results were obtained in Rotorua, and those in different climates will need to adjust using their experience and the differences in climate.

As always, this short, applied paper is only the tip of the iceberg. We would also like to acknowledge that the work has not considered bare-root planting stock. There remains significant work to be done to bring all desired native species up to speed, regardless of the stock type. We are now working to discover trends after two years, as well as testing containers on a few species that did not have seed available at the time. More research should also be done in this area to explore the impact of pots on roots, including the effect of air pruning, tray type, and plug paper and media composition on root development.

These results are very useful as New Zealand heads face-on into the aspirational goal of 300,000 ha by 2035, informing nursery growers and forest managers on what stock to grow and plant for sites that are poor or good quality. There is no doubt that planting indigenous forests will contribute to this goal – the question is rather how brave are we to try something new?

Acknowledgements

We would like to acknowledge Te Uru Rākau New Zealand Forestry Service (1BT-00606 & TUR_1BT_2020_026), Scion Strategic Science Investment Fund (C041707, Forest System Platform) and Scion investment in the Scion nursery facilities that have enabled this research. We would also like to thank NZIF for the opportunity to present this research at their recent conference.

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Update on forest regulation in New Zealand

David Raudkivi



Figure 1: Export logs at Port Chalmers, Otago

Abstract

This paper summarises the current state of the Log Traders and Forestry Advisers legislation that has now been incorporated into the Forests Act 1949. It also discusses the further proposed amendments under the Forests (Legal Harvest Assurance) Amendment Bill that was introduced last year. Relevant parties are required to register by 6 August 2023. Having a compliance programme in place will be important given the various obligations in the reform that are entirely new to the sector.

Regulation of log traders and forestry advisers

In mid-2020, while a Member of Parliament, Shane Jones introduced the Forests (Regulation of Log Traders and Forestry Advisers) Amendment

Bill. The Bill aimed to establish a registration system for log traders and forestry advisers, with a view to strengthening the integrity of the forestry supply chain and supporting continuous, predictable and long-term supply of timber for domestic processing and export.

This was part of New Zealand First's election deal with the coalition Labour Government and the Bill was rushed through, receiving Royal Assent by 6 August 2020. At the time, there were some allegations of undercutting of domestic producers by foreign buyers of New Zealand logs, although the Bill did not address price. Much of the Parliamentary debate focused on creating jobs in the sector in the regions.

During the course of its Parliamentary passage the Bill changed significantly. Despite the main purposes of the Bill described above, its operative provisions

were quickly watered down to the point that it is questionable as to whether it in fact achieves any of its purposes. Many have described it as a solution looking for a problem. What we now have is regulation in an area of commerce that was largely unregulated, where most of the business is between established and often very experienced and sophisticated parties.

The Bill was passed and resulted in changes to the Forests Act 1949, which had otherwise largely been repealed, together with the introduction of the Forests (Regulation of Log Traders and Forestry Advisers) Regulations 2022. The key requirements are as follows.

Log traders are required to register

Under the legislation, a ‘log trader’ is any person who, in trade:

- buys New Zealand logs, whether after harvest or as trees to be harvested at an agreed time – whether or not the person intends to on-sell any of the logs
- exports New Zealand logs
- processes logs that the person has grown themselves, subject to a minimum threshold of 2,000 m³ per annum.

The term also captures agents for any person doing the above.

Entities or individuals can register and the registration process involves confirmation of being a fit and proper person. This includes a criminal record check (on the individual, if the individual is to be registered, or the decision-makers within the entity if an entity is to be registered), and a declaration that the person has no relevant civil liabilities.

Once registered, the log trader would need to keep records of all log trading transactions that are entered into, and any disputes that have arisen. There are registration fees and levies involving a few hundred dollars.

There will be an obligation to complete an annual report covering the financial year ending 30 June by the subsequent 1 December, for provision to the Ministry for Primary Industries.

Comment

In the author’s view, this legislation is unusual in that there are generally no restrictions on the sale of products that are not inherently dangerous or restricted. There is a more principled basis for this in addressing concerns about illegally harvested timber, including under international obligations, which is discussed below. However, as it currently stands, it is not at all clear how this will strengthen the integrity of the forestry supply chain. Given the large proportion of forests in foreign ownership (circa 75%), and the fit and proper person requirements under the Overseas

Investment Act 2005, one would also hope that there would be some recognition of those who had already met the OIO’s fit and proper person assessment.

There are also a few matters that are not clear from the legislation. For example, those buying a large volume of logs (even as principally for their own use) fall within the regime, although legislation to be passed indicates that the regime should cease to apply beyond the point at which the logs have received their first processing.

The jurisdictional extent of the regime is not clarified in the legislation, so requires the common law interpretation to apply as an overlay. Normally, common law requires that there be a sufficient nexus to New Zealand for New Zealand legislation to apply. When you apply these common law principles, a sale of logs to a party offshore that is not solicited within New Zealand would arguably not capture the foreign buyer.

However, the position remains to be tested and it would be useful if the position could be clarified through legislation or an exemption. For example, it appears that it may be a more practical outcome where the vendor needs to be registered, but once the logs have been sold in the foreign market by a registered seller the offshore purchaser need not be registered.

Forestry advisers

There is also a restriction on providing any ‘forestry adviser service’ for reward unless the person is either authorised to provide the service or is exempt.

‘Forestry adviser services’ include the giving of advice in the ordinary course of business that relates to:

- the establishment, management or protection of a forest
- the management or protection of land used in connection with a forest
- the appraisal harvest, sale or utilisation of timber of other forest produce
- appraisal of a forest
- the advice on the application of the New Zealand Emissions Trading Scheme (ETS) regime to forest activities
- advice on the beneficial effects of forests (e.g. environmental and economic outcomes).

For forestry advisers, only individuals can register. This is also based on a fit and proper person assessment, as well as meeting criteria set by the regulations. The particular criteria include the following:

- holding a forestry-related qualification at NZQA Level 5 or above (or an overseas equivalent qualification), and having two or more years of experience providing forestry advice in New Zealand, or

- having at least five years of experience providing forestry advice in New Zealand (this will be the provision that will likely grandfather most existing advisers), or
- there is a possible discretion to register the person where the person has five years' experience in the sector, a diploma and has been supervised for two years.

As one might expect, consistent with other legislation there are exemptions for those acting in a professional capacity in a regulated occupation. These include real estate agents, accountants, lawyers and registered financial advisers acting in the course of their role.

Once registered, the person will appear on a public register. There are also registration fees and levies involving a few hundred dollars.

Similar to the above, there are obligations to keep records of advice given. In particular, this should cover who provided the advice and to whom, when the advice was given and any recommendations you made as part of the advice, as well as assumptions. The adviser will also need to meet the forestry practice standards when conducting business, when these are published, and comply with the code of ethics for forestry advisers.

Comment

The following comments about the regime are made in relation to forestry advisers.

There is a requirement going forward for experience, specific qualifications and supervision of advisers. It is important to consider implications for succession within organisations, implications for diversity, client choice and capacity and efficiency. For example, it would appear important to promote diversity from the time of course intake and at recruitment, as well as among those who fulfil the supervisory role.

More broadly, this legislation has the character of consumer protection legislation. Comparable regimes such as the Consumer Guarantees Act 1993 and the Financial Markets Conduct Act 2013 allow sophisticated parties to opt out of the protections the regime provides and therefore reduce the associated bureaucracy. There are no opportunities for this provided for in the regime, even when many of the transactions covered will be between highly sophisticated and financially significant parties.

Finally, the jurisdictional reach is also difficult and the regime appears to capture advice within the broad legal umbrella of an organisation. In this regard, a number of New Zealand forestry



Figure 2: Mechanised felling Tokoiti Forest, Otago

organisations are ultimately managed by large offshore timber investment organisations (TIMOs). These entities provide advice from offshore and often have no physical presence in New Zealand other than a limited presence through a subsidiary that fulfils a direct property management role.

It will be important to consider the position of these offshore TIMOs in relation to registration requirements under the regime. These organisations may ultimately decide to give the advice solely through their New Zealand subsidiary, which may require some restructuring of agreements on the management side – or directly to their offshore clients.

Timing

Log traders and forestry advisers have been able to register since 6 August 2022. An important date is approaching. From 6 August 2023 it will be an offence to operate without being registered and there is generally no other transition contemplated under the regime.

Further reform

However, it should be noted that the log traders regime is subject to review. In a further step that did not receive much publicity, the Forests (Legal Harvest Assurance) Amendment Bill was introduced in June 2022. The submissions to the Select Committee closed during 2022 and its report was provided in mid-December 2022.

The proposed reforms aim to establish a new regulatory system to provide legal harvest assurance for the forestry and wood processing sector, with a particular focus on:

- assisting in the prevention of international trade in illegally harvested timber
- strengthening the international reputation of the New Zealand forestry and wood processing sector
- safeguarding and enhancing the market for access to New Zealand forestry exports
- reducing the risk that timber imported into New Zealand is sourced from legally harvested timber.

This does have a more principled basis. It is consistent with steps many other jurisdictions are taking to reduce the risk of trade in illegally harvested timber. For example, the US, Canada, the European Union, Australia, China, Vietnam, the Republic of Korea and Japan have similar laws.

The implications of this are that forest owners and others with the right to harvest ‘regulated timber’ will need to comply with the legal harvest information requirements when supplying timber to another person in trade. ‘Regulated timber’ would be broadly defined to include roots, stumps, branches and leaves.

Log traders, primary processors of timber and importers and exporters of timber products will need to register with the Ministry of Primary Industries and maintain a due diligence system to demonstrate that the timber they have obtained has been legally harvested. This includes harvesting in compliance with resource consents and laws relating to the use of and access to the land the timber is harvested from.

Care will need to be taken in this regard, as it may only emerge after the fact that there has been a breach of the resource consent in harvesting timber, which may have been technical or inadvertent, even if there had been a good faith intention to comply. It seems odd that timber could not be sold in those circumstances.

The implementation of this reform is some way off, with most provisions in the Bill only coming into force three years after it receives Royal Assent. However, the log traders’ provisions will be moved to fit within that regime, but be substantively reproduced as described above.

Concluding remarks

With the August 2023 registration date fast approaching, organisations and individuals will need to make sure to get their registrations in place in relation to their log trading and forestry advising activities.

It will also be prudent for organisations to set up a compliance checklist and compliance calendar. This will ensure that they are in a position to prepare the reports and meet the other compliance requirements on an expedited basis.

As noted, particularly on the forestry adviser side, the regime has implications for succession, diversity and capacity within the workforce, so steps should be taken now to plan for that.

At a broader level, it is expected that forestry regulation will only continue to increase over the next few years with the amount of scrutiny that is placed on permanent carbon forests, the tension between the farm lobby and those planting forestry both for plantation and climate change reasons, as well as the implications of climate change. Watch this space.

Disclaimer

This paper is a general summary and is not legal advice, which should be sought from a qualified legal adviser. Legislation and regulation in this area are changing and should continue to be monitored.

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Update on research and development programmes managed by Forest Growers Research Ltd

Paul Adams



Figure 1: Biomass chipping at G.J. Hunger Contracting Ltd, Taranaki

Abstract

Forest Growers Research Ltd is an industry-owned research management company that facilitates and delivers R&D programmes for the benefit of the New Zealand forest growing sector. More than 20 programmes and projects are supported by co-funding from the Forest Growers Levy, industry, government and universities. These projects include genetic improvement, nurseries and propagation, silviculture, biosecurity, harvesting and transport, and environmental projects. The science and innovation facilitated by Forest Growers Research is critical for improving and future-proofing the industry. This paper includes an update on three of the key research programmes – Automation and Robotics, Specialty Wood Products and Precision Silviculture – and comments on the challenges and opportunities ahead.

Introduction

In the mid-1980s, the funding and management of forest research moved from being largely state-funded to a user-pays model, with industry

creating research cooperatives covering radiata and eucalypt breeding, seed orchard management, site management, plantation management and growth modelling. This system provided the main means of engagement between industry and researchers for more than 20 years.

Then in 2007, following a review by forest owners, it was recommended that the funding and organisation of forest growing research be put on a more professional and commercial footing, with industry investing more in the upfront scoping and identification of research needs and priorities. This resulted in the formation of an industry-owned company, Future Forests Research Ltd, to coordinate and manage forest growing research on behalf of those providing the funding. Under this model, control over the research programmes lay with those providing the industry funding via a trustee shareholding arrangement.

In 2013, forest growers voted to introduce a compulsory commodity levy from 2014 to more fairly share the load of industry-good activities, such

as research, biosecurity and promotions. This meant that the industry had to organise itself differently and, most importantly, improve communications across a broader range of stakeholders. Future Forests Research was renamed Forest Growers Research to better align with its purpose and the levy trust funding, and the shareholding was transferred and held in trust for the broader industry. A Board – Forest Growers Levy Trust (FGLT) – was established to govern the levy collection and investment process along with evaluating research outcomes. An industry Forest Research Committee (FRC) was also installed to make recommendations to the FGLT on proposals for funding support.

A strong science and innovation sector is considered critical for future-proofing the industry and its ongoing success. The Forest Growing Science and Innovation Strategy 2020–2035 states that industry needs to be more agile and future-focused, with the following three key drivers:

- Continued changes in forest ownership and the potential for non-traditional investment
- Changing markets in response to pressure for circular bio-economies
- The need for our forests to be more resilient to deal with future threats.

The Science and Innovation Strategy also provides the overarching strategic framework for R&D investment, with three core themes and suggested levy allocation:

- The sustainable profitability of our core plantation forest resource (50–60%)
- Other trees species, contingency species and other forest systems (10–20%)
- Protecting and future-proofing our industry and growing community support (25–35%).

Currently, the Forest Growers Levy Trust invests 60% of the levy Work Programme costs each year in research, and in the 2022 calendar year this amounted to \$5.4 million across about 20 projects/programmes. Forest Growers Research works hard to leverage that funding, and total support for the overall research portfolio was close to \$20 million. The extensive range of research initiatives extend right across the value chain from advanced biotechnology through to harvesting and supply chain logistics.

Figure 2 shows the allocation of funds across the Research and Development portfolio. The red box highlights the five main programmes. Three of these programmes are now discussed in more detail –Automation and Robotics (A&R), Specialty Wood Products (SWP) and the Precision Silviculture Programme (PSP). The A&R programme has been operating for four years, SWP finished at the end of 2022 and the PSP commenced in 2022. The paper is rounded off with some comments on strategic issues, challenges and opportunities ahead.

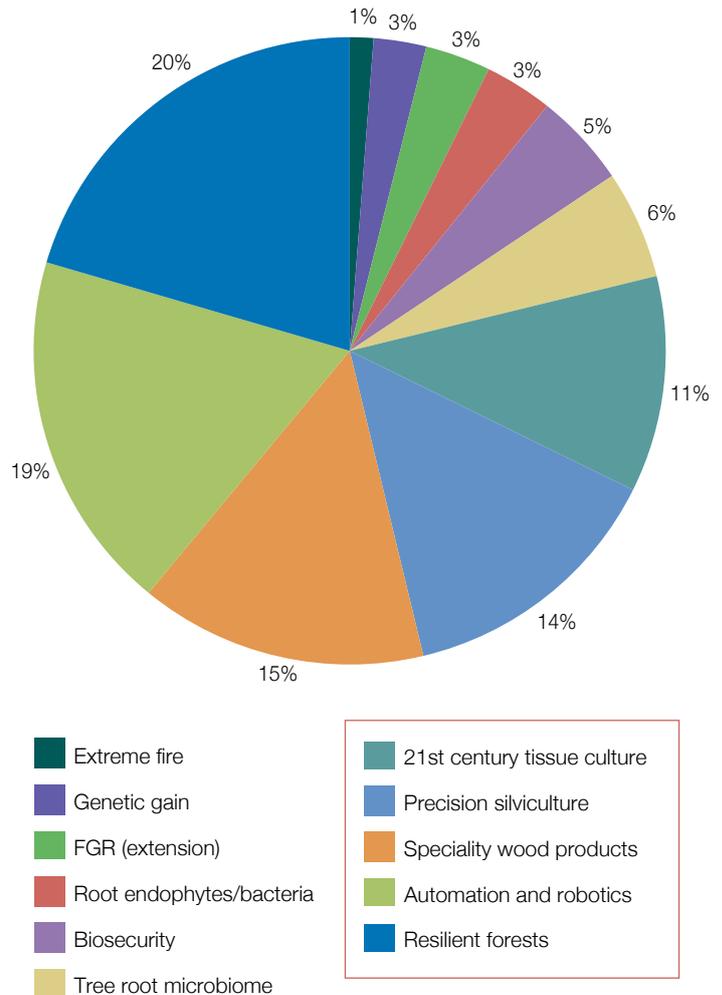


Figure 2: Percentage allocation of the \$5.4 million levy funds across the Research and Development portfolio in 2022

Automation and Robotics (A&R) – Te Mahi Ngahere i te Ao Hurihuri

This seven-year Primary Growth Partnership programme with the Ministry for Primary Industries commenced in 2019 and follows the successful Steepland Harvesting Programme (2010–2017). The goal is to optimise the forestry supply chain by creating more value, improving profitability and enhancing sustainability through the design, development and commercialisation of innovative harvesting and log sort yard technology. There is a strong emphasis on increased automation and robotics.

The programme involves a consortium of leading forestry companies and 10 machinery manufacturing/engineering partners. There are three main project areas (with more than 20 individual projects underway):

- New automated technology
- Human factors in automation
- Commercialisation and deployment.

To date, specific achievements in the A&R programme include:

- An Automated Tower Hauler and Grapple to increase cable-logging automation and efficiency. Rosewarne and May Ltd has developed an integrated carriage and hauler and this is undergoing trials.
- In the Improved Residual Biomass Management project, several current chipping and biomass processing operations have been studied in Otago, Taranaki and Canterbury (Figure 1).
- In the Automated Log Tagging and Tag Reading project, automated log marking will improve log tracking and traceability, and reduce bottlenecks at log-scaling stations and at ports. Otmetka AB, the Swedish technology developer, has completed the technical design and build of the log marker, and it is now being installed on a Woodsman processor (Figure 3). Pocket Solutions Ltd, who are developing technology to read the log mark, will undertake further punch code readability trials when the log marker is installed and tested under New Zealand logging conditions.
- The Automatic Quick Coupler, manufactured by Steelwrist in Sweden, enables rapid change-over of machine attachments, so the same base machine can be used for multiple operations without lengthy delays while attachments are switched. The coupler has been installed on a Sumitomo 300 base machine and is currently undergoing field tests with a local harvesting contractor in the Waikato region (Figure 4).



Figure 4: Steelwrist SQ80 coupler with Waratah 624 processor attached (note processor cradle)



Figure 3: Otmetka log marker prototype ready for installation on Woodsman processor



Figure 5: Trinder Engineering auto tensioner mounted on a log trailer

- The Automated Log Load Securing project has developed an automated log truck load securing system suitable for all logs, including debarked and slippery logs. The system developed by Trinder Engineering Ltd includes: a chain placer mechanism to eliminate manual chain throwing; an auto tensioner (Figure 5) to eliminate manual chain tensioning and maintain chain tensions automatically throughout the trip; and a real-time load monitoring system, including in-cab monitoring.

Specialty Wood Products Partnership (SWP)

The SWP is a seven-year partnership between Forest Growers Research, the Ministry for Business Innovation and Employment (MBIE), research providers and industry partners and officially finished in December 2022. The programme focused on:

- Developing improved breeding stock to overcome current wood quality and forest health issues (Figure 6)
- Transforming processing options for species other than radiata pine, namely, Douglas-fir, eucalypts and cypresses (Figure 7)
- Developing a new naturally durable eucalypt resource.

The long-term vision is to encourage regional investment in specialty species and four regional business cases or strategies have been developed to identify implementation pathways for the key outputs from the SWP.

The SWP has identified and developed market sectors, including naturally durable timbers,



Figure 6: Assessing genetically improved eucalyptus seedlots in the Dryland Forestry Initiative

engineered timbers (such as LVL and CLT), and high-value applications that make the most of the attractive colours and grain of some specialty species. Over 150 technical reports have been produced, reporting on the clear wins that are beginning to emerge for all the species in the programme, and both small- and large-scale growers stand to benefit.

Cypresses and Douglas-fir

A 20-year Cypress Strategy has been produced to encourage investment in the cypress industry.



Figure 7: Strength testing of Douglas-fir CLT element

Thermal modification technology of both cypress and Douglas-fir improves durability and creates more product options for these species.

A structurally efficiency and cost-effective wall joint for Douglas-fir CLT has been proven, with the wall-hold down joints successfully repaired after testing. This would make building remediation after an earthquake event much faster and cheaper. These connection results provide valuable technical information for engineers to design mass timber structures utilising Douglas-fir CLT to resist seismic loads.

Non-durable eucalypts

Eucalyptus fastigata LVL (laminated veneer lumber) was shown to have significantly higher stiffness than typical radiata LVL and it is believed that this species could be commercially bonded with standard phenolic formulations to make plywood or LVL.

Eucalyptus nitens flooring product produced from trees grown for pulp showed very good performance when compared to a commercially available oak flooring product.

Eucalyptus nitens OEL (optimised engineered lumber) achieved stiffness levels of SG12, providing an opportunity to upgrade some of the *E. nitens* resources to higher value products.

Durable eucalypts

Peeling of young (15 years) durable *E. bosistoana* showed very high stiffness values for the veneer (16.6 GPa).

A vineyard post survey in Marlborough found the rate of breakage of *E. bosistoana* and *E. globoidea* posts had been a fraction of the breakage rate of radiata posts (0.3% compared to 5%).

Significant plantings have been established to demonstrate the growth and performance of durable eucalypts and annual sales of seedlings are rapidly increasing.

With the completion of the SWP in December 2022, work is progressing on developing a new long-term research programme with industry and government support. The aim is to realise the potential that alternative species have in diversifying the forest industry and the broader bioeconomy, and also their role in helping New Zealand meet its emissions reduction targets.

Precision silviculture for the 21st century (PSP)

The PSP is the latest in the Forest Growers Research portfolio and was formally launched in May 2022. This \$25.5 million, seven-year programme aims to transform commercial forestry by adopting mechanisation, automation, digital technologies and robotics throughout the silviculture value chain. There are five main workstreams:

1. Nursery Automation
2. Precision Planting
3. Mechanised Pruning
4. Mechanised Thinning
5. Management of Digital Data.

The programme is being co-funded by the Forest Growers Levy, the Ministry for Primary Industries' Sustainable Food and Fibre Futures (SFF Futures) fund and the industry.

Early work has focused on establishing the Programme Governance Group (PGG) and leadership teams for each of the workstreams, along with the development of workplans and contractor engagement.

Technology scans have been completed on developments overseas, to check for relevance to New Zealand conditions. Work is underway to develop automation solutions for forest nurseries and trials have been done on automated post-planting spot spraying with an unmanned aerial vehicle (UAV). Pruning trials have been undertaken to evaluate improved hand-held tools, and also test a new mechanised pruning machine developed by Hudson Clearwood Ltd (Figure 8).

The programme is also developing data standards to ensure the interoperability and consistency between different machines that are used for different silvicultural operations.

This programme is attracting much interest and support from across industry, government and communities. It has the potential to significantly transform the way silvicultural operations are implemented, managed and monitored.

Key strategic issues

The Forest Growers Levy is successfully funding collaborative research for industry, enhancing partnerships, with shared goals and the common vision of improving the productivity, profitability and sustainability of forests and forestry in New Zealand. Forest Growers Research Ltd manages that part of the levy allocated to annual forestry research programmes and is recognised as an experienced research management company with a good track record for delivering industry-good research outcomes.

These outcomes are aligned with, and guided by the vision of, the Forestry Roadmap to 2050 and the Forest Growers Science and Innovation Strategy. A key feature of Forest Growers Research's success has been the ability to leverage co-funding, partnerships and collaboration with forestry-aligned research providers, well connected to today's challenges and future opportunities. Scion, the University of Canterbury, Lincoln University and the Marlborough Research Centre are some of the key research providers in this group, and they contribute to the



Figure 8: Hudson Clearwood pruning machine undergoing field trials

successful delivery of research and results that are applicable to small, medium and large forest growers.

This forest research funding and management model operates within the wider New Zealand science system, which is centred on National Science Challenges and Crown Research Institutes (CRI's). To many, however, the system is considered no longer 'fit for purpose', with structural and funding challenges making it difficult for funding to be more future-focused on big challenges such as climate change and environmental degradation.

It has also been difficult to secure long-term funding and support for high-quality applied research and, for research providers like Scion, this has been

a significant problem with impacts on recruitment and retention of staff, critical mass, viability and capability of research programmes and teams. Many of these issues are widely recognised and are being considered in the current government review of the science system (Te Ara Paerangi – Future Pathways White Paper).

There are also initiatives, such as the Climate Emergency Response Plan and the Forestry and Wood Processing Industry Transformation Plan (ITP), which are expected to enhance research funding and collaboration. Industry is already actively engaged in these processes through direct partnerships and a range of committees and advisory groups. The SFF Futures fund is also supporting a range of initiatives across the primary sector and is currently co-funding the Precision Silviculture Programme.

The science system review, initiatives and funding sources can be expected to lead to increased investment in forestry research. The time is right, as we see increasing awareness by society that forests and forestry are well positioned to respond to many economic, environmental, social and cultural challenges in New Zealand. This includes the increasing interest in more species diversification and the significant opportunities that could flow from a fully functioning circular bio-economy. More proactive strategies, greater engagement with stakeholders and new iwi owners, better training and education, and much larger financial investment, collaborations and partnerships will be required.

The industry needs to adapt to changes in societal expectations and be committed to continual improvement. The global transition to bio, and circular, economies represents a massive opportunity for fibre producers, but one that will only be properly capitalised on with a comparable investment in research. Sustainability, social licence and kaitiakitanga are ever-evolving terms and forestry, from cone to customer, needs to adapt in parallel. To do this, it will rely on research results to provide the ways and means.

The future is exciting, the challenges are real and the opportunities are huge. Science and innovation are critical for future-proofing the industry, addressing the challenges and making the most of the opportunities. Forest Growers Research is looking forward to playing its role in managing and delivering outcomes that help move the industry forward for the benefit of the nation, regions and communities in New Zealand.

Dr Paul Adams is Research and Development Director for the national programme of work funded by the Forest Growers Levy and CEO for Forest Growers Research Ltd. Email: paul.adams@fgr.nz

Ngā Maunga Whakahī o Kaipara's forest journey

Malcolm Paterson

*Tīmatahia ki te tihi o te Atuanui
Te maunga whakahī o Te Manawanui,
Te marae tēnei o Puatahi e.*

*Ka huri tō titiro ki te tihi o Taranaki.
Te maunga kōrero o te Pā o Te Aroha.
Kei Araparera e.*

*Waho atu ko Tuhirangi Maunga,
Te toka kamaka o Kākānui o Paneira,
Te Kia Ora Marae, kei raro iho ra.*

*Waho atu ko Tauwhare Maunga,
E toha nei ki te tai whakararo,
Te maunga kōrero o Whiti te Rā,
Te marae tēnei o Reweti e.*

*Huri atu ki te uru, ki Tarawera,
Te maunga kōrerorero,
Ngā Tai i Tūria ki te Marowhara,
Te marae tēnei o Haranui e.*

*Kaipara Moana, e ngurunguru, ngurunguru, e
ngurunguru nei,*

*Ko ngā rārangi maunga.
Tū tonu, tū tonu, tū tonu e.
Ko ngā rārangi tāngata
Ngaro noa, ngaro noa, ngaro atu rā*

Hei Ha!

'Tīmatahia' by Haahi Walker, Chair NMWoK – identifying the five marae of south Kaipara and their associated maunga (whakahī)

Abstract

This paper summarises the events and rationale leading to the 2013 purchase of the Woodhill Forest estate (and a block of Riverhead Forest) by Ngā Maunga Whakahī o Kaipara (NMWoK – the 'post-settlement governance entity' of the marae and hapū of Ngāti Whātua o Kaipara). It then describes the pitfalls, challenges and opportunities NMWoK has identified in managing and developing its forest estates as a cultural landscape with important overlying economic use. This can serve as an exemplar for other iwi groups considering (or in) ownership of their own commercial forests.

Ngāti Whātua o Kaipara and WAI 312

Ngāti Whātua o Kaipara (NWoK) is a hapū grouping based around the five marae of south Kaipara. In 1992, the five marae lodged a claim with the Crown for breaches of the Treaty of Waitangi. This was finally settled through an Act of Parliament in 2013, with the Crown apology reading as shown in Figure 1.

The apology

This is the text of the Crown's apology to Ngāti Whātua o Kaipara:

The Crown recognises that, from the signing of the Treaty of Waitangi, Ngāti Whātua o Kaipara committed themselves to a close and positive relationship with the Crown and, through Sales and other means, provided lands for European settlement. The Crown deeply regrets that the benefits Ngāti Whātua o Kaipara were led to expect from the relationship, including benefits from the sale of land, were slow to arrive or were not always realised.

The Crown profoundly regrets and unreservedly apologises for its actions, which have resulted in the virtual landlessness of Ngāti Whātua o Kaipara. This state of landlessness has had devastating consequences for the social, cultural, economic, spiritual and physical well-being of Ngāti Whātua o Kaipara that continue to be felt today.

With this apology and settlement the Crown seeks to atone for these wrongs and to begin the process of healing. The Crown intends to improve and strengthen its historically close relationship with Ngāti Whātua o Kaipara based on the Treaty of Waitangi and its principles so as to create a solid foundation for the future.

Figure 1: Crown apology 2013

The key element of redress in the Treaty settlement was the purchase by NWoK (using settlement monies) of 12,400 ha (almost all) of the Woodhill Forest estate, and then subsequently some 500 ha (the Ararimu Block) of Riverhead Forest.

As is required under Treaty settlements, NWoK established a 'post-settlement governance entity' to manage its settlement assets. The name chosen for this was Ngā Maunga Whakahī o Kaipara (NMWoK). The subsidiary responsible for managing the forestry estates is NMWoK Ngahere Ltd.

Woodhill Forest and the Ararimu Block

At purchase, the vast bulk of the two forest estates was planted in radiata pine, respectively owned by TPL3 Ltd and Matariki Forests (both ultimately with American ownership). Under the expiring Crown Forest Licences (CFLs) for the two estates, the tree crop owners had 35 years from 2013 to continue to manage and harvest their crop, and relinquish their use of the land.

Woodhill supported a range of commercial recreational businesses – mountain biking, an arboreal adventure park, paintball, four-wheel driving, horse-riding and off-road motorcycling. It was a well-known location for filming and events (e.g. orienteering). There

was a well-established balloted hunting programme and a long history of adjacent farmers grazing in the forest.

Early decisions

In 2014, NMWoK developed a range of strategic plans covering the commercial assets it had gained under settlement. These addressed a number of fundamental decisions that needed to be made – notably whether Woodhill and the Ararimu Block were to continue predominantly as commercial pine forests (actually, in the case of Woodhill, the only default permitted use), or whether conversions for other purposes were to be pursued.

It was confirmed that the major use of the estates was to continue to be for plantation pine into the foreseeable future, and so a forestry partner would be sought to work with on re-planting as the standing crop owners harvested and 'returned' land.

The ongoing challenge

A forestry joint venture (Te Rau Manga) was established with Matariki Forests for two rotations following the expiry of the CFL – effectively out to the end of this century (Figure 2). The first crop was planted in 2016 and so in about 27 years it was



Figure 2: Te Rau Manga joint venture crop

understood that a share of stumpage would start to make its way to NMWoK. For those 27 years, however, about 400 ha of standing pine was expected to be harvested annually, with an attendant loss of tens of thousands of dollars of land rental.

Although NMWoK had invested funds and would make the most of limited/occasional commercial property opportunities that came out of the settlement, the forest estates still needed to function as the reliable year-on-year provider of baseline cashflow for the group (for its own operation and to fund its educational, health, cultural and social development programmes for hapū members). A steady reduction of revenue from the forestry land rental over time would need to be replaced in order for the group to (at the least) reliably maintain its core functions.

NMWoK therefore decided that we would continue to licence the various recreational businesses operating in Woodhill and support them to grow, in turn increasing returns to us. We would not look to take ownership or management of most of them directly as the majority seemed to require specialised technical knowledge and/or were associated with activities that exceeded our appetite risk (e.g. the arboreal adventure park). The exception to this was the horse park, which we took management of and renamed Kake Hōiho (Figure 3).

The Te Rau Manga joint venture also allowed for up to 20% of the productive area to be kept out for other purposes that NMWoK might decide offered 'higher and better use'.



Figure 3: Kake Hōiho horse park in Woodhill Forest

Plugging the gap

Cognisant of the potential ongoing drop in cashflow from the forestry estates, since 2013 NMWoK has purchased stands of trees in the forest that support recreational and/or filming activity in order to prevent their harvest (Figure 4).

Ngahere has made a dedicated effort to promote the forests to the film industry. Ironically, during the height of the COVID pandemic, when much of the economy suffered, Woodhill especially had a couple of bumper years in terms of filming activity and the associated income generated. *The Lord of the Rings: The Rings of Power* is an example of a large-scale production that made use of Woodhill over that time.

The single biggest standalone development undertaken since the hapū purchase of the estates has been the licensing of a sand extraction and clean-fill facility in Woodhill (Figure 5). The proposition was not without internal challenge, as the concept of 'selling our whenua (sand)' and taking fill from other whenua raised questions about cultural and spiritual appropriateness and environmental protection.

Following its own assessment of environmental and cultural effects, NMWoK successfully gained resource consent for a sand extraction and clean-fill facility in Woodhill in late 2018. It became operational in early 2019, under licence to Woodhill Group. In several years of operation, only a handful of fill sources have been approved because of the very high acceptance thresholds in our resource consents and operating agreement with Woodhill Group.

Likewise, there have been no notable incidents of contamination from accepted soil because of these stringent conditions and the associated monitoring programme. A clean-fill review committee meets regularly to consider quality control processes and potential new sources of fill. Aside from Ngahere Ltd and Woodhill Group, and supporting environmental engineering expertise, there is a NWoK representative from the local marae on the committee to provide greater diversity of interested input.

Intense discussions with hapū members prior to the facility beginning operation, ongoing consultation, the adherence to strict acceptance criteria and the presence of a respected marae community member on the clean-fill review committee allowed the operation to commence and to have now continued successfully for several years. This added hundreds of thousands of dollars annually to the income from the estate.

Beware of pups

Given the chance to choose the form of its Treaty settlement, NWoK may well not have elected to invest in a large forest estate planted in an exotic species and with all sorts of covenants in place limiting alternative land uses.



Figure 4: Whānau members enjoying the Tree Adventures course in 2021 – on trees recently purchased by NMWoK

Treaty settlements, however, focus on financial compensation and available Crown land – and inevitably this means that forestry, education and conservation properties become prominent in negotiations, as was the case in south Kaipara. Woodhill Forest, and to a lesser extent Riverhead Forest, was easily the most significant and commercially worthwhile piece of Crown land in the rohe that could be considered as part of the settlement. The fact that it is a significant cultural landscape, traversed regularly by our tūpuna and still holding evidence of their occupation and use (and even their bones), gave it greater interest than just the economic.

Having intergenerational knowledge of the landscape and community before the forest and then throughout the decades of its development and management, through the greater part of which many of our people were involved (e.g. as forestry workers),

we weren't blind to the potential issues we would face as landowners. We knew we had bought a 'pup' – but it was a pup we were willing to have. Still, there have been experiences in these first nine years that have disappointed, although not necessarily surprised, and occurrences that we would not see repeated given the chance (either for us or other iwi groups entering into similar arrangements).

Early moves by the majority crop owner to return large pieces of non-productive land were reasonable, but the implications weren't fully understood by us. Large unharvested/wilding trees near boundaries are proving a frequent (and expensive) problem for us as they fall across fences and/or onto neighbouring properties. In hindsight, we would have assessed these boundaries more carefully and insisted on the removal of trees such as these before accepting the land back.

We have found Crown agencies, especially the Department of Conservation (DoC), extremely difficult to deal with post-settlement, particularly around trying to resolve issues of shared interest. In at least five years of constant, earnest trying, including expenditure on legal advice and attempts to get meaningful action from the Crown's Māori engagement body Te Arawhiti and even relevant ministers, we have failed to get any formal, clear position from the Crown on its responsibilities for the public easements in its name that transect the forest. Land Information NZ says DoC is responsible for them, and in our view over the last five years the Department has frequently changed its position on this from absolute agreement to, again lately, denial.

The easements have only ever had maintenance undertaken by the Crown when we have brought to their notice that their condition has deteriorated to the point where they are unsafe for public usage, and lately even that has not been enough. The easements remain a constant route of trespass into the forest (with attendant issues around theft, vandalism, risky behaviour and unpermitted fire), but our experience is that the Crown undertakes no management or monitoring of them. The easements are therefore a weak point in the security of the forest, and we are finding that the Crown will not help and yet won't legally remove them. By default, having staff present in the forest and being the landowner, we feel we are in reality left to deal with most of the operational and safety problems resulting from the easements.

Prior to NMWoK ownership, the forests were Crown land under licence to the crop owners, and there was a degree of expectation of general public access, albeit not into areas of clear high risk, such as harvesting. The sale into private ownership should have removed that expectation. Certainly, the tightening of workplace health and safety legislation in 2015 would have meant that whoever owned and/or managed the forests (workplaces by definition with multiple over-lapping 'PCBUs') would have had to have been more stringent about public access than had previously been the case.

We have also encountered problems relating to the locals living around the forests, and we feel there is dismissal of our ownership rights by those wanting to access them unpermitted for their own individual benefit. We are frequently challenged about our actual right to limit access in a way that we do not believe other private landowners in the district (e.g. lifestyle block-holders/farmers) generally are. Of course, trespass onto farmland is not uncommon either, although many who do it would concede that this is what they are doing, which is often not the case with respect to the forest.

Another concern for us is that local social media frequently carries posts that set us up as the opposition to other, 'real' residents – the 'iwi'/'Maoris' infringing on their freedoms. One even re-branded



Figure 5: Fill deposition at Woodhill in 2022

Woodhill as 'Muriwai Forest' and its followers as the 'friends of'. On occasion, more overtly racist slurs have been posted online or even graffitied onto forest infrastructure. We certainly seem to attract more overt 'hate' than the American-owned companies managing the forests, who also strive to restrict unpermitted access.

We spend six figures annually on what we optimistically call monitoring and public education, some of which is addressing issues of immediate high risk to workers and legitimate users of the forest and surrounds (e.g. poaching and setting of fires). However, a lot of our activity is repetitively dealing with unrepentant recidivist trespassers, dozens of whom we have formally trespassed over the years. An interesting development has been that trespassers who don't like what other trespassers are doing are reporting to us about them. For instance, joggers running where we don't want them have reported someone with a dog who was aggressive to them, and a dog-walker who was nearly killed by unpermitted motorbikes that found their way into the forest off the beach advised us of that.

As there is a place for almost every activity in Woodhill, trespass is actually unnecessary. Aside from the aforementioned licensed/permitted recreational parks and activities, the public easements provide kilometres of access through the forest for walkers, joggers, horse-riders, mountain bikers and even (in the case of two of the three) vehicles.

A final issue of concern is that some people who come onto our private estate disturb our sacred places, which of course is upsetting.

The silver lining to this endless need to monitor and 'educate' the public is that our kaitiaki group, who lead on this work, has been our single biggest team of employees over the years. Between the kaitiaki and our more office-based staff, we have employed dozens of hapū members in the forests in this time, providing training, experience, work and, importantly, connection to our whenua tuku iho.

Looking forward

In the years and decades to come, Woodhill will continue to be an important landscape for NWoK – providing cultural and spiritual sustenance, resources for our weavers, meat for our tangi, firewood for our kaumātua, recreational space, and even a place to continue to bury our dead.

We will continue to need to find new sources of cashflow to (at the least) offset the steadily diminishing forestry land rental returns and have a strategy to do so.

In the next 10 years or so we will concentrate our active efforts on improving and growing the commercial recreational activity in Woodhill. Due diligence is also underway on whether to pursue the development of a wind and solar energy park in the forest and, if the decision is to do so, then this too will likely be established in the coming decade.

As we have done over the past nine years, in addition to our own strategic priorities we will continue to vet reasonable proposals brought to us by third parties. To date, we have declined ideas such as poultry farming, avocado orchards and the establishment of a waste-to-energy plant, but doubtless other possibilities worthy of consideration remain untested.

Broadly, NMWoK will consider any ancillary/alternative activity that:

- Offers a higher return than the current forestry, or
- Is complementary to the current forestry, and
- Respects our values (e.g. kaitiakitanga/sustainable management of the environment and respect for culturally significant sites such as urupā).

Proposals will be viewed with particular interest if they:

- Offer opportunities for the training/employment of our people
- Offer the opportunity for us to learn about/invest in/partner in the enterprise, with a view to potentially owning and running it ourselves
- Promote the presence and visibility of our people and language/culture.

We thank you in advance for your good ideas. Mauri ora.

Malcolm Paterson is Tumuaki/Chief Executive Ngā Maunga Whakahī o Kaipara Ngahere and Te Rau Manga Ltd based in Kaipara. Email: tumuaki@kaiparangahere.com



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Tāne's Tree Trust's vision – weaving more native forest back into our landscapes

Jacqui Aimers and David Bergin

Abstract

Tāne's Tree Trust (TTT) is a nationwide charitable trust with a vision of seeing landowners successfully establishing and sustainably managing native forest for multiple purposes. This includes non-timber values, such as enhancement of indigenous biodiversity, water quality, cultural identity and aesthetic landscape values, and other environmental and cultural benefits. It also includes the option for sustainable production of high-quality timber and other resources, where appropriate, via continuous-cover forestry regimes.

The Trust is committed to scientific research as a basis for developing best practice. It has an applied research and development (R&D) programme and collaborates with organisations that have a shared ethos.

In 2021, the Trust launched a collaborative platform with Pure Advantage to promote more widely the benefits of, and best practices for, establishing and managing multi-purpose native forest. This led to a well-received conference in October 2022. The ultimate aim is to see more native forest successfully woven back into our landscapes and sustainably managed in perpetuity.

Introduction

The Trust had its origins in 1999 and was formally established in 2002. It is managed by a CEO, a chairperson, and a group of trustees with decades of experience in scientific research, forestry, farm forestry, ecology and conservation. The Trust has two patrons – Drs Andrew and Mary McEwen.

The Trust has a broad membership base and works with a wide range of organisations, including allied non-government organisations (NGOs), local and central government, research organisations, iwi and landowners. Funding comes from membership, donations and legacies. Direct and in-kind funding for projects comes from central government departments, such as the Ministry for Primary Industries and the Department of Conservation, philanthropic organisations like The Tindall Foundation, and local authorities. The Trust is always on the look out for more funding.

Aims of the Trust

The main goals of the Trust include:

- Promoting best practice establishment and sustainable management of native forests for multiple benefits
- Reducing impediments to establishing and managing native forest

- Identifying knowledge gaps and priorities for applied research
- Advocating for increased funding into research and technology transfer
- Maximising economic incentives, including advocating for landowner incentives and reducing the cost of establishment and early management
- Promoting indigenous forestry as an attractive land-use option by advancing knowledge through research and practical demonstration
- Encouraging and facilitating knowledge-sharing amongst stakeholders and interest groups.

TTT's work programme

TTT undertakes applied research to deliver practical science-based technical information. Projects are based around forest establishment (planting and assisted natural regeneration) through to supporting long-term sustainable management of permanent native forest.

Normalising Native Forestry (core research programme)

This is funded by The Tindall Foundation, with additional support leveraged from other funders. It includes six workstreams:

1. Working with nature to establish native forests at scale through planting and encouraging natural regeneration.
2. Promoting continuous-cover native forestry for sustainable harvesting.
3. Making the most of TTT's growth and reference databases.
4. Incentivising landowners by developing an economic case for native forestry and supporting incentive schemes.
5. Evaluating novel transitional ecosystems – transitioning of exotic species to native forest.
6. Collaboratively building capability by working with others involved in, for example, pest animal, bird predator and selective weed control.

Other ongoing and recently completed work

- Native Forest Toolkit (Figure 1) – calculators developed for: (i) planting and budgeting; (ii) productivity; (iii) carbon sequestration; and (iv) economics (returns and benefits). Largely funded by the Sustainable Farming Fund (SFF) and based on the Trust's Indigenous Plantation Database.

- Adaptive Management of Coastal Forestry Buffers, with the Coastal Restoration Trust. Preliminary guidelines are available for this recently completed SFF-funded project.
- Factsheets on forest establishment (planting and assisted natural regeneration) funded by Te Uru Rākau.
- Re-measurement of farm-tōtara trials established by the Northland Tōtara Working Group.
- A practical guide to the management of tōtara on private land, co-funded by Te Uru Rākau.
- Videos and workshops on best practice restoration and management of native forests – a collaborative project, co-funded by the Department of Conservation.
- Establishing seed islands, Waikereru Ecosanctuary, Tairāwhiti.
- Monitoring system for early survival and growth of plantings in collaboration with Trees That Count, Tasman Environment Trust, Auckland Council and Pamu Farms.
- Transitioning exotic forest to natives – a recently initiated five-year project, largely funded by the Sustainable Food and Fibre Futures Fund (SFFF).
- Valuing ecosystem services – a recently initiated multi-agency collaboration with Pāmu Farms, largely funded by SFFF.

- Ongoing work on submissions and consultation with the Government, advocating for all aspects of native forestry, and incentives for landowners.

More information on these projects, and others not listed here, is available in the Trust’s Annual Report available on the TTT website: www.tanestrees.org.nz

Why are native forests important?

Prior to human arrival, Aotearoa New Zealand was almost entirely forested below the tree line. The current forested area represents over 70% reduction from the pre-human state. This large-scale deforestation has been disastrous for our soils, water and biodiversity.

According to the Tax Working Group (2019), the well-being of New Zealanders is critically dependent on the state of our natural environment and the health of our ecosystems, with natural capital ‘a profound and non-substitutable basis for the economy.’ This is something long recognised by indigenous cultures.

‘Ka ora te whenua, ka ora te tāngata – When the land is well, we are well.’

Māori proverb

A recent TTT project reviewed non-timber values (NTVs), focusing on native forests outside the conservation estate (Aimers et al., 2021; Figure 2). NTVs cover all elements of the ecosystem services concept other than wood products. NTV categories include: (i) non-timber forest products (NTFPs) and other provisioning



Figure 1: The Native Forest Toolkit can be accessed via the TTT website. The four calculators are designed to assist with planting and managing native trees for multiple objectives

services; (ii) environmental regulating services; and (iii) socioeconomic, cultural and spiritual services.

Knowledge gaps and deficiencies were identified, and implications for land-use decisions and policy-making were examined. Weaving more native forest back into our rural and urban landscapes would provide a myriad of ecosystem services that would improve environmental and cultural values. It would also mitigate the effects of climate change, urbanisation and intensification of land use. Native forestation should be incentivised as the benefits accrue far beyond the sites where landowners sustainably manage and extend native forest cover.

Aggregated NTVs of native forests are likely to be greater than for exotic plantations, particularly concerning scenic, cultural and spiritual values, biodiversity, water quality and the protection of erodible steep land, downstream infrastructures and ecosystems (Aimers et al., 2021). NTVs are best viewed in a broad context, rather than focusing on a single NTV, which could lead to perverse outcomes. However, the research indicated that biodiversity is a pivotal NTV, i.e., efforts to increase biodiversity values will likely concurrently increase most other NTVs.

Native forest, carbon sequestration and climate resilience

In its advice to the Government, the Climate Change Commission recommended the establishment of nearly 300,000 ha of new native forests before 2035, to help meet New Zealand's international climate change commitments (CCC, 2021). This was followed by a commitment in the first Emissions Reduction Plan to establish native forests at scale to develop long-term carbon sinks, and improve biodiversity values and climate resilience.

A major focus for TTT's R&D work programme is cost-effective ways of weaving more native forest onto private land. While planting of natives remains important, TTT advocates for assisted natural regeneration for landscape-scale native forest establishment, i.e. working with nature to re-cloak vast areas of marginal eroding hill country (Bergin, 2021). Key elements include:

- Pest animal control
- Selective aggressive weed control
- Bird predator control
- Fencing
- Strategic use of planted seed islands
- Interplanting of key native tree species where needed.

TTT also advocates for integration of more native forest within our lowlands, to enhance existing productive land uses, rather than compete with them. This is where native forest is now particularly scarce, and where the greatest gains will be in growth and carbon sequestration.

TTT is aware of unmanaged, degenerating remnants of native forest throughout New Zealand. Fencing and excluding browsers, pest animal and weed control, and enrichment planting would quickly result in a flip from carbon loss to carbon gain, plus a myriad of other ecosystem services. This is an example of 'additional' in carbon sequestration in existing native forest.

TTT's research shows that sustainably-managed planted native forest is better at sequestering carbon than commonly considered (Kimberley et al., 2021). This research is based on TTT's indigenous plantation database, which is New Zealand's largest national database for planted native forest. It comprises over 60 different native tree and shrub species, ranging from five to 110 years old in over 100 planted stands surveyed nationwide. Growth rates of planted natives are generally faster than naturally-regenerating sites, which are often on exposed marginal sites.

TTT are currently working with the Ministry of Primary Industries to provide data for Look-up Tables for planted native forests, to complement the current Look-up Table for natives, which is based on naturally-regenerating kānuka/mānuka shrubland.

Strategically established native forests can have many benefits (Aimers et al., 2021):

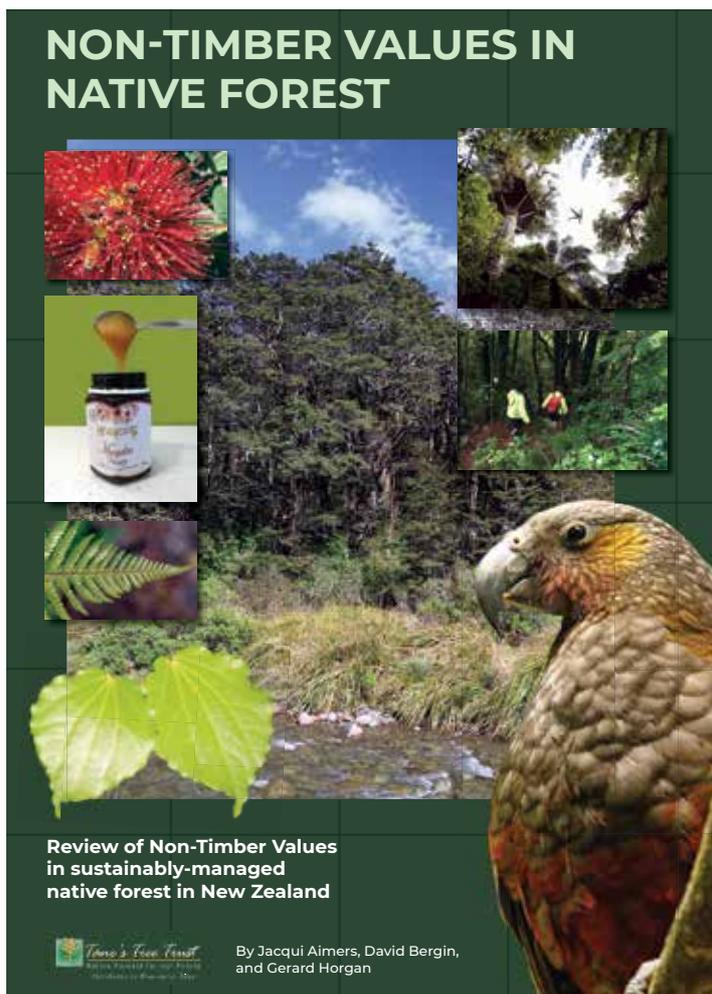


Figure 2: TTT bulletin on NTVs in sustainably-managed native forest, available on the TTT website www.tanestrees.org.nz

- Climate resilience via soil stabilisation and catchment protection
- Green firebreaks that reduce the risk of wildfire spread (if largely constructed with low-flammability species)
- Shade, shelter and trapping of moisture, ameliorating local climate issues
- Green infrastructure and coastal buffers that reduce the impact of extreme weather events, including floods and storm surges
- Co-benefits such as improved water quality and biodiversity values.

Urban forests also have benefits (Aimers et al, 2021):

- Mental and physical well-being and community values
- Flood alleviation, shade and amelioration of the urban heat island effect
- Improvement of air and water quality and biodiversity values
- Cultural services, including recreation and amenity values.

Forest products

Some native tree species can be utilised for timber on a sustainable basis, as exemplified by the Northland Tōtara Working Group (NTWG) and the Tōtara Industry Pilot project (Quinlan et al., 2011; Steward & Quinlan, 2019; Dunningham et al., 2020). TTT facilitates NTWG, in collaboration with other stakeholders, to promote the management of naturally-regenerating second-growth, tōtara-dominant forest on farmland in Northland based on continuous-cover forestry methods.

TTT Trustee Paul Quinlan has a key role in managing NTWG and promoting sustainable management of tōtara-dominant regenerating forest on Northland farms. Trustee Jon Dronfield, based in Westland, promotes the management of beech forest using continuous-cover forestry principles.

Our native trees provide an alternative suite of timbers with a range of characteristics, including greater hardness, distinctive colour and figure, and some with natural durability and outstanding wood-working properties. Some species are prized for high-value cultural and contemporary end uses (Bergin & Gea, 2007).

Low-impact sustainable harvesting of farm-tōtara has been demonstrated in Northland via best practice continuous-cover forestry principles (Quinlan, 2022). Harvesting is undertaken as single-tree or small-group felling, to ensure the NTVs of high forest are not compromised, as described in the TTT Bulletin on continuous-cover forestry by retired Trustee Ian Barton (Barton, 2008).

There are also non-timber forest products. Mānuka and kānuka are often planted as a pioneer nurse species

and are increasingly used for honey, oils, medicinal and cosmetic products, along with other native species (Aimers et al., 2021). There is a base of cultural knowledge (rongoā) increasingly being supported by scientific evidence showing that extractives from some native species have important medicinal properties.

Resources

TTT has a wide range of free resources accessible via the website (www.tanestrees.org.nz), including:

- The TTT Technical Handbook
- Native tree species profiles
- Bulletins and technical reports (e.g. Figures 2 and 4)
- Newsletters and project updates
- Factsheets (Figure 3)
- Toolkit – suite of calculators (Figure 1)
- Videos on best practice establishment and management.

Technology transfer is an integral part of the Trust's work. Workshops are held regularly for landowners, community groups, allied NGOs, iwi and local authorities.

O Tātou Ngahere campaign

The O Tātou Ngahere (Our Forest) campaign is a collaboration between TTT and Pure Advantage. The overarching goal has been to influence a shift from a perception of native forests being an unproductive land use, to where they are seen as a valuable use of land. The campaign was launched in March 2021 with a 12-minute documentary, plus 36 topical articles and related webisodes from subject experts (www.tanestrees.org.nz/projects/o-t-tou-ngahere-our-forest/).



Figure 3: Native Forest Factsheets Series on establishing native forest via planting and assisted natural regeneration, which will soon be available via the TTT website. Nine Factsheets have been completed, with a further nine in the pipeline

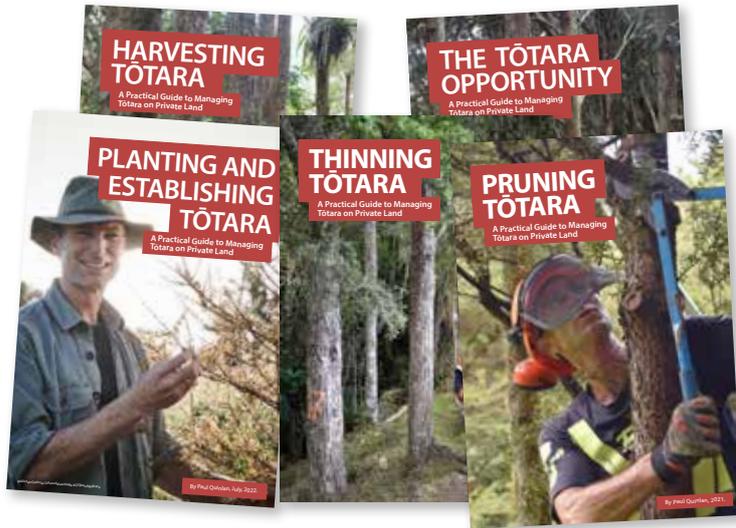


Figure 4: 'A Practical Guide to Managing Tōtara on Private Land', recently published by Trustee Paul Quinlan and available via the TTT website. Short instructional videos are also available

This was followed by the O Tātou Ngahere Conference – Regenerating Our Landscape with Native Forest, in October 2022. Over 1,000 people attended the two-day conference, which we believe broke records for a forestry conference in New Zealand, reflecting enthusiasm for native afforestation. Many speakers highlighted the need to urgently recalibrate our policy settings to incentivise the protection of existing native forests and the establishment of new native forests.

There was a strong consensus for the need to tackle both the biodiversity and climate crises, with recognition of the potential for native afforestation to heal our landscapes. Conference organisers ran a poll to rank the top 'where to next' themes. The top theme by a strong margin was to 'Encourage urgent action by the Government to establish a biodiversity credit "standard".'

A biodiversity credit in this context is an earnable commodity that represents a return on investment either by afforestation, or by additionality in existing native forest (as explained above). This would encourage:

- Native afforestation, by bridging the gap between native trees becoming established and increasing their growth rate to earn enough carbon credits to reward landowners
- Good management of existing native forests, much of which are currently threatened by browsers, predators and weeds compromising ecosystem services, including carbon storage.

These points were communicated in a joint letter to Government ministers.

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Carbon economics of natural regeneration at scale

Sean Weaver

Abstract

Natural regeneration on eligible post-1989 land is a carbon project where nature establishes the forest for free. Converting marginal farmland to natural regeneration and registering this free gift from nature in the New Zealand Emissions Trading Scheme (NZETS) would be an ideal way to finance carbon sequestration. This could deliver on our Paris Agreement target alongside considerable biodiversity and sustainable land management co-benefits. Similarly, managing natural regeneration on existing pre-1990 indigenous scrub and forest land induces additional carbon sequestration that (in theory) could also be traded in a voluntary carbon market and contribute to our national climate change mitigation goals.

This paper presents a practitioner perspective on these two aspects of natural regeneration for carbon management, with a particular emphasis on operating at a scale that has a meaningful impact on national carbon sequestration goals.

A discounted cash flow (DCF) analysis was undertaken for four approaches to forest carbon sequestration projects commencing in 2024, at a scale of 100,000 ha:

- Scenario 1: Natural regeneration on eligible post-1989 land (a 'shut the gate' approach).
- Scenario 2: Indigenous afforestation planted at 2,000 stems/ha.
- Scenario 3: Exotic afforestation transitioned to indigenous forest over a 60-year period.
- Scenario 4: A combination of exotic afforestation transitioning to indigenous forest (70,000 ha) plus indigenous afforestation at 2,000 stems/ha (30,000 ha).

Results showed that (under Scenario 1) natural regeneration starting in 2024 would contribute zero carbon sequestration towards the 2030 Paris Agreement target, cost \$650 million in investment (assuming no land purchase costs) and not be financially viable (i.e. unlikely to gain access to investment capital and not be financially self-sustaining). Indigenous afforestation planting 2,000 stems/ha (Scenario 2) would deliver approximately

800,000 carbon credits towards the Paris Agreement target, require \$1.5 billion in investment and also not be financially viable. In contrast, a project that used exotic afforestation (Scenarios 3 and 4) would deliver between 2.77 million and 3.5 million tCO₂e by 2030 (respectively), is financially viable, and could therefore be delivered at no cost to the taxpayer.

Pre-1990 indigenous forest regeneration was also examined using an additionality lens consistent with international forest carbon standards. 'Additionality' is a measure of whether a project is delivering carbon benefits to the atmosphere that resulted from human intervention that is additional to: (a) what nature would do anyway; and b) what humans would do anyway. Pre-1990 natural regeneration is not additional unless there is a change in forest management (project scenario) that causes a measurable change in carbon benefits compared with business-as-usual (baseline scenario). This can be delivered through avoided logging of commercially viable timber volumes (via land-use change from productive to permanently protected forest) and/or enhancing carbon sequestration through (for example) enrichment planting.

Introduction

National and global climate change mitigation requires a change from the current situation where greenhouse gas (GHG) emissions from sources are running at a higher rate than GHG removals by sinks. The shift of this dynamic ratio to avoid dangerous climate change requires a significant reduction of emissions from sources (beyond what is currently occurring) combined with a significant increase of emission removals by sinks.

Forests are one form of carbon sink and the lowest hanging fruit in the carbon sink world. Forest carbon stock change is relatively easy to measure, and interventions that cause this change are relatively easy to attribute to a causal agent (e.g. someone planted the forest on non-forest land).

For this reason, the first phase of global carbon sink management has been dominated by forest carbon sequestration. Subsequent phases of global and domestic carbon sink management will likely have a greater emphasis on non-forest systems, including soils, wetlands, saltmarsh and grasslands. But forests are also likely to remain a key component in climate change mitigation due to the technical and logistical

suitability of forests to function as carbon sinks and reservoirs.

The Climate Change Commission (CCC) has made recommendations for carbon emissions reduction and carbon sequestration targets to enable Aotearoa New Zealand to meet its Paris Agreement obligations. The emission reductions and removals required between 2021 and 2035 are listed in Table 1.

Table 1: Climate Change Commission emissions reductions and removals targets for the period 2021–2035. Source: 2021 Draft Advice Scenarios Dataset (CCC, 2021)

| Emissions sector | GHG reductions 2021–2035 |
|----------------------------|--------------------------|
| Transport | -43% |
| Buildings | -33% |
| Heat, industry & power | -49% |
| Agriculture | -14% |
| Waste & hydrofluorocarbons | -26% |
| Forestry | +135% |

These sector targets include the assumption of the Government purchasing ~100 million tCO₂e of climate change mitigation from offshore. If the nation fails on any of these targets, we will need to either buy additional offshore mitigation, or plant more forests (or both).

As such, GHG removals by forests plays a central role in meeting national emissions targets. Since 2022, there has been considerable controversy over the policy settings for carbon sequestration in the forest sector. Of particular interest to the public debate is the relative roles of exotic and indigenous forestry, with special reference to the permanent forest category of the New Zealand Emissions Trading Scheme (NZETS).

The Government asserted a desire for a much greater role for indigenous forests in its public announcements during 2022. This included a proposal to exclude exotic forests from the NZETS permanent forest category (MPI, 2022). The Government backtracked on this proposal (Radio NZ, 29 July 2022), but then set in motion consultation with relevant stakeholder groups to establish rules for the use of exotic species in the permanent forest category.

At the core of this policy debate are the economic realities of indigenous carbon forestry and the impact this reality will have on the effectiveness of policy settings. Practitioners in the NZETS have asserted that the high cost of indigenous forest establishment, the slow-carbon sequestration rates of indigenous forest and price sensitivity among carbon buyers means that carbon-financed afforestation using solely indigenous species is often not financially viable

(Weaver, 2021, 2022; Weaver et al., 2022). Situations where indigenous afforestation can be financially viable include:

- Natural regeneration (where nature planted the forest without charge)
- Transitioning exotic forests to indigenous forests (through active management)
- When indigenous afforestation projects are financed jointly with exotic afforestation projects as part of an indigenous and exotic investment portfolio (Weaver, 2022, op. cit.).

Because natural regeneration has very low forest establishment costs, it is plausible to consider that this approach to afforestation could play an important role in meeting national sequestration targets while: (a) reducing reliance on exotic forests; and (b) substantially contributing to biodiversity conservation. This includes project activity types undertaken inside the carbon accounting boundary of the NZETS (post-1989 forestry) and outside the NZETS (pre-1990 forestry).

This study has two parts:

1. Financial viability analysis for post-1989 natural regeneration at scale.
2. Additionality analysis for pre-1990 natural regeneration.

Post-1989 natural regeneration at scale

A discounted cash flow (DCF) analysis of carbon-financed natural regeneration at scale has been undertaken to test the ability of this approach to contribute to national climate change mitigation targets. It does so by comparing four project scenarios undertaken at the scale of 100,000 ha.

Scenario 1: Natural regeneration on eligible post-1989 land (a 'shut the gate' approach).

Scenario 2: Indigenous afforestation planted at 2,000 stems/ha.

Scenario 3: Exotic afforestation transitioned to an indigenous forest over a 60-year period through strip/patch harvest and replanting. This scenario delivers 100% indigenous forest by year 60 with harvest and replanting interventions starting in year 15.

Scenario 4: A combination of exotic afforestation transitioning to an indigenous forest in the manner of Scenario 3 (70,000 ha) plus indigenous afforestation at 2,000 stems/ha (30,000 ha). A 70:30 ratio of exotic forest to indigenous forest was the highest ratio of indigenous afforestation possible while delivering a financially viable project venture at the carbon prices modelled.

This analysis uses 100,000 ha as a benchmark to provide an indication of the extent to which natural regeneration can be used to meet the potential identified by the CCC (e.g. 740,000 ha of marginal land that could revert to native forest) (CCC, 2022).

The regeneration scenario modelled the termination of grazing at the initiation of the project intervention and then letting natural regeneration take place thereafter. This scenario assumed that it would take 12 years for the pasture to be populated. It also assumed sufficient native tree species to meet the forest definition in the NZETS, and during those 12 years the landowner would need to receive a land rental payment (modelled at \$150/ha/yr being the same rate used in financial scenario modelling by local government entities that the author works with) to compensate for the loss of pastoral revenue from the land in question.

It is assumed that such land rental payment is not required for years when the project is issuing carbon credits and receiving carbon revenue. In reality, the time it would take for closed pasture to eventually meet the forest definition of the NZETS would vary, depending on factors such as rainfall, aspect and proximity to seed sources.

Another approach that could be tested is natural regeneration where the regeneration started in the past where the native forest is already present now having established (e.g. 12 years ago). The problem with this approach is that although it is undertaken routinely in the NZETS now, it does not occur at the scale under consideration. To come close to achieving the scale envisioned by the CCC (i.e. hundreds of thousands of hectares), new natural regeneration on land that is currently non-forest land will be required.

Methodology

A DCF analysis was employed to generate key financial indicators, including investment required, internal rate of return (IRR) and net present value (NPV). The analysis is designed to shed light on the scale of investment required, risk and expected return. These are key financial attributes to consider when attempting to secure investment funding and before considering the non-financial costs and benefits accruing to the investor or society.

Key assumptions and inputs used:

1. Cashflows are unleveraged (no debt), before-tax and real (no inflation)
2. Project is undertaken by a landowner on their own land
3. Project development starting year (e.g. recruiting land) – 2023
4. Project intervention start year (e.g. shut the gate and/or plant forest) – 2024
5. Starting carbon price in 2024 – \$90 – aligned

to the mid-range of the Treasury shadow carbon prices (The Treasury, 2021)

6. Annual average real carbon price increment (three scenarios) = CP1 \$1.50; CP2 \$4.75; CP3 \$8
7. Fencing/tracking costs = \$0
8. Average native seedling price = \$2 each
9. Average exotic seedling price = \$0.50 each
10. Indigenous forest carbon sequestration rate = 80% of the Ministry for Primary Industries (MPI) Lookup Tables, to realistically align with field measurement results from forest carbon projects. Some have argued that carbon sequestration rates in natural forest are higher than the MPI Lookup Tables. This is not supported by the experience of forest carbon projects in practice, which typically deliver carbon sequestration rates considerably lower than the MPI Lookup Tables. The latter experience aligns with the national average carbon sequestration rate for indigenous forest of 3.5–3.7 tCO₂e/ha/yr (Payton, 2007)
11. Exotic forest carbon sequestration = 100% of MPI Lookup Tables for ‘other softwoods’ (to be conservative)
12. Exotic planting density = 1,000 stems/ha
13. Native planting density = 2,000 stems/ha
14. Cashflow period = 25 years
15. No terminal value
16. Discount rate = 6% (the assumed required rate of return for the investor)
17. Carbon accounting method = stock change
18. Exotic management regime = continuous cover forest management transitioning to native forest through harvest and replacement with harvest strips or patches never exceeding NZETS forest definition for any given hectare
19. Forests established over two years when planted (2024 and 2025).

Results

The DCF results are shown numerically in Table 2, and graphically in Figures 1–5 below.

As shown in Table 2, the different carbon price scenarios are material to the financial viability, with increasing returns as the carbon price increases from CP1 to CP3.

Internal rate of return (IRR)

The IRR is an indicator of the financial viability of a project. Different investors will require different rates of return, depending on their investment preferences and the amount of real or perceived financial risk in the project venture. The IRR reflects a discount rate where the NPV of a cashflow equals zero.

Table 2: Discounted cash flow results (red numbers indicate negative numbers)

| | IRR CP1 | IRR CP2 | IRR CP3 | Capex | Investment | Investment/ha |
|-------------------|---------|---------|---------|-----------------|-----------------|---------------|
| Regeneration | -2.3% | 0.1% | 1.7% | \$5,750,000 | \$650,000,000 | \$6,500 |
| Native | -1.9% | 0.7% | 2.5% | \$1,262,815,230 | \$1,500,000,000 | \$15,000 |
| Exotic transition | 8.9% | 12.3% | 14.8% | \$357,880,000 | \$550,000,000 | \$5,500 |
| Exotic & native | 4.6% | 7.7% | 9.9% | \$628,670,615 | \$800,000,000 | \$8,000 |

| | NPV CP1 | NPV CP2 | NPV CP3 | Total credits | Credits by 2030 |
|-------------------|-------------------|-----------------|-----------------|---------------|-----------------|
| Regeneration | (\$512,783,022) | (\$437,851,757) | (\$362,289,805) | 23,600,000 | 0 |
| Native | (\$1,052,439,632) | (\$837,749,049) | (\$622,639,680) | 25,736,000 | 796,000 |
| Exotic transition | \$208,346,868 | \$563,742,446 | \$919,138,024 | 42,858,300 | 3,550,000 |
| Exotic & native | (\$127,534,095) | \$187,744,269 | \$503,022,633 | 37,848,010 | 2,775,400 |

Note: IRR = internal rate of return of the project; NPV = net present value to the investor; Capex = capital expenditure; Total credits = carbon credits delivered across the 50-year cashflow period; Credits by 2030 = carbon credits delivered by 2030; CP1, CP2, CP3 = three different carbon price change scenarios listed in the methodology bullet points

The respective IRR results for the different afforestation scenarios are shown in Figure 1.

Negative and marginally positive IRRs tend to fail to gain access to investment capital due to the low projected returns when considered alongside the financial risk involved (i.e. losses arising from unforeseen events). Higher returns (e.g. those towards the right-hand side of Figure 1) increase the probability of gaining access to investment capital.

Net present value (NPV)

NPV is a more reliable measure of the financial viability of a project as it provides a measure of a project's level of profitability, including 'not-for-profit' ventures that need to break even to be financially viable. It is calculated as the sum of all discounted costs and revenues for a project over the investment period where the discount rate applied is consistent with the investor's required rate of return. In this analysis, the discount rate applied is 6%.

Results of the NPV for each afforestation scenario are shown in Figure 2.

The NPVs for natural regeneration and native afforestation (Scenarios 1 and 2) are negative at all carbon price scenarios. In contrast, the exotic transition to indigenous forest (Scenario 3) and the 70% exotic afforestation transitioning to indigenous forest and 30% indigenous afforestation (Scenario 4) both show predominantly positive NPVs, with the exception of Scenario 4 under the lower CP1 carbon price projection. In each scenario the carbon project NPVs can be compared with the NPV of same land receiving a land rental of \$150/ha/yr instead of a carbon project.

Investment required

The investment required is the amount of capital needed to fund project establishment and any negative operational cashflows in early years when the project is running at a loss. This is presented in Figure 3 for each scenario.

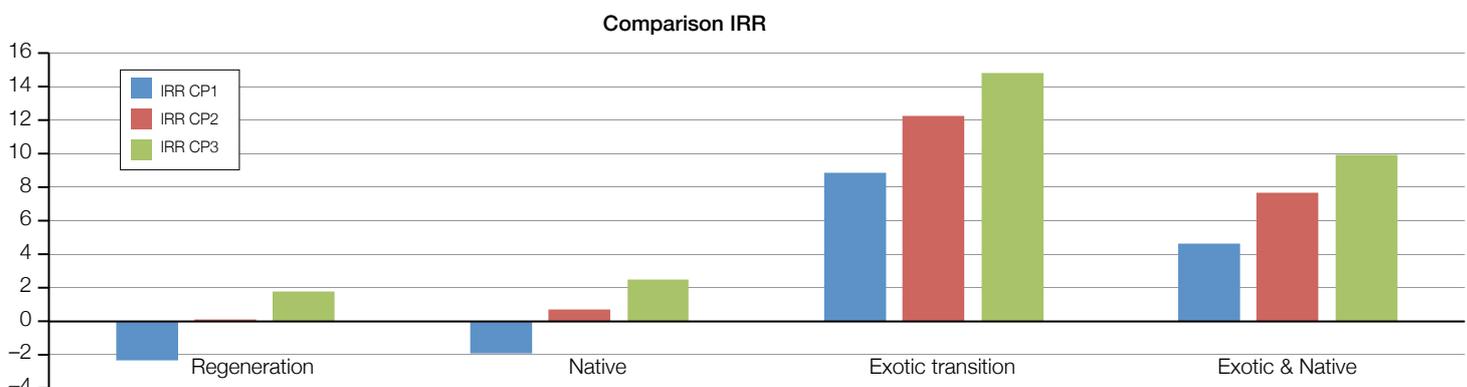


Figure 1: IRR for the four forest establishment scenarios showing the three different carbon price change scenarios (CP1, CP2 and CP3) for a 25-year investment period

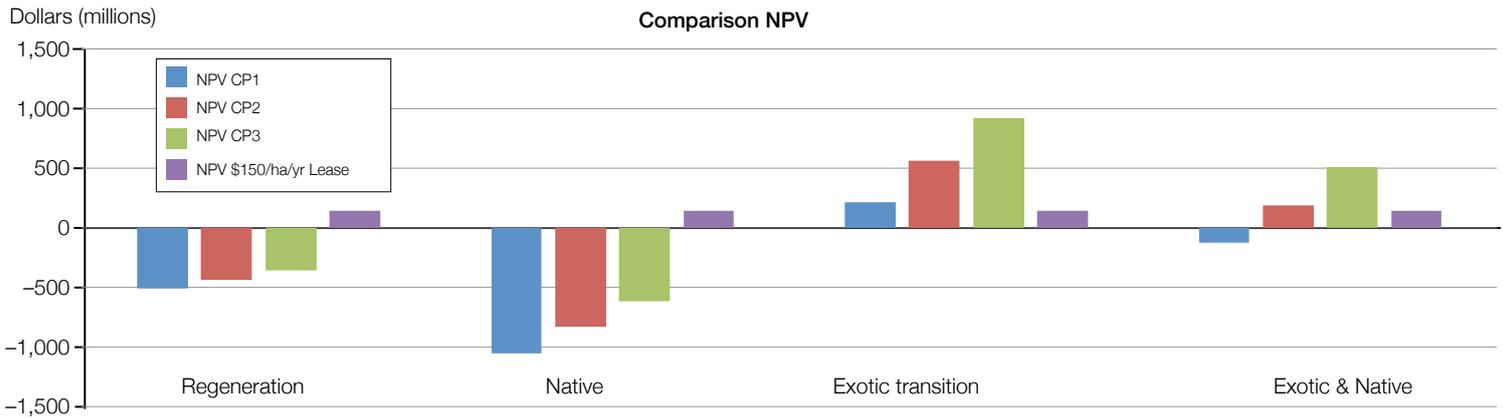


Figure 2: NPV for the four forest establishment scenarios showing the three different carbon price change scenarios (CP1, CP2 and CP3) and for leasing out the same land at \$150/ha/yr for the investment period (i.e. instead of a carbon project)

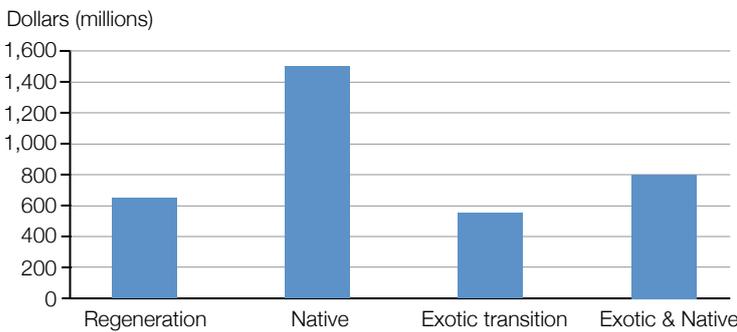


Figure 3: Investment required for the four forest establishment scenarios for a 25-year investment period

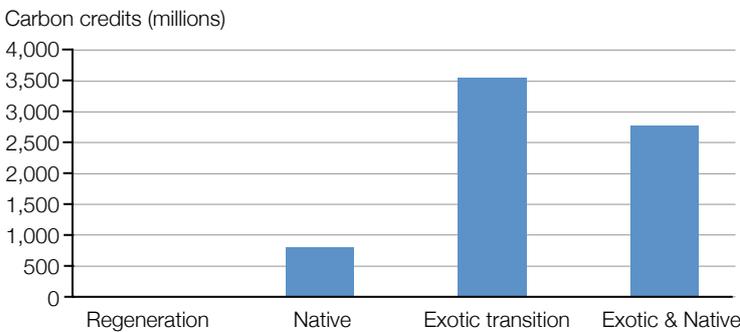


Figure 4: Carbon credits delivered by the four forest establishment scenarios by 2030

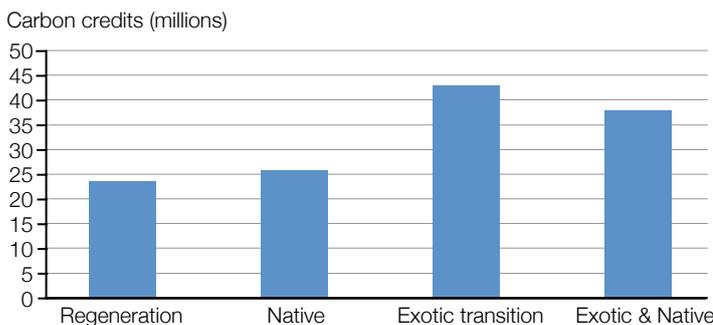


Figure 5: Carbon credits delivered by the four forest establishment scenarios by 2050

Figure 3 shows that Scenario 2 (indigenous afforestation) requires the greatest capital investment at \$1.5 billion (\$15,000/ha). Scenario 4 (70% exotics/30% indigenous) requires \$800 million (\$8,000/ha). The lowest capital investment required is for Scenario 3 (exotic afforestation transitioning to indigenous forest) at \$550 million (\$5,500/ha).

Notable also is the relatively high amount of investment required for Scenario 1 (natural regeneration) (\$650 million), which may seem an anomaly because nature did the planting for free. While this is true, this project type also needs to fund the land rental costs of \$150/ha/yr for the 12 years when no carbon credits (and no carbon revenue) can be delivered to the landowner (i.e. the period of natural forest establishment). While there may be some landowners willing to forego a land rental payment when no carbon revenue is being received, most rural landowners need to make a living from their land and cannot afford to forego revenue from such land for 12 or more years while nature gets the forest established.

Also, because of the relatively low volume of carbon credits delivered in the first 25 years, it is difficult for this project type to support debt funding and/or deliver the necessary dividends to the investor in a manner that enhances liquidity (the ability for an investor to exit the project at any time during the project investment period).

Limited initial cashflow revenue is a common attribute of all four scenarios. This extends the period of investment and has the effect of increasing the perceived project risk for both investors and debt funders.

Carbon credits delivered

A key purpose of forest carbon sequestration at scale is to help the nation deliver its Paris Agreement obligations by 2030. Figure 4 shows the volume of carbon credits delivered by each project type by 2030.

As can be seen in Figure 4, Scenario 1 (natural regeneration) delivers zero carbon credits as a contribution to the Paris Agreement by 2030. As such, this option can at best be seen as a component of a long-term carbon management strategy. To this

end, carbon credits delivered by 2050 have also been modelled, with results shown in Figure 5.

As shown in Figure 5, indigenous forests can make a significant contribution to carbon credit supply over a longer timeframe, but still deliver less than an exotic forest that transitions to indigenous forest, and a forest including 70% of exotic forest transitioning to native forest and 30% indigenous afforestation.

Analysis and discussion

Trade-offs

Financial analysis provides an opportunity to weigh the merits of different project types in relation to what they also do not allow (trade-offs). Trade-offs come into play when considering the purpose of carbon forestry in the context of a national obligation to the Paris Agreement, an aspiration to be a net-zero carbon nation by 2050 and a climate emergency response. When viewed through a climate change mitigation lens, indigenous forests perform slowly and take opportunities away from other more cost-effective options. This is because those other options cannot be resourced with land or capital that has been used by indigenous afforestation and/or natural regeneration.

Because the volume of carbon credits delivered by natural regeneration is zero by 2030, this afforestation approach cannot help Aotearoa New Zealand deliver on the Paris Agreement target. This means that the \$650 million in investment required for 100,000 ha of natural regeneration will deliver a zero return to the 2030 Paris target. If, on the other hand, the same investment was allocated to an exotic forest transitioning to indigenous forest the return to the Paris target will be in the order of 43 million tCO₂e.

Another problem is that natural regeneration at scale is not financially viable. The NPV for this activity type is negative for all three carbon price scenarios, meaning that this project type is unlikely to gain mainstream investment funding. One could remedy this by means of a taxpayer subsidy to lift the returns to private investors. The subsidy required to deliver a positive NPV at carbon price change scenario CP2 (starting at \$90 and rising annually on average at \$4.75) is \$450 million for every 100,000 ha reforested. In contrast, project scenarios (3 and 4) incorporating exotic afforestation would deliver 3.5 million tCO₂e and 2.77 million tCO₂e by 2030, respectively, at no cost to the taxpayer.

With the challenges facing society (COVID-19 recovery, high inflation, a cost-of-living crisis, a supply chain crisis, a human resources crisis in health, education, policing and across the private sector, and a climate change emergency), society needs a cost-effective climate change solution. New Zealand requires an affordable approach that can be delivered at least cost to the taxpayer now and into the future. Least cost now means avoiding taxpayer subsidies for forest establishment. Least cost in the future means

reducing the need to buy more offshore carbon credits due to failure to deliver emission reduction and carbon sequestration targets under the Paris Agreement.

Taxpayer and philanthropic funds are not limitless, and if we are to succeed as a nation at avoiding dangerous climate change, we need these finite financial resources to be allocated to an urgent set of 'must-haves' in the form of investment in low-carbon transportation, agriculture, buildings and clean energy. In the meantime, the private sector can fund the carbon sequestration element of the national climate change emergency response using a combination of exotic and indigenous afforestation without the need for taxpayer or philanthropic funding. If well designed, this private sector afforestation contribution will also comprise much-needed climate resilience and adaptation through permanently reforesting erosion-prone landscapes.

Sitting in the background are farmers who do not want the forest sector to multiply its land area needs by a factor of three or four, as required for indigenous regeneration in comparison with blended approaches that employ exotic and indigenous afforestation.

Pre-1990 natural regeneration additionality analysis

Methodology

This analysis examines the definition of 'additionality' in international carbon standards and as applied by the New Zealand Ministry for the Environment (MfE) in the context of natural regeneration in pre-1990 indigenous forests. It then uses these definitions to identify legitimate ways to pass an additionality test in a pre-1990 indigenous forest setting. This analysis is designed to inform public policy in preparation for potential future changes to the Climate Change Response Act 2002 (and NZETS) to include pre-1990 indigenous forests. It also provides a context for evaluating the validity of voluntary carbon market activities in pre-1990 forests.

Additionality analysis

The CCC has indicated that recognition of carbon stock change in pre-1990 forest has the potential to assist in meeting New Zealand's 2030 Paris targets. According to the CCC, accounting for carbon stock change in pre-1990 forests involves estimating additional emissions and removals in pre-1990 forests above or below 'business-as-usual' due to changes in forest management (CCC, 2022, p. 202). This echoes the United Nations Framework Convention on Climate Change (UNFCCC) definition of climate change mitigation, which 'involves human interventions to reduce the emissions of greenhouse gases by sources or enhance their removal from the atmosphere by sinks' (UNFCCC, 2009).

A key principle (MfE, 2022; Verified Carbon Standard, 2022; Gold Standard, 2020) in international

carbon markets relating to carbon sequestration is that sequestration eligible to be used to offset GHG emissions must be derived from:

1. A human intervention, and
2. Be additional to what nature would do anyway (e.g. additional to sequestration by natural forests and the oceans), and
3. Be additional to what humans would do anyway (e.g. additional to activities already required by law, regulation or common practice).

In carbon projects there are two main components of additionality:

- Project additionality – the carbon credits issued may only be those arising from the project as a result of human intervention
- Financial additionality – the human intervention in the project would not occur in the absence of revenue derived from the sale of carbon credits. In this way, the purpose of carbon credit sales revenue is to fund an activity that could not happen without that revenue.

Without ‘financial additionality’ the so-called ‘carbon credits’ would be a fiction and potentially fraudulent, as they would have happened naturally or did not need carbon revenue to occur. Their use to offset real and additional GHG emissions may give the impression (to a third party) that something beneficial to the atmosphere is occurring when in fact no additional carbon sequestration or removal has been delivered. This would potentially breach the Environmental Claims Guidelines of the Commerce Commission (Commerce Commission, 2020 p. 11):

Carbon-offsets are credits for emission reductions gained by projects such as tree planting or energy efficiency. The offsets can be used to cancel out the negative environmental impact of carbon emissions, by achieving lower emissions elsewhere. Businesses might use carbon-offset claims to promote themselves and/or their good or service, or they might allow customers to participate in carbon-offsetting (i.e., by purchasing carbon credits as part of the sales process).

Carbon-offset claims should clearly inform consumers about what is being offset and how it is being offset.

In some indigenous forest management activity types such as habitat enhancement, biodiversity benefits are being delivered that are additional (i.e. the benefits would not occur without money spent on biodiversity conservation activities such as pest and weed control). But for such activity to be traded in a carbon market, as opposed to a biodiversity market or philanthropy, the project must pass the minimum requirements for carbon benefit delivery (i.e. comprise additional carbon benefits). This coalescence of carbon and biodiversity benefits delivered through the same

project actions has been recognised by international carbon standards such as the Plan Vivo Standard, the Gold Standard and the Verified Carbon Standard. The biodiversity benefits, however, remain secondary to the carbon benefits required by these standards.

Where an activity type delivers biodiversity benefits, but not carbon benefits, the project would fall outside the ecosystem accounting boundary of the carbon market and outside the scope of a carbon market financing instrument. This by no means suggests that there is anything inferior about biodiversity conservation in comparison with carbon benefits. It simply recognises that the carbon market was designed for carbon outcomes as the core deliverable to be traded.

This potential alignment of biodiversity and community co-benefits with carbon projects has led many actors in the carbon market domestically and internationally to focus carbon project and programme development on delivering a range of non-carbon co-benefits alongside the carbon benefits. Examples include the multitude of nature-based solutions projects already certified to the Plan Vivo Standard and the combination of the Verified Carbon Standard and the Climate, Community and Biodiversity Standard.

When the non-carbon co-benefits of a forest conservation project cannot be accommodated in the carbon project (e.g. because the beneficial carbon stock change is marginal or non-existent), such a project has the opportunity to pursue other (non-carbon) market-based financing instruments and approaches. Such market-based financing instruments and approaches to biodiversity conservation internationally include the:

- Business and Biodiversity Offsets Programme (BBOP, 2016)
- Plan Vivo Biodiversity Standard (in development) (Bohannon, pers. comm)
- Ekos Sustainable Development Units programme developed by the author (World Economic Forum, 2022)
- Sustainable Development Verified Impact Standard (SD VISta) (Verra, 2019)
- Gold Standard for the Global Goals (Gold Standard, 2019)
- DHF Model (Environmental Finance, 2021)
- EcoAustralia credits
- Wallace Trust biodiversity credit methodology (World Economic Forum, op. cit.)
- Biodiversity credit initiatives of ValueNature, Terrasos, Qarlbo Natural Asset Company, the Scottish Wildlife Trust and the Biodiversity Credits Alliance (BCA) – the author is a founding committee member of the BCA.

There is also a range of sustainable financing revenue streams and modalities for biodiversity conservation (Weaver et al., 2022b), including (but not limited to):

Sustainable revenue streams, including:

- Taxes, levies fees and fines
- Results-based payments
- Payment for ecosystem services
- Voluntary surcharges
- Environmental trust funds.

Sustainable financing modalities, including:

- Impact investment
- Blended finance
- Impact bonds
- Pooled funds
- Partnerships for public purpose (PPP)
- Crowdfunding
- Catalytic capital
- Debt-for-Nature Swaps.

Non-additional 'carbon credits', even if they deliver considerable non-carbon co-benefits, make the atmosphere worse off rather than better off for the following reasons:

1. Money spent on these carbon credits could have been spent on genuinely additional carbon benefits to the atmosphere (e.g. investing in emission reductions like installing a solar photovoltaic system, or purchasing legitimate carbon offsets from planting a new permanent forest).
2. The seller and buyer of those carbon offsets has made a carbon-related claim that is fictional (i.e. claimed to have offset their fossil fuel emissions when they have not). This threatens the integrity of the carbon markets and can impede investment flows and consumer demand for carbon market solutions for a low-carbon economy.

Table 3 provides examples of different aligned definitions of additionality by different carbon market standards and integrity initiatives.

The only legitimate way for a carbon credit seller and buyer to maintain integrity in a carbon credit transaction is for the carbon credits used for carbon offsetting to be: (a) certified to an internationally recognised carbon standard (to safeguard additionality); and (b) issued and tracked by an internationally recognised carbon credit registry (to safeguard against double counting).

According to the MfE Interim Guidance for Voluntary Climate Change Mitigation (2022), for voluntary climate change mitigation to be considered credible it must take account of these principles:

- Information on the mitigation must be transparent, clearly stated and publicly available

- Mitigation must be real, measurable and verified by a third party to a reputable, and publicly disclosed, carbon standard (including the NZETS)
- Mitigation must be additional to business-as-usual activity
- Mitigation must not be double used*
- Mitigation must not result in leakage of emissions elsewhere
- Mitigation must be permanent.

In this guidance double use does not refer to mitigation claimed at the organisation and country level. Units representing voluntary climate change mitigation used towards a country's Nationally Determined Contribution should be transparently disclosed in the claim made by the organisation (see Weaver et al., 2022).

At the time of writing MfE had not released its 2023 guidance on the voluntary carbon market.

The MfE Interim Guidance for Voluntary Climate Change Mitigation (2022) lists several types of New Zealand Units (NZUs) that cannot legitimately be used for voluntary carbon offsetting. These are units freely allocated by the Government that were not earned by undertaking specific emissions reduction or removal activities. These units include:

- Emissions-intensive, trade-exposed allocation (NZU_EITE)
- Pre-1990 forestry allocation plan (NZU_FA)
- Fishing allocation (NZU Fishing)
- NZUs sold by auction (NZU_AUC).

Voluntary carbon market

Project types not eligible to register in the NZETS can potentially deliver legitimate carbon offsets through the international voluntary carbon market. This market functions by means of international carbon standards and international carbon credit registries.

Internationally recognised carbon standards include:

- Verified Carbon Standard
- Gold Standard
- Clean Development Mechanism
- Plan Vivo Standard
- Climate Action Reserve
- Joint Implementation
- American Carbon Registry
- Emissions Reduction Fund (ERF) of the Australian Government.

* In this guidance 'double use' refers to: multiple organisations using the same units representing voluntary climate change mitigation to meet their own organisational targets; or an organisation using the same units representing voluntary climate change mitigation for their mandatory compliance obligations and making a claim of voluntary action.

Table 3: Additionality definitions by different carbon standards and programmes

| Carbon standard | Additionality definitions/guidance |
|---|---|
| Verified Carbon Standard Methodology Requirements (2022) | <p>A project activity is additional if it can be demonstrated that the activity results in emission reductions or removals that are in excess of what would be achieved under a ‘business-as-usual’ scenario and the activity would not have occurred in the absence of the incentive provided by the carbon markets. Additionality is an important characteristic of GHG credits, including VCUs, because it indicates that they represent a net environmental benefit and a real reduction of GHG emissions, and can therefore be used to offset emissions. Methodologies shall set out a procedure for demonstrating additionality using a project method or a standardized method (i.e. performance method or activity method).</p> <p>Source: Verified Carbon Standard, 2022</p> |
| Plan Vivo | <p>The benefits from a Project Intervention are considered to be additional if they would not be achieved in the absence of the Project.</p> <p>Source: Plan Vivo Standard, 2022</p> |
| Gold Standard | <p>Additionality is a defining concept of carbon-offset projects. To qualify as a genuine carbon offset, the reductions achieved by a project need to be ‘additional’ to what would have happened if the project had not been carried out (e.g. continued as business as usual).</p> <p>The concept of additionality is important as only carbon credits from projects that are ‘additional to’ the business-as-usual scenario represent a net environmental benefit. Without the ‘additionality’ requirement, there is no guarantee that the emissions reduction activities will lead to a reduction of GHGs into the atmosphere. Therefore, in simple terms, if carbon credits are awarded to activities that would have happened anyway, emissions are allowed to rise without a corresponding cut elsewhere, making the process meaningless. Any business or individual considering purchasing carbon credits to ask questions to ensure that the standard or system backing the credits require proof of additionality.</p> <p>Source: Gold Standard, 2020</p> |
| CDM | <p>Project additionality The first requirement is that the project activity is not a ‘null’ activity (i.e. it achieves real ‘net anthropogenic GHG removals by sinks’ relative to the ‘business-as-usual’ scenario – called the ‘baseline scenario’).</p> <p>Financial additionality The second requirement is that the project activity must be in need of additional resources and it should be possible to cover this resource gap with the expected Clean Development Mechanism (CDM) revenue (i.e. the financial incentives expected from carbon credits under the CDM must be demonstrated to be both necessary and sufficient for the project activity to be implemented). The difference made by the financial incentives expected from carbon credits must therefore be shown to be a decisive factor in enabling the project activity.</p> <p>Source: UNFCCC, 2013</p> |
| Integrity Council for the VCM | <p>The GHG emission reductions or removals from the mitigation activity shall be additional (i.e. they would not have occurred in the absence of the incentive created by carbon credit revenues).</p> <p>Source: Integrity Council for the Voluntary Carbon Market, 2022</p> |
| ICROA | <p>Project-based emission reductions and removals shall be additional to what would have occurred if the project had not been carried out. International Carbon Reduction and Offset Alliance (ICROA) members shall demonstrate the project would not have occurred without the availability of carbon finance.</p> <p>Source: ICROA, 2019</p> |
| Ministry for the Environment | <p>The GHG emissions reductions or removals are due to a specific intervention and would not have occurred under business-as-usual. This means the voluntary climate change mitigation cannot be an action or activity that was going to happen anyway, something that is already required under existing regulation, or incentivised by other policy measures.</p> <p>Business-as-usual management of a pre-1990 forest is likely to sequester carbon. Only measurable carbon benefits in a pre-1990 forest that result directly from a specific new action could be considered additional.</p> <p>Source: MfE, 2022</p> |

Each of these carbon standards is listed as an eligible offset type by the International Carbon Reduction and Offset Alliance (ICROA). Note that the ICROA endorsement of the Plan Vivo Standard occurred after publication of its 2019 Code of Best Practice.

Natural regeneration in the international voluntary carbon market

To date, there is only one forest carbon project registered in the international voluntary carbon market in Aotearoa New Zealand – the Rarakau Forest Carbon Project on Māori land in western Southland. This project is certified to the Plan Vivo Standard (Weaver, 2018a, 2018b) and applies an improved forest management methodology. It has passed two additionality tests through two international validation and verification audits (2013 and 2018), issues carbon credits in the Markit Environmental Registry (New York) and has traded carbon credits since 2014.

The carbon accounting methodology for the Rarakau project involves avoided conventional logging of tall indigenous forest. The baseline (business-as-usual) situation was low impact logging under the Forests Act 1949 and the Resource Management Act 1991 (RMA). The landowners had been logging the forests until the 1990s and during a pause in the logging cycle in the mid-2000s agreed to permanently give up the property right to log their forests and instead transition to a forest carbon project to earn revenue from carbon credit sales instead of indigenous timber.

The carbon benefits from the project are delivered through a combination of avoided emissions from logging (one-off small carbon benefit), plus enhanced carbon sequestration caused by the change in land use from production forestry to long-term protection and the ability of the measured natural regeneration to continue uninterrupted by periodic logging for a limited period. The total carbon benefits to the atmosphere are modest, averaging 3.3 tCO₂e/ha/yr (i.e. approximately half of the 50-year average indigenous carbon sequestration rate in the MPI Lookup Tables) (MPI, 2017).

Avoided emission carbon project activities in the forest sector has provoked controversy internationally in recent times (Verra, 2023). Avoided emissions in the energy and forest sectors are conceptually challenging because they are preventing harm from happening rather than causing something new and desirable to happen. ‘Harm avoidance’ involves effort and cost to ensure that nothing (bad) happens. Similar public policy challenges are common, such as preventing disease from tobacco, preventing road accidents and preventing fires, through to preventing dangerous climate change.

Projects that prevent or reduce harm face the problem of not knowing exactly when the harm would have happened without the intervention.

Yet carbon markets have successfully supported renewable energy and energy efficiency projects for many years, despite no-one knowing for certain the extent to which such projects slowed down the rate of fossil fuel extraction and burning globally.

As such, ‘avoided harm’ project types need to be treated slightly differently to ‘causing good’ project types. Additionality tests in avoided harm projects need to examine the plausible level of emissions that would occur without the intervention, based on a detailed examination of local drivers across time. The alternative is to not do the climate change equivalent of fencing swimming pools until we can prove that this fence will save the life of this child. The trouble with climate change and child drownings is the permanence of the harm that results from a failure to prevent or reduce the risk of that harm.

The other main activity type eligible in principle for carbon project development in pre-1990 indigenous forest land is enhanced carbon sequestration from improved forest management of land that does not have any commercially viable timber and cannot be otherwise cleared for farming (i.e. is protected under the RMA). Enhancing the carbon sequestration rate in such forest could conceivably be delivered through one or more of the following interventions:

- Herbivore control at such a level that a significant increase in carbon sequestration is demonstrated through measurement in comparison with a reference (control) area
- Enrichment planting of tree species that will lift the carbon sequestration rate from the baseline rate (baseline: ‘business-as-usual’ or ‘without intervention’)
- Invasive herbaceous weed control (e.g. eliminating *Clematis vitalba*) to enhance woody vegetation growth rates.

While each of these interventions could conceivably deliver carbon benefits in comparison with a baseline, in practice the annual volume of carbon benefits will need to generate sufficient carbon credits to cover project costs, including the cost of capital/borrowing.

Simply declaring that natural regeneration is occurring in pre-1990 indigenous forest land is not sufficient for issuing and trading carbon credits for the purpose of carbon offsetting. This is because natural regeneration is a baseline (business-as-usual) activity (i.e. it is happening anyway), in the same way that natural carbon sequestration into the oceans is a natural occurrence (taking place in the baseline) and is therefore not additional (i.e. not a human intervention that needs to be funded through the sale of carbon credits).

For carbon projects to pass an additionality test, the project activity (i.e. the human intervention) needs to deliver carbon benefits that are not delivered

in the baseline. The volume of carbon benefits that can legitimately be turned into carbon credits is equal to the sum project carbon benefits minus the baseline carbon benefits.

To illustrate this concept in a natural regeneration setting on pre-1990 forest land one can imagine the following contrasting carbon scenarios:

1. Baseline = natural regeneration without human interventions to speed it up.
2. Project = enhanced natural regeneration with human interventions that speed up the rate and amount of carbon sequestration.

Subtracting the baseline carbon benefits from the project carbon benefits delivers the net carbon benefits delivered by the project. This concept is illustrated in Figure 6.

The annual difference between the carbon benefits delivered by the natural regeneration (green line) and the enrichment planting (blue line) amounts to the annual additional carbon benefits delivered by the project intervention and that can be legitimately issued as carbon credits.

Note also that the total carbon benefits delivered by the project is not equal to the carbon credits that can be traded from a project in the voluntary carbon market. This is because such projects are required by international carbon standards to self-insure by means of allocating a percentage of 'buffer credits' that are issued but which cannot be sold. Such buffer credits are used to 'make good' on any carbon credits damaged in the case of a reversal (e.g. fire). The buffer credits are typically held and owned by the carbon standard in a pooled buffer. The volume of buffer credits required for a project is calculated by means of a detailed risk assessment – the higher the risk the larger the buffer.

Conclusion

Despite my own preferences for indigenous forests as a climate change solution, including a career

in indigenous forest conservation that runs back to the late 1980s, my experience working with indigenous forest carbon projects at scale has revealed a set of economic realities and public policy trade-offs.

Naturally regenerating indigenous forest carbon projects can and do work well at a small scale and/or where landowners are wealthy enough to not need to replace pastoral revenues on reforested lands. But at a scale sufficient to have a material impact on national carbon sequestration targets, economic and public policy realities come into play that cannot be ignored. These realities include: (a) the need to cover forgone income (e.g. replacing pastoral revenues and/or covering land rental costs); (b) the slow delivery of carbon credits (missing the Paris Agreement deadline); and (c) the much larger land area required to deliver the same volume of carbon sequestration that could be delivered in a much smaller area when exotic forests are included in the carbon sequestration portfolio. This is at a time when there is considerable political pressure from the agricultural sector to avoid turning good farmland into forests amid high inflationary pressures on the economy.

If the taxpayer were asked to fund the forgone income mentioned in (a) above, trade-offs to consider include: (i) deciding what domestic public spending budgets to cut; and/or (ii) the impact of reallocating public funds earmarked for the acquisition of international carbon credits to domestic forest carbon through natural regeneration. During a cost-of-living crisis in the wake of a global pandemic the public will rightfully demand a cost-effective solution to climate change. Any public spending on carbon sequestration internationally or domestically will need to deliver a cost-effective outcome – otherwise climate change policy will fail politically.

The inconvenient truth elaborated in this paper shows that indigenous regeneration at scale is a far less cost-effective option compared with other regenerative options at scale, including continuous cover exotic forestry (e.g. the kind that gets sustainable forest management certification), continuous cover exotic

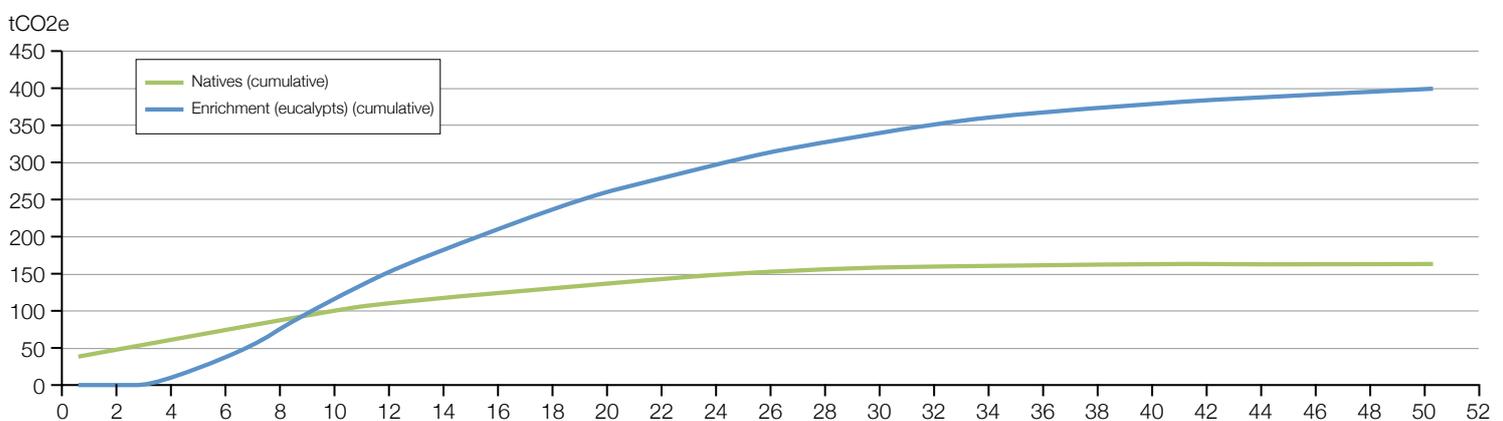


Figure 6: Cumulative baseline (green line) and project (blue line) carbon benefits in natural regeneration that has been enrichment planted with widely-spaced eucalypt

forestry transitioning to indigenous forest (through careful management including harvest and replacement), combined with indigenous afforestation plantings. The latter combination can deliver a high-carbon sequestration outcome, in time for the Paris Agreement deadline, at no cost to the taxpayer. This approach can also include indigenous regeneration wherever possible, but as part of a climate change strategy that does not rely on this practice as the core solution.

Indigenous regeneration will deliver high biodiversity benefits. But so too will indigenous afforestation that has been funded by exotic continuous cover forestry, and such forestry that transitions through to indigenous forest across several decades. Moreover, biodiversity conservation costs money in the short and long term (pest and weed control in perpetuity).

A forest carbon project focused on biodiversity conservation needs to fund that biodiversity conservation effort. If the financial viability of that forest carbon project is negative or highly marginal, there will be little or no funds available for pest and weed control now and into the future. This is for the hundreds of thousands of hectares that need reforestation to meet our Paris Agreement obligations, our biodiversity conservation goals, our net-zero carbon nation aspirations, and to get our landscapes ready for the intense ex-tropical cyclones that will become the norm in a warmer climate.

Improved forest management of pre-1990 indigenous forest is worthy of inclusion in a national forest carbon strategy. But this activity will need to demonstrate additionality through either being included in the Climate Change Response Act 2002, with appropriate additionality safeguards, or being certified to the additionality requirements of internationally recognised forest carbon standards. To do less would create a flawed carbon market and leave the door open to fraudulent carbon trading activities that are both not benefiting the atmosphere and are degrading the integrity of the carbon market itself.

If project proponents want to pursue biodiversity conservation in situations that are not delivering additional carbon benefits to the atmosphere, they have the option to pursue biodiversity conservation financing pathways including (but not limited to) philanthropy and biodiversity markets. Such philanthropy could include the funds no longer needed for native afforestation because the carbon markets are delivering this at scale in a blended exotic and indigenous approach.

If an activity cannot be funded, it will not happen. We are in a climate emergency and this demands open-minded innovation, extraordinary responses to an extraordinary situation and an acceptance that, according to the Italian proverb *La Bégueule 'le meglio è l'inimico del bene'* – the perfect is the enemy of the good.

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Value versus villain

Peter Hall

Unsurprisingly, my main topic for this ‘Last word’ is post-harvest residues and their potential for good or bad. My first look at logging residues took place in the mid-1990s when working for LIRO. Birds-nests of logging slash perched on a hill in Nelson caught my eye and I started measuring how much of what was in there. My initial interest was in the potential for getting some value out of it, with concern over collapses of landing surrounds.

I have worked on this topic (amongst others) on and off since then. It is notable how much the landscape has changed over the years – from almost no interest from forest companies and fuel users in the 2000s to significant recent developments occurring in the use of landing residues for boiler fuel substituting for fossil fuels (coal and LPG). Most of this is driven by government policy such as carbon price and the intent to get rid of coal boilers in pursuit of lower carbon emissions. The use of these residues can potentially be a source of extra revenue to the forest manager or grower.

This year has seen yet another storm-related flood in an area with a lot of production forestry. Much of what makes the news points the finger at the forest industry, and logging residues, and at least some of this is probably warranted. Utilising logging residues in some value-add process would remove the potential for the logging debris to cause damage. If it is not left on the hillside (landing surrounds or cutover), it can’t flow off it. The farmers, councils and homeowners will then be left with just the silt to deal with.

Utilise the residues – easy to say and harder to implement – change always is. However, for the residues, the where, when, what and how much is reasonably well known. Machinery and supply chains to get forest residues to bioenergy users or bio-product manufacturers exist and are entirely possible. The cost to extract and transport is also known. However, in some regions there needs to be a bit of extra effort and innovation as the supply of residue and demand for energy are mismatched, with an oversupply of residues being the most problematic issue when searching for a solution to them causing harm.

Fortunately, there are multiple options for the use of the wood from logging residues: fuel, densified fuel (which can be transported much further economically), biochar, activated carbon and a range of biochemicals. Some of these processes are more developed than others and research is ongoing. Distributed manufacturing is a possible solution.

To more rapidly develop the commercial deployment of these various options will take effort, cooperation and collaboration from all players in the game – forest growers, loggers, truckers, investors, processors and government (local and central).

These residues have potential societal value, as well as the potential to cause harm. Some investment in the opportunities to utilise this material is in the interest of growers if we wish to maintain the right to harvest without increasingly severe restrictions on what operations are permitted.

In my view, the forest growers need to take a lead on this and some already are. There also needs to be support and leadership from government, via policy and the continuation/expansion of low-carbon support funds such as GIDI, and possibly support for feasibility studies including market intelligence on demands for a range of possible wood residue-based products.

There are multiple benefits in doing something productive with logging residues (increased revenue, new jobs) and a reduction in costs (less post-harvest management, court action, fines, operating restrictions). Even if the processing ventures are not immediately profitable in the short term, they may still add value due to the avoidance of the costs and impositions of failing to act. I find it hard to see a downside.

We also need to be proactive in our messaging. There will be more storms and it is probable that there will be more debris issues, so we need to let people know that we are doing something positive to reduce issues now and eliminate them in the long term.

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Appeal for Funds



Please help us to help NZ Forestry?

The NZIF Foundation was established in 2011 to support forestry education, research and training through the provision of grants, scholarships and prizes, promoting the acquisition, development and dissemination of forestry-related knowledge and information, and other activities.

The Foundation's capital has come from donations by the NZ Institute of Forestry and NZIF members. With this, the Board has been able to offer three student scholarships and a travel award each year. It has also offered prizes for student poster competitions at NZIF conferences.

To make a real difference to New Zealand forestry, including being able to offer more and bigger scholarships and grants, the Board needs to grow the Foundation's funds. Consequently it is appealing for donations, large and small, from individuals, companies and organisations.

The Board will consider donations tagged for a specific purpose that meets the charitable requirements of the trust deed. A recent example has seen funds raised to create an award in memory of Jon Dey who was known to many in New Zealand forestry. Donations for that award are still being sought.

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