



Tāne's Tree Trust
NATIVE FORESTS FOR OUR FUTURE
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Submission for

Ministerial Inquiry into Land Use in Te Tairāwhiti, Tūranganui-a-Kiwa and Te Wairoa

Alternative forestry regimes for climate resilience

*Native afforestation and continuous
cover forestry systems*

Submitted to

The Ministerial Inquiry Panel:

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Executive Summary

Alternative forestry regimes for climate resilience - Native afforestation and continuous cover forestry systems

Tane's Tree Trust is a nation-wide organisation with a vision to support landowners in successfully establishing and sustainably managing native forest, for all the benefits they provide. We have 701 members, including members within Tairāwhiti and Wairoa regions. We are committed to scientific research as a base for best practice guidelines. Our resources are freely available to all. We have field trials throughout NZ, including project work in Tairāwhiti and Hawke's Bay.

The Tairāwhiti and Wairoa have a long, well documented history of severe hill country erosion and flooding. This is an area with highly erodible soils and steep topography. Gisborne District has 26% of its land susceptible to severe erosion, compared with 8% of land in New Zealand. However, the erosion has been made much worse by changes in land use, driven in good part by government policy.

The increased frequency and severity of major storm events due to climate change have exacerbated the problems. The enormous amount of sediment washed from the highly erodible soils on hill country farms, and forestry slash and sediment from recently clear-felled forestry sites appear to have caused most of the damage downstream.

However, underlying these issues is the extensive loss of native forest historically, and the current lack of exotic forests managed primarily for catchment protection - both factors driven by past government policy. There is a history of imbalance in land-use decision-making between those who benefit from short-term economic gains and those suffering the long-term impacts from the historical loss of permanent forest cover and the ecosystem services they provided.

The native forest cover that was historically destroyed in the steep hinterlands, would likely have contributed billions of dollars in ecosystem services, particularly in keeping vulnerable hillsides relatively stable, and reducing impacts to downstream communities, infrastructures, local economies, food production, and natural ecosystems. It would also have reduced the loss and trauma experienced by thousands of people impacted by extreme weather events such as the Esk Valley floods (historic and recent), and Cyclones Bola, Hale, and Gabrielle.

Past Governments funded forestry plantings, primarily for land stabilisation and catchment protection, such as the East Coast Forestry Project initiated in 1992 following Cyclone Bola. However, while the East Coast was still in post-Bola recovery mode, **the Forestry Corporation was sold off and catchment protection became subservient to timber production and market forces.**

In 1993, a Parliamentary Commission for the Environment report on progress towards sustainable land management in the Gisborne region, following Bola, stated that **though the cost of land use change is high, the cost of disaster relief is enormous** - *"Immediately after the Bola storm, Government disaster relief totalled \$111 million. Money spent on disaster prevention is money well spent."*

Clear-fell regimes of radiata-pine leave a vulnerable period of approximately 6 years, during which time there is a risk of erosion in high-intensity rain events. So, attempts at amelioration of some of the erosion (by planting commercial forests) have themselves caused problems, particularly with the mobilization of forestry slash and the damage that this has caused to infrastructure, communities, other businesses, and the environment.

Harvesting of forest plantations should be staggered in a mosaic pattern to avoid large land areas being denuded of forest cover and becoming vulnerable to erosion in extreme weather events. This has been done in other regions, but Gisborne District Council failed to do this when the post-Bola forest plantations reached rotation age, but had the capability to do this via consenting processes.

There is a wealth of published research quantifying the role of forests – exotic plantations and permanent native forest and shrubland – in reducing erosion on steepland erodible soils, much of which is based on data from Tairāwhiti.

Multi-age, multi-species, permanent native forests are more likely to be resilient to the impacts of climate change.

New Zealand urgently needs alternative forestry regimes for climate resilience, managed primarily for ecosystem services and the public good. However, landowners need revenue for forest cover on their land (whether exotic or native). Apart from carbon, there are few opportunities for those establishing permanent native forest cover to realise any ecosystem service benefits that this would provide, as **most benefits accrue to the wider community** – locally, regionally, and nationally, but **particularly those downstream**.

Central and local governments must work together to right past wrongs and, in liaison with stakeholders (particularly tangata whenua), **urgently develop models to incentivise sustainable land use**, for the benefit of all.

Tane's Tree Trust would like to see solutions that will improve climate resilience and protect communities, livelihoods, and natural ecosystems. We are committed to supporting landowners, community and iwi groups in restoring and protecting native forest in this region and elsewhere.

Forests need to not only be environmentally sustainable, they also need to be socially and culturally beneficial to contribute to sustainable development.

Tane's Tree Trust would like to see tangata whenua have a major leadership role in healing the whenua. There are already ecological restoration and conservation programmes in the regions that have been very successful in not only environmental gains, but also in positive outcomes for local people. There are already engaged and trained workforces through programmes such as Jobs for Nature, which only have a limited period of funding. We would like to see the funding extended for these groups, particularly in light of the recent destruction and the need for restoring natural ecosystems, which will improve climate resilience.

The problem is – **How do we value the extremely important non-market forest ecosystem services** within our current economic systems and frameworks, which fail to value natural capital in land-use decision-making, and in doing so, short change future generations?

The models urgently need to be developed to incentivise native afforestation and reward landowners for the provision of environmental and cultural services, for the benefit of all.

Tane's Tree Trust's recommended solutions include:

- A more comprehensive review of land use, with a timeframe long enough to fully analyse the damage on the ground, identify the contributing causes, undertake adequate stakeholder consultation, and analyse the data and identify workable long-term solutions to mitigate erosion risks and downstream impacts from future extreme weather events in this region.
- First consider wider landscape land-use options and potential mosaic of land use – native and exotic forestry species, ongoing pasture, etc., to match sites.

- We see a significant role and opportunity to integrate native forestry into the landscape, as part of a mosaic-like landscape pattern of vegetation types and multi-purpose land management. This is likely to take a diverse range of forms and include different weightings and balances of management objectives, depending on the characteristics of each site and stakeholder priorities.
- Multi-purpose, inter-generational, and locally integrated, land-use and land management plans are needed, which are site-specific and also recognise the many ecosystem services that native forests provide.
- There is 'no one size fits all', as there is a wide range of sites, stakeholder requirements, and management concepts involved, including planting native species, natural regeneration, assisted natural regeneration, sustainable indigenous forestry, CCF, carbon farming, transitional forestry, and exotic/native mixes.
- Specific solutions for native forest establishment, from a TTT perspective, are provided in APPENDIX 2. In short, this includes reducing the cost of planting, working with nature (i.e., assisted natural regeneration), pest browser and bird predator control, seed islands and enrichment planting, use of existing cover of brush weeds as a nurse, selective weed control, ongoing monitoring and an adaptive management approach.

Finally, TTT recommends the following land use scenarios:

- most vulnerable hill country transitioned into permanent native forestry;
- continuous cover forestry (CCF) considered as an option on some sites;
- exotic forest transitioned to native forest on these vulnerable sites, based on science and demonstrated best practice (currently being researched and developed by TTT and partners);
- ongoing exotic forest production where appropriate, with appropriate safeguards, e.g., generous riparian buffers, strict controls on clear-felling, management of slash, etc.;
- alternative exotic forestry, e.g., redwoods on lower slopes, valley floors, and river flats (which is covered in other submission, e.g., NZ Farm Forestry Association);
- ongoing pastoral grazing on slopes with a low risk of erosion;
- appropriate catchment protection upstream of horticultural land and communities; and
- strategic placement of green firebreaks of low flammability native species.

Successful, cost-effective, large-scale establishment of native forest will depend on working with nature, i.e., **assisted natural regeneration, plus complementary planting where needed**, e.g., seed islands. Integration with supportive economic drivers is essential, i.e., investment, markets, industries, and incentives.

There is an urgent need for financial incentives to bridge the gap between native trees becoming established and increasing their growth rate sufficient to earn enough carbon credits to reward landowners. Ongoing monitoring and an adaptive management approach are recommended as all forests need active ongoing management.

We must start now but recognise that there are knowledge gaps and a need for an adaptive management approach - to help inform and refine site-specific forest/land management plans, and cater for stakeholder requirements. Ongoing applied research programmes are needed to help counter the knowledge gaps and development of appropriate management practices.

There will be **job opportunities**, including highly-skilled forest managers and workers. There is a need for training and continuing professional development programmes in alternative forestry regimes, **but funding is needed to make this happen**. There is support for this within the plantation forestry industry.

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Details of Submitter – Tāne’s Tree Trust

- **Tāne’s Tree Trust (TTT) was established in 2000**, with the vision to support landowners in successfully establishing and sustainably managing native forest, for all the benefits they provide – <https://www.tanestrees.org.nz/>
- Our resources are freely available to all – <https://www.tanestrees.org.nz/resources/>
- We currently have 701 TTT members, including members in Tairāwhiti and Hawkes Bay.
- **We have ongoing project work in Tairāwhiti and Hawkes Bay** with collaborative partners.
- We are amongst those best informed and most experienced at native forestry in NZ.
- **We are a nation-wide organisation** with 13 trustees who have expertise in forest science, forestry management, ecological restoration, ecology, genetics, tree physiology, economics, policy, carbon sequestration, farm forestry, landscape architecture, kaitiakitanga, rongoa, Wai 262, conservation, natural resource management, sustainable land use and water quality.
- We are researching a range of options to **cost-effectively establish native forest at landscape scale**, including assisted natural regeneration and use of seed islands.
- **We are committed to scientific research** as a base for best practice guidelines.
- **Our Annual Report details our comprehensive research & development programme** – https://www.tanestrees.org.nz/site/assets/files/1037/ttt_annual_report_2022.pdf
- **We are highly qualified and experienced** – eight trustees have postgrad qualifications, including three doctorates. Between us, we have 43 years of experience in government organisations, 55 years in university academia, 68 years in CRI research positions, 70+ years in technical roles and private consulting, and 100+ years in professional forestry management.
- **We manage NZ’s largest national database** on planted natives with over 60 different native tree and shrub species measured throughout NZ from over 100 stands, age 5 to over 100 years old.
- **We have field trials throughout NZ** that underpin our databases and development of resources.
- **We recently developed an online Native Forest Toolkit** <https://toolkit.tanestrees.org.nz/> - which is a suite of calculators designed for those planting and managing native trees to meet multiple objectives from environmental restoration to sustainable production. It draws on scientifically robust data from **TTT’s Indigenous Plantation Database** to provide farmers, iwi, environmental NGOs, foresters, community groups and individuals with realistic expectations for their plantings.
- **The Toolkit** includes a Planting & Budgeting Calculator, a Growth and Yield Calculator, an Economics Calculator (which includes non-timber values), and a Carbon Calculator.
- **The Carbon Calculator:** <https://www.tanestrees.org.nz/resource-centre/carbon-calculator/?highlight=carbon+calculator> is for planted native forest. TTT data shows that the Look-up tables significantly underestimate C sequestration in planted, managed native forest – <https://pureadvantage.org/carbon-sequestration-by-native-forest-setting-the-record-straight/>
- **We are currently developing a fact sheets series**, to assist those establishing and managing native forest to meet multiple objectives. These will soon be uploaded to our website.
- **We hold workshops throughout NZ**, including in Tairāwhiti and Hawkes Bay.
- **We co-hosted (with Pure Advantage) a conference at Te Papa**, Wellington, in October 2022 – *O Tatou Ngāhere – Regenerating our landscape with native forest*. Over 1,000 people attended, breaking records for a forestry conference in New Zealand
- **We have expertise in and are proponents of continuous cover forestry:** https://www.tanestrees.org.nz/site/assets/files/1069/continuous_cover_forestry_-_web.pdf
- We are advocates for **continuous cover forestry (CCF) regimes** as opposed to clear-fell regimes.
- **We convene the Northland Tōtara Working Group** and facilitate research into the sustainable management of this naturally regenerating native forest resource.
- Some of our trustees have worked across forestry with indigenous species and exotic plantation species. Several trustees have hands-on experience in sustainable indigenous forestry management via CCF regimes, under part 3A of the Forests Act.

We are happy to provide further information and are best contacted via office@tanestrees.org.nz

The Issues & Causal Factors

Frequent and high-intensity storms, exacerbated by a lingering La Nina cycle and climate change, and vulnerabilities in existing land uses, culminated in the highly damaging floods during Cyclones Hale and Gabrielle in February 2023. High levels of erosion, silt deposition, and forestry slash and other woody debris caused extensive damage to downstream infrastructures and communities in the Tairāwhiti and Wairoa regions.

The underlying factors contributing to the recent devastation include:

- the highly erodible soil types;
- steep topography;
- historical deforestation;
- ‘blanket’ land uses that are ill-suited to the fragile environment;
- failure to manage forestry harvesting patterns to mitigate the well-recognised, 6-year period of vulnerability between harvest, and sufficient canopy closure of the new crop; and
- more frequent and extreme weather events due to climate change.

The region has geology and soils that are naturally highly erodible, but this natural erosion is made worse through the historical clearance of native forest¹.

In hindsight, we can now see the value of the native forest cover that was destroyed to create extensive pastoral land. **It would likely have contributed billions of dollars in ecosystem services**, particularly in keeping vulnerable hillsides relatively stable, and reducing impacts to downstream communities, infrastructures, local economies, food production, and natural ecosystems (from mountains to the sea). It would also have reduced the loss and trauma experienced by thousands of people impacted by extreme weather events such as the Esk Valley floods (historic and recent), and Cyclones Bola, Hale, and Gabrielle.

Unfortunately, many forest ecosystem services are not fully appreciated until the forests are damaged or destroyed.

Rural production land uses in New Zealand are heavily influenced by global primary produce markets and investment. These tend to encourage and support broad-scale, mono-functional land management activities (e.g., extensive areas of pastoral farming and production plantation forestry), that are not necessarily functionally well when integrated into their local landscape settings and contexts – ecologically, culturally, or socially.

Moreover, **extensive single-purpose land use is often at odds with the complex nature and diversity of the landscape**, even within each property’s boundaries. Subtle variations in soil types, topography, aspect, and natural and cultural features, systems, and values, all bring unique combinations of issues, restraints, risks, and opportunities. Therefore, appropriate land management needs to be responsive to these variations right down to a micro-site level. This approach generally results in a rich, diverse, ‘mosaic-like’ landscape pattern, as opposed to ‘blanket-like’ single-purpose land uses. We contend that the latter, whether as part of a pastoral or forestry system, is also a shortcoming that has contributed to the recent problems experienced in the region and beyond.

The devastation in Tairāwhiti and Wairoa was predictable. There is a wealth of research on land use and erosion in this region and elsewhere, as discussed below. Poor land-use decisions, often driven by ill-conceived policy and poor application of regulations, are contributing factors.

¹ <https://soils.landcareresearch.co.nz/topics/soil-quality/state-of-nz-soils/>

A Messy Land-Use History - Government Must Right Past Wrongs

Underlying the issues faced in Tairāwhiti and Wairoa (and elsewhere) is the extensive loss of native forest historically, and more recently, the lack of exotic forest managed primarily for the public good - both **driven by past government policy**.

Therefore, does Government not have an obligation to subsidise land use change that will improve climate resilience, and protect natural ecosystems, downstream communities, and livelihoods?

In the late 1800s and throughout the 1900s, government policy supported an agriculturalist economy. **Clearing of virgin forest was encouraged to create pastoral farmland; this included erodible hill country.**

Concerns were raised about erosion and flooding from the early 1900s. In April 1938, prolonged heavy rain over 3 days caused severe flooding in Hawke's Bay and Gisborne². Most roads suffered damage from slips or flooding. Esk Valley was the hardest hit, with most homes and farmland flooded and buried in silt.

Large-scale afforestation efforts to protect erosion-prone land and catchments in the region started with the planting by the NZ Forest Service, of Mangatu Forest from 1949 to 1969, which was hailed as a success in erosion control³.

A pivotal report on the management of erosion-prone lands, the 'Taylor Report'⁴, was released in 1970, after a Government initiated investigation into repeated severe erosion, flooding and sedimentation events in the Tairāwhiti region, which was impacting a "large section of the rural community". A key recommendation was that 140,000 ha of pastoral hill country was deemed unsuitable for farming and should be afforested for soil conservation and catchment protection, and the benefits would "accrue to all sections of the community and to the nation".

However, counter to this, **in the 1970s and early 1980s, government subsidies resulted in agricultural development being pushed into marginal, erosion-prone land** where it would otherwise be uneconomical⁵.

All too quickly, it became apparent that erosion and sedimentation were a widespread problem on this marginal land, resulting in **further planting of exotic forests from 1980 onwards⁶**. Various Government schemes provided incentives for afforestation of vulnerable, highly erodible land (Land-Use Classes 6 to 8).

The NZ Forest Service was disbanded and the forests were placed into commercial crown-owned entities.

² https://hwe.niwa.co.nz/event/April_1938_Gisborne_and_Hawkes_Bay_Flooding

³ Olsen (1970). Mangatu: A production forest with major protection value. NZ Journal of Forestry 15(2) 169-183. http://nzjf.org.nz/free_issues/NZJF15_2_1970/AF80D9D6-DA72-4CD7-BF25-CC07D390FA45.pdf

⁴ Taylor NH comp. 1970. Wise land use & community development, report of Technical Committee of Inquiry into the problems of the Poverty Bay–East Cape District of New Zealand. Wellington, Water and Soil Division, Ministry of Works for the National Water and Soil Conservation Organisation.

⁵ MPI (2017). New Zealand Agriculture. A policy perspective. <https://www.mpi.govt.nz/dmsdocument/27282-New-Zealand-Agriculture>

⁶ Marden et al. (1991). Declining soil loss with increasing age of plantation forests in the Uawa Catchment, East Coast Region, North Island, New Zealand. Pp. 358–361 in: Henriques P, editor. *Proceedings of the International Conference on Sustainable Land Management*, Napier, New Zealand.

Extensive and severe erosion and flooding caused by Cyclone Bola was a further warning that many existing land uses were not sustainable⁷. Aerial imagery showed that pasture and young plantations (under 5 years old) suffered eight times more erosion than mature native forest and established pine plantations⁸. Regenerating scrub and young pine forest aged 6- to 8-years-old provided an intermediate level of protection⁹.

The government subsequently funded further forestry plantings, primarily for land stabilisation and catchment protection, such as the East Coast Forestry Project initiated in 1992. This was later expanded to allow for a mix of commercial exotic forest plantings and natural forest regeneration¹⁰.

However, attempts at amelioration of some of the erosion by planting commercial forests, have themselves caused problems, particularly with the mobilization of forestry slash and the damage that this has caused to infrastructure, other businesses and the environment.

In 1993, a Parliamentary Commission for the Environment (PCE) report on progress towards sustainable land management in the Gisborne region, following Bola, gave a mixed review¹¹. Concern was raised about the risks associated with clear-fell harvesting on highly erosion-prone land.

The PCE stated that though the cost of land-use change is high, the cost of disaster relief is enormous.

“Immediately after the Bola storm, Government disaster relief totalled \$111 million. Money spent on disaster prevention is money well spent.”

While the East Coast was still in post-Bola recovery mode, **the Forestry Corporation was sold off and catchment protection became subservient to timber production and market forces**. The east coast forestry plantations are currently owned by multiple forestry companies, and many are in remote, difficult-to-access areas, and therefore, economically marginal for forestry production. When these plantations reached rotation age, they were clear-felled when log prices were high to maximise financial returns.

Harvesting of these stands should have been staggered in a mosaic pattern to avoid large land areas being denuded of forest cover and, therefore, becoming vulnerable to extreme weather events – as has been done in other regions. **Gisborne District Council** (district and regional authority for Tairāwhiti) **could have ensured this through consenting processes, but failed to do so**.

⁷ PCE (1993). Water and soil resource management on the East Coast: A review of progress towards sustainable land management in the Gisborne region following the Bola storm in 1988. <https://pce.parliament.nz/publications/archive/1997-2006/water-and-soil-resource-management-on-the-east-coast-a-review-of-progress-towards-sustainable-land-management-in-the-gisborne-region-following-the-bola-storm-in-1988/>

⁸ Phillips et al (1989). Planning for forestry after Cyclone Bola - a comment. *NZ Journal of Forestry* 34(3) 16-17. http://nzjf.org.nz/free_issues/NZJF34_3_1989/C016AE54-9E84-4544-B2B1-CC8BBE67C7A3.pdf

⁹ Marden and Rowan (1993). Protective value of vegetation on tertiary terrain before and during Cyclone Bola, East Coast, North Island, New Zealand. *New Zealand Journal of Forestry Science* 23(3): 255-263. https://www.scionresearch.com/_data/assets/pdf_file/0017/17702/NZJFS2331993MARDON255_263.pdf

¹⁰ MPI (2014). East Coast Forestry Project. Proposed Changes to the Operation of the Scheme. Options for improving the East Coast Forestry Project. <https://www.mpi.govt.nz/dmsdocument/3519/direct>

¹¹ PCE (1993). Water and soil resource management on the East Coast: A review of progress towards sustainable land management in the Gisborne region following the Bola storm in 1988. <https://pce.parliament.nz/publications/archive/1997-2006/water-and-soil-resource-management-on-the-east-coast-a-review-of-progress-towards-sustainable-land-management-in-the-gisborne-region-following-the-bola-storm-in-1988/>

In summary, **the underlying issues contributing to the extent of cyclone damage** in the Tairāwhiti and Wairoa region **are poor land-use decisions and the strong dichotomies in land management** in New Zealand between conservation and production, and indigenous and exotic ecosystems¹².

This is particularly evident in forestry, and **it limits the realisation of the wider value of forests (native and exotic) in our rural working landscapes and urban areas**, and their importance for land stabilisation, biodiversity, climate adaptation, water quality, and human well-being.

There is a strong dichotomy between clear-fell systems on one side, and retirement to native forest on the other – with nothing much in between, other than a very small minority of brave practitioners of continuous cover forestry (CCF) systems. This polarised dichotomy has largely been driven by short-sighted, black-and-white policy initiatives from previous New Zealand governments. It has stymied diversification, and therefore climate resilience, in forestry land use in New Zealand.

¹² Parliamentary Commissioner for the Environment (PCE) (2002). Weaving Resilience into our Working Lands: recommendations for the future roles of native plants. Parliamentary Commissioner for the Environment, Wellington. ISBN 1–877274–05–4. https://www.pce.parliament.nz/media/pdfs/weaving_pdf.pdf

Impact on Mana Whenua & Possible Opportunities

Tāne's Tree Trust is concerned about the impact of the extreme weather events on tangata whenua, and the potential increase in inequities in communities within the region. We are also aware of the determination of the Tairāwhiti and Wairoa communities to restore their landscape and their way of life.

In many parts of New Zealand, including the Tairāwhiti and Wairoa Districts, **Maori historically have had to adjust to the loss of large areas of native forest, culturally significant flora and fauna, traditional food sources, and traditional ways of life**, which has negatively impacted on cultural values and well-being¹³. Environmental damage causes loss of cultural values such as access to natural resources, including traditional food gathering, fibre for traditional weaving and wood for carving, and Rongoa Maori medicinal plant resources and practices.

Looking at the aerial imagery of the devastated areas, it is disturbing to see not only the high number of large landslips, particularly on pastoral hill country, but also the massively gouged out riparian areas, the sediment-clogged waterways and the brown plumes of sediment fanning out into coastal waters. This will have **huge long-term effects on mahinga kai and kaimoana**. Possibly even local extinction of key species.

There will also be long-term impacts on local businesses and employment.

TTT would like to see tangata whenua have a major leadership role in healing the whenua. There are already ecological restoration and conservation programmes in the regions that have been highly successful in not only environmental gains, but also giving positive outcomes for local people.

An example is the extensive restoration project funded by Job's for Nature and led by Whanau-a-Apanui and Ngāti Porou for the whole of the Raukumara Range. We know that Graeme Atkins is concerned that the people who they have trained need work once the Jobs for Nature programmes are finished – he is anxious that the work continues as they are seeing good results and they don't want to lose an engaged and trained workforce.

In all the nightmare of devastation, there may be opportunities for ecological restoration work, and people gaining skills and employment, as well as stronger connections to the land. **There may also be opportunities for iwi groups to become involved in regenerative forestry** projects such as working with nature to help with forest regeneration. This could include establishing seed sources of key native forest species that are locally extinct or scarce, controlling browsers, reducing the impact of bird and seed predation by stoats, rats and possums, and possibly developing industries involving alternative forestry regimes – permanent forests, either unharvested or continuous cover forestry (CCF) regimes with native or exotic species.

Potentially, Tāne's Tree Trust could help with many of these aspects.

Not only does forestry management need to be environmentally sustainable - it also needs to be socially and culturally beneficial to contribute to sustainable development².

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

¹³ Aimers, J., Bergin, D., Horgan, G. (2021). Review of non-timber values in sustainably-managed native forest in New Zealand. Tāne's Tree Trust bulletin, Hamilton, New Zealand. 119 pages.
https://www.tanestrees.org.nz/site/assets/files/1099/non_timber_values_in_native_forests_-_web.pdf

Land Use, Soil Stability, and Catchment Protection

Stabilisation of slopes and the subsequent catchment protection provided by forests is a key ecosystem service in New Zealand because many regions are vulnerable to erosion due to their geology and relatively high frequency of extreme weather events². Tairāwhiti and Wairoa are well recognised for their history of severe erosion, which has been made worse through the historical clearance of native forest¹⁴.

Hill country erosion was estimated to cost New Zealand \$100-150 million per year in 2014 (NZ \$124-186 million in 2022-dollar values)¹⁵ due to lost production, damage to infrastructure and sedimentation. **Gisborne District has 26% of its land susceptible to severe erosion**, compared with 8% of land in New Zealand¹⁶.

Enormous amounts of topsoil have been lost due to erosion where there has been clearance of native forest and conversion to agriculture in unstable hill country^{17,18}. This has led to loss of topsoil, negatively impacting agricultural productivity, and causing damage to infrastructure and sedimentation of streams, rivers and harbours, which has affected water quality and caused loss of biodiversity in freshwater and estuarine ecosystems^{3,19}.

Also, **denuded hillsides shed more water during intense rainfall events, leading to greater flood events downstream**, damaging communities, infrastructure and freshwater, estuarine and marine ecosystems^{20,21}.

A report prepared for the Hawke's Bay Regional Council quantified **ecosystem services lost** from grazed pasture following a heavy rainstorm in 2011 that caused landslides and soil erosion from hill slopes along a 250 km coastal zone in Hawke's Bay²². The cost-benefit analysis showed that planting trees was not profitable unless the trees were harvested for timber, and low discount rates (less than 5%) were used. However, **when considering the value of the extra provision of ecosystem services**

¹⁴ <https://soils.landcareresearch.co.nz/topics/soil-quality/state-of-nz-soils/>

¹⁵ MPI (2015). *Sustainable management of New Zealand's forests*. New Zealand's third country report on the Montreal process criteria and indicators: <https://www.teururakau.govt.nz/te-uru-rakau-forestry-new-zealand/about-te-uru-rakau/our-work-and-partnerships/montreal-process/>

¹⁶ MPI (2014). East Coast Forestry Project. Proposed Changes to the Operation of the Scheme. Options for improving the East Coast Forestry Project. <https://www.mpi.govt.nz/dmsdocument/3519/direct>

¹⁷ Ausseil, A.G.E., Dymond, J.R., Kirschbaum, M.U.F., et al. (2013). Assessment of multiple ecosystem services in New Zealand at the catchment scale. *Environmental Modelling and Software*, 43: 37 – 48. <http://dx.doi.org/10.1016/j.envsoft.2013.01.006>

¹⁸ Basher, L.R. (2013). Erosion processes and their control in New Zealand. Pp 363 - 374 in Dymond, R. (ed.) *Ecosystem services in New Zealand: Conditions and trends*. Manaaki Whenua Press, Lincoln, NZ. http://www.mwpress.co.nz/_data/assets/pdf_file/0004/77053/2_7_Basher.pdf

¹⁹ Gluckman, P. (2017). *New Zealand's fresh waters: Values, state, trends and human impacts*. Office of the PM's Chief Science Advisor. <http://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Freshwater-Report.pdf>

²⁰ Duncan, M.J., & Woods, R.A., (2013). Water regulation. Pp 460 - 473 in Dymond, J.R. (editor) *Ecosystem Services in New Zealand: Conditions and Trends*. Manaaki Whenua Press, Lincoln, NZ. http://www.mwpress.co.nz/_data/assets/pdf_file/0020/77060/2_14_Duncan.pdf

²¹ Awatere, S., Marden, M., Warmenhoven, T., Pohatu, P., Daigneault, A., Monge, J., Dowling, L., & Harrison, D. (2018). *Climate resilient Māori land*. Contract Report: LC3133 Manaaki Whenua – Landcare Research. <https://deepsouthchallenge.co.nz/wp-content/uploads/2021/02/Climate-Resilient-Maori-Land-Technical-Report-Final-Pipiri-2018.pdf>

²² Dominati, E., & MacKay, A. (2013). *An ecosystem services approach to the cost of soil erosion and value of soil conservation RE500/2013/086*. Prepared for the Hawke's Bay Regional Council by AgResearch Limited; Palmerston North. <https://envirolink.govt.nz/assets/Envirolink/1259-HBRC175-An-ecosystem-services-approach-to-the-cost-of-soil-erosion-and-value-of-soil-conservation.pdf>

(largely avoided erosion) the Net Present Value of the investment in planting trees was strongly positive, regardless of the discount rate.

It is estimated that NZ\$300 million a year (in 2022-dollar values) could be saved through avoided erosion if another 2.9 million hectares of forests were to be planted²³.

Unfortunately, in Tairāwhiti, historical attempts at reducing erosion (by planting commercial forests) have themselves caused problems, particularly with the mobilisation of forestry slash and the damage that this has caused to infrastructure, other businesses and the environment. Observations on the impact from the recent extreme weather events in the region indicate that sediment lost from hill country farms, and forestry slash and sediment from forestry sites that were clear-felled in recent years, appear to have caused the most of the damage downstream.

A wealth of research has identified that **clear-fell regimes of radiata-pine have a vulnerable period of approximately 6 years** between the decaying of root systems of the logged crop and the new crop becoming established, **during which time there is a risk of erosion in high-intensity rain events**^{24,25}

This is a concern, because almost one-quarter of New Zealand's plantation forest estate is on erosion-prone land, i.e., high to very high erosion susceptibility classification^{26,27}.

Social license to operate (community acceptance) has become a significant issue regarding clear-fell regimes and exotic plantation forestry²⁸.

Riparian buffers can help limit the negative impact of harvesting operations^{29,30}. However, massively gouged out riparian areas are evident in aerial imagery in a few catchments, after Cyclones Hale and Gabrielle, where riparian plantings have disappeared and would likely have contributed to the woody debris that caused issues downstream. Nevertheless, riparian buffers probably helped limit the negative impact of harvesting and mobilisation of slash and silt in many other catchments.

²³ Yao, R.T; Harrison, D.R. & Harnett, M. (2017). The broader benefits provided by New Zealand's planted forests. *New Zealand Journal of Forestry* 61(4) 7–15.

http://www.nzjf.org.nz/free_issues/NZJF61_4_2017/140A070B-042D-4f0f-9DED-CD8915E14A17.pdf

²⁴ Bergin, D.O., Kimberley, M.O., & Marden, M. (1995). Protective value of regenerating tea tree stands on erosion-prone hill country, East Coast, North Island, New Zealand. *New Zealand Journal of Forestry Science*, 25 (1), 3-19. https://www.scionresearch.com/_data/assets/pdf_file/0004/59638/NZJFS2511995BERGIN3-19.pdf

²⁵ Bloomberg, M., Cairns, E., Du, D., Palmer, H., & Perry, C. (2019). Alternatives to clear felling for harvesting of radiata pine plantations on erosion-susceptible land. *NZ Journal of Forestry* 64(3), 33–39.

http://www.nzjf.org.nz/free_issues/NZJF64_3_2019/5D9ABDDD-40ED-494f-BE1F-BE5BE4AF5A64.pdf

²⁶ Bloomberg, M., Cairns, E., Du, D., Palmer, H., & Perry, C. (2019). Alternatives to clear felling for harvesting of radiata pine plantations on erosion-susceptible land. *NZ Journal of Forestry* 64(3), 33–39.

http://www.nzjf.org.nz/free_issues/NZJF64_3_2019/5D9ABDDD-40ED-494f-BE1F-BE5BE4AF5A64.pdf

²⁷ Te Uru Rākau (2019). *Erosion Susceptibility Classification by class & area of plantation forestry (excluding Department of Conservation Land)*: <https://www.agriculture.govt.nz/dmsdocument/29804/direct>

²⁸ Bayne, K.; Edwards, P. & Payn, T. (2019). Media coverage of recent New Zealand storm events. *New Zealand Journal of Forestry*, 64(1), 17–25. https://www.nzjf.org.nz/free_issues/NZJF64_1_2019/50AC3E90-9D43-48c9-A469-E41E00B26F7E.pdf

²⁹ MPI (2015). *Sustainable management of New Zealand's forests*. New Zealand's third country report on the Montreal process criteria and indicators: <https://www.teururakau.govt.nz/te-uru-rakau-forestry-new-zealand/about-te-uru-rakau/our-work-and-partnerships/montreal-process/>

³⁰ Gluckman, P. (2017). *New Zealand's fresh waters: Values, state, trends and human impacts*. Office of the PM's Chief Science Advisor. <http://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Freshwater-Report.pdf>

Permanent unharvested forests, or forests managed under continuous cover regimes³¹, provide significantly better maintenance of soil cover and catchment protection, compared with plantation forests managed under clear-fell regimes³².

A study of land slipping was undertaken on the highly erodible, steep hill country on the East Coast, in the aftermath of Cyclone Bola³³. **It compared pasture to areas reverting to native shrubland** of different ages. Landslide damage showed a rapid and highly significant reduction against increasing age of reverting manuka/kanuka shrubland. Compared to pasture, there was a 65% reduction in shallow slipping of hillsides in reverting shrubland by age 10 years; and **a 90% reduction by age 20 years**. Other studies indicate that radiata-pine forest provides similar protection from landslide damage as reverting native shrubland, within 10 years of establishment on steep hill country. However, there is a vulnerable period of approximately 6 years post-harvest, as described above.

A review of erosion processes and control in New Zealand concluded that a **closed-canopy of tall woody vegetation typically reduces landslides in large storms by an estimated 70 – 90%**³⁴.

Patterson and Cole (2013)³⁵ cite Cyclone Bola as a good example of an erosion event occurring on land once protected by native forest. For just that one event, the economic cost of losing this ecosystem service of erosion control (due to deforestation) was estimated at NZ\$225 million (in 2022-dollar values). Early indications are that the economic cost due to damage caused by Cyclones Hale and Gabrielle is much greater than that documented for Cyclone Bola.

Griffiths et al. (2020)³⁶ developed a spatial model for landslides that occurred during a period of heavy rain from ex-tropical Cyclone Gita. They used the model to demonstrate that landslide occurrence in the Tasman District, could be substantially reduced by limiting the clear-fell harvest of plantation forests and increasing the extent of permanent forest cover on landslide-prone slopes.

Yao and Velarde (2014)³⁷ used NZeem[®] to estimate avoided erosion values in exotic production forest and native forest in Ōhiwa catchment, eastern Bay of Plenty. They calculated the aggregated economic value of avoided erosion and sedimentation, and flood mitigation, by using economic data

³¹ Barton, I.L. (2008). Continuous cover forestry: A handbook for the management of New Zealand forests. Tāne's Tree Trust, Pukekohe. 104 p.

https://www.tanestrees.org.nz/site/assets/files/1069/continuous_cover_forestry_web.pdf

³² Aimers, J., Bergin, D., Horgan, G. (2021). Review of non-timber values in sustainably-managed native forest in New Zealand. Tāne's Tree Trust bulletin, Hamilton, New Zealand. 119 pages.

https://www.tanestrees.org.nz/site/assets/files/1099/non_timber_values_in_native_forests_-_web.pdf

³³ Bergin, D.O., Kimberley, M.O., & Marden, M. (1995). Protective value of regenerating tea tree stands on erosion-prone hill country, East Coast, North Island, New Zealand. *New Zealand Journal of Forestry Science*, 25 (1), 3-19. https://www.scionresearch.com/_data/assets/pdf_file/0004/59638/NZJFS2511995BERGIN3-19.pdf

³⁴ Basher, L.R. (2013). Erosion processes and their control in New Zealand. Pp 363 - 374 in Dymond, R. (ed.) *Ecosystem services in New Zealand: Conditions and trends*. Manaaki Whenua Press, Lincoln, NZ.

http://www.mwpress.co.nz/_data/assets/pdf_file/0004/77053/2_7_Basher.pdf

³⁵ Patterson, M.G., & Cole, A.O. (2013). Total economic value of New Zealand's land-based ecosystems and their services. Pp. 496 - 510 in Dymond, R (ed.) *Ecosystem services in New Zealand: Conditions and trends*. Manaaki Whenua Press, Lincoln, New Zealand. <https://www.landcareresearch.co.nz/publications/ecosystem-services-in-new-zealand/>

³⁶ Griffiths, J.W.; Lukens, C.E. & May, R. (2020). Increased forest cover and limits on clear-felling could substantially reduce landslide occurrence in Tasman, New Zealand. *New Zealand Journal of Forestry Science* 50(13) 1-13. <https://doi.org/10.33494/nzjfs502020x94x>

³⁷ Yao, R.T. & Velarde, S.J. (2014). *Ecosystem Services in the Ōhiwa Catchment*. A commissioned report submitted to the Bay of Plenty Regional Council, New Zealand. ISBN: 978-0-478-11033-3: <https://www.epa.govt.nz/assets/FileAPI/hsno-ar/APP203660/Yao-and-Verlarde-2014-ecosystem-services-in-the-ohiwa-catchment.pdf>

based on avoided expenditure costs, derived from discussions with local government staff. The value of avoided erosion provided by the native forest was about 37% higher than for the exotic forest. This was largely because the exotic production forest included the negative impacts of clear-felling systems.

The most effective measures for maintaining soil cover (and protecting catchments) are to retain existing forest and shrub cover, or encourage reforestation of erosion-prone areas and riparian zones^{38,39}. There is a wealth of data showing that the area of soil eroded by storms is consistently less (in the range of 50% to 90% less) where native forest is retained, or marginal land is allowed to revert to native vegetation, or forest is planted – as compared with pastureland^{40,41}.

The evidence from the collective research shows that **where there are highly erodible hill country soils, a better land use is permanent native forest grown primarily (or solely) for environmental services**, rather than exotic timber plantations grown on a clear-fell regime.

However, even if permanent native forest was restored on all the erodible soils, it would not provide a complete solution. There would still be some woody debris washed down in extreme weather events, as is evident in south Westland where there are no clear-fell plantations, just native forest in the hinterlands. **But the risk and extent of this would be considerably lower.**

One important consideration is the composition of the woody debris mobilised by Cyclones Hale and Gabrielle. It is likely that not all of it is forestry slash. Based on available imagery, it appears that some of the woody debris are whole trees, possibly from riparian plantings, as it appears from aerial imagery that that some riparian areas have been massively gouged out. TTT recommends an analysis to correlate the dominant land use in the catchment with the degree of siltation and slash downstream. For example, did unlogged exotic forest in the later part of their rotation, or native forest contribute any slash debris? Did the largest amounts of sediment come from pasture dominant catchments, etc?

In summary, the Tairāwhiti and Wairoa have highly erodible soils, and the erosion has been made much worse by changes in land use – the past destruction of the original forest cover and its replacement with grass. Added to this, there is the increasing frequency and severity of major storm events due to climate change. Also, attempts at amelioration of some of the erosion (by planting commercial forests) have themselves caused problems, particularly with the mobilization of forestry slash. Clear-fell regimes of radiata-pine leave a vulnerable period of approximately 6 years, during which time there is a risk of erosion and mobilization of slash in high-intensity rain events.

³⁸ MPI (2015). *Sustainable management of New Zealand's forests*. New Zealand's third country report on the Montreal process criteria and indicators: <https://www.teururakau.govt.nz/te-uru-rakau-forestry-new-zealand/about-te-uru-rakau/our-work-and-partnerships/montreal-process/>

³⁹ Gluckman, P. (2017). *New Zealand's fresh waters: Values, state, trends and human impacts*. Office of the PM's Chief Science Advisor. <http://www.pmcsa.org.nz/wp-content/uploads/PMCSA-Freshwater-Report.pdf>

⁴⁰ Blaschke, P., Hicks, D., & Meister, A. (2008). *Quantification of the flood and erosion reduction benefits, and costs, of climate change mitigation measures in New Zealand*. Blaschke and Rutherford Environmental Consultants for the Ministry for the Environment. Wellington. <https://environment.govt.nz/publications/quantification-of-the-flood-and-erosion-reduction-benefits-and-costs-of-climate-change-mitigation-measures-in-new-zealand/>

⁴¹ Ausseil, A.G.E., Dymond, J.R., Kirschbaum, M.U.F., et al. (2013). Assessment of multiple ecosystem services in New Zealand at the catchment scale. *Environmental Modelling and Software*, 43: 37 – 48. <http://dx.doi.org/10.1016/j.envsoft.2013.01.006>

SOLUTIONS – Land Use Analysis, Risk Mitigation, and Alternative Forestry Regimes for Climate Resilience

Analysis of Land Use Issues & Immediate Risk Mitigation Measures

This Ministerial Inquiry has had a very short timeframe for submissions, probably not long enough for submitters to fully analyse the damage on the ground, identify the contributing causes, and analyse the data and identify long-term solutions. As a follow-up to this Inquiry, TTT recommends a more comprehensive review of land use, with a timeframe long enough for adequate stakeholder consultation, to identify solutions to help mitigate the impacts of future extreme weather events in this region. There is also a wealth of research papers and reports that provide significant insight and, in some cases, include prudent recommendations.

However, it is clear that **reducing the source of eroding sediment and mobilisation of slash from both farming and forestry catchments urgently needs addressing.**

Unfortunately, there are no easy or quick fixes, although there are a few immediate risk mitigation measures that can be undertaken, as explained below. Vegetation management and land-use changes would provide key solutions in responding to the challenges that have developed, as explained below. However, it will take decades to be fully effective. Unfortunately, some areas of deeply cut erosion are likely to be beyond stabilising by vegetation cover.

Also, are there piles of slash of forestry sites that could still be mobilised in future extreme weather events? In other words, even if all clear-felling was stopped now, would more forestry slash come down the rivers if another extreme weather event hits the East Coast within the next few years? This needs to be checked and remedied, if possible.

Aerial imagery is available for at least some of the affected areas, and we are aware that other organisations, such as Scion, have undertaken analyses of various aerial/satellite imagery. These analyses would likely help identify which vegetation types are most effective in reducing erosion, and what stage in the plantation forestry cycle is most vulnerable to erosion and debris loss. For instance, what is the difference between catchments that have mostly radiata-pine forest (logged versus unlogged, and age of plantation cover), and catchments dominated by pasture, and those catchments with a high proportion of native forest or shrubland cover?

The information gleaned from aerial imagery analysis would likely corroborate the wealth of research on land use and soil stability, and catchment protection, as described in the previous section.

Immediate risk mitigation measures include:

- **Identifying (via aerial imagery) and removing remaining forestry slash**, where possible, as it could be mobilised by the next extreme weather event, if that were to happen before the slash became fully decomposed.
- **Professional geological and engineering input on erosion susceptible land**, within this region (and possibly other vulnerable catchments) to identify priorities for immediate risk mitigation.
- **Initiating land-use change** in areas identified as having a high risk of erosion and flooding.
- **Creating more resilient infrastructure** (stop banks, roads, culverts, bridges, etc.,) in vulnerable catchments.
- **Placement of debris traps**⁴², which could include strategic plantings of trees.

⁴² Visser and Harvey (2020). Design of Debris Slash Traps: Considerations for NZ Plantation Forestry Operating. School of Forestry, University of Canterbury, Christchurch, NZ. Report prepared for Gisborne Regional Council.

Trees, forests, and land use/management changes are inextricably related and, in this case, will have a central role in trying to remedy the situation. There is significant interest in the potential scope and roles for indigenous forests as a long-term solution. However, the situation is complicated in many ways, including by the exotic trees and forests that have already been established, the needs and rights of landowners, and the difficulties in reforesting much of the steep terrain that would benefit from permanent forest cover.

Alternative Forestry Regimes for Climate Resilience – Part of the Solution

Strategically-established native forest can provide climate resilience via soil stabilisation and catchment protection; green firebreaks reduce the risk of wildfire spread; trees provide shade, shelter, and trap moisture, ameliorating local climate in urban areas and farmland; and green infrastructure and coastal buffers protect urban and rural landscapes by moderating extreme weather events, including flood events and storm surges^{43,44}.

In continuous cover forestry (CCF) or ‘near to nature’ forestry regimes, selected trees are harvested without compromising the integrity of the forest and the myriad of ecosystem services it provides⁴⁵. Permanent forest cover is maintained, along with high-forest ecosystem services, and there is a future revenue stream for landowners in addition to carbon.

Multi-age, multi-species forests are more likely to be resilient to the impacts of climate change⁴⁶.

The problem is – **How do we value these extremely important non-market forest ecosystem services within our current economic systems and frameworks**, which fail to value natural capital in land-use decision-making, and in doing so, short changes future generations?

Landowners need revenue for forest cover on their land (whether exotic or native), and presently, apart from carbon, there are few opportunities for them to realise any ecosystem service benefits that permanent forest cover would provide. This is despite **most benefits of establishing permanent forest accruing to the wider community** – locally, regionally, and nationally, but **particularly those downstream**.

The **models urgently need to be developed to incentivise native afforestation** and reward landowners for provision of environmental and cultural services, for the benefit of all.

We see a significant role and opportunity to integrate native forestry into the landscape, as part of a more sophisticated approach to land-use design and planning – one that results in a **mosaic-like landscape pattern of vegetation types and multi-purpose land management**. This is likely to take a diverse range of forms and include different weightings and balances of management objectives.

https://www.gdc.govt.nz/data/assets/pdf_file/0010/11305/forestry-slash-traps-uc-visser-harvey-2020-final.pdf

⁴³ Aimers, J., Bergin, D., Horgan, G. (2021). Review of non-timber values in sustainably-managed native forest in New Zealand. Tāne’s Tree Trust bulletin, Hamilton, New Zealand. 119 pages.

https://www.tanestrees.org.nz/site/assets/files/1099/non_timber_values_in_native_forests_-_web.pdf

⁴⁴ Aimers, J. (2021). Future-proofing our Ngahere. O Tātou Ngahere (Our Forest) -

<https://pureadvantage.org/future-proofing-our-ngahere/>

⁴⁵ Barton, I.L. (2008). Continuous cover forestry: A handbook for the management of New Zealand forests.

Tāne’s Tree Trust, Pukekohe. 104 p.

https://www.tanestrees.org.nz/site/assets/files/1069/continous_cover_forestry_web.pdf

⁴⁶ Aimers, J. (2021). Future-proofing our Ngahere. O Tātou Ngahere (Our Forest) -

<https://pureadvantage.org/future-proofing-our-ngahere/>

In some areas, soil conservation values will be the priority; in other areas, natural, ecological, archaeological, or cultural features and values may require special management; or sustainable timber production may be an appropriate land use. Different mixes and balances of various management objectives could vary across short distances and within a landscape.

Realising locally appropriate and multi-functional forestry will require more than just a range of forest management concepts (such as CCF) – involving exotic and native species, mixed species, and transitions), and skilled practitioners. It will also require long-term investors, the development of supportive industries/markets, conducive policy and regulatory frameworks, and probably financial incentives such as some form of payment for ecosystem services.

New Zealand urgently needs alternative forestry regimes for climate resilience and other important environmental services, cultural values and socioeconomic benefits.

Examples of successful CCF in NZ include:

- The Totara Industry Project in Northland – <https://www.totaraindustry.co.nz/>
<https://www.tanestrees.org.nz/about-us/northland-totara-working-group-ntwg/>
- Forever Beech in Westland – <https://www.healthbasedbuilding.com/foreverbeech>
- Woodside Forest in Canterbury – John Wardle’s operation with radiata-pine and black beech, near Oxford - https://www.tanestrees.org.nz/site/assets/files/1067/newsletter_39.pdf
<https://pureadvantage.org/quantifying-multi-purpose-indigenous-forest-management-in-nz/>

New Zealand currently imports about NZ\$100 million of specialty timbers each year⁴⁷, some of which are from non-sustainable sources, e.g., kwila. NZ could produce more of its own specialty timbers, including timber from native species; e.g., sustainably-grown totara could be a substitute for imported western red cedar in many applications.

The **Totara Industry Project**⁴⁸ demonstrated the practical feasibility and potential business case for sustainable forest management, with naturally regenerating totara on marginal Northland hill country (as per Part 3A of the Forests Act). Totara is also a culturally important resource for Maori.

A viable native timber industry is required to encourage sustainable native forestry. Government investment can help expedite this, providing funding for developing industry, markets and infrastructure to support production of high-value timber from CCF regimes. This is reflected in the Government’s Forestry and Wood Processing Industry Transformation Plan (ITP)⁴⁹ which identified accelerating the uptake of CCF, in its various forms, as a priority under action 7.2.

In remote, difficult-to-access areas, it is unlikely that any form of timber harvest would be economically viable due to logistics and lack of infrastructure. Carbon sequestration is likely to be the only market-based ecosystem service. Regardless, **the myriad of non-market ecosystem services provided by permanent forests in these areas must be seen as valuable and worthy of investment**⁵⁰. Note that ongoing management would be needed, particularly pest control.

⁴⁷ MPI (2021a). Wood product markets. Data on forestry imports, exports, and indicative log prices: <https://www.mpi.govt.nz/news-and-resources/open-data-and-forecasting/forestry/wood-product-markets/>

⁴⁸ Totara Industry Project – see <https://www.totaraindustry.co.nz/>

⁴⁹ <https://www.mpi.govt.nz/forestry/forest-industry-and-workforce/forestry-and-wood-processing-industry-transformation-plan/>

⁵⁰ Aimers, J., Bergin, D., Horgan, G. (2021). Review of non-timber values in sustainably-managed native forest in New Zealand. Tāne’s Tree Trust bulletin, Hamilton, New Zealand. 119 pages.
https://www.tanestrees.org.nz/site/assets/files/1099/non_timber_values_in_native_forests_-_web.pdf

TTT supports a wider landscape review of land-use options, to provide a mosaic of land uses to match appropriate sites, including:

- most vulnerable hill country transitioned into permanent native forestry;
- continuous cover forestry (CCF) could be an option on some sites;
- exotic forest with hope of transition on these vulnerable sites, based on science and demonstrated best practice (currently being researched and developed);
- ongoing exotic forest production where appropriate, with appropriate safeguards – e.g., generous riparian buffers, strict controls on clear-felling, management of slash, etc.;
- alternative exotic forestry, e.g., redwoods on lower slopes, valley floors, and river flats;
- ongoing pastoral grazing on slopes with a low risk of erosion;
- appropriate catchment protection upstream of horticultural land and communities;
- strategic placement of green firebreaks of low flammability native and exotic species.

Pathways to Alternative Forestry Regimes & Climate Resilience

How can the historical government policy and land-use decisions, which contributed to the damage, be counteracted? **Government must incentivise or subsidise forestry land use changes that result in the ‘greater good’**, i.e., provide long-term environmental, societal and economic sustainability.

This needs to include managed retreat from clear-fell forestry systems in vulnerable catchments, to be replaced by alternative forestry regimes for climate resilience. This could either involve establishing permanent native forest after clear-felling, although this carries a period of vulnerability until forest cover is established^{51,52}, or radiata pine could be transitioned to permanent native forest while maintaining canopy cover. The latter is difficult due to knowledge gaps, as described below.

Current road-blocks to alternative forestry regimes include:

- perceptions that these forestry regimes are uneconomic;
- high costs of native planting stock, lack of infrastructure and expertise;
- the complexity and diversity of our native forests, and knowledge gaps around indigenous forest restoration and management - due to decades of divestment;
- limited financial incentives for native afforestation, transitioning exotics to natives, and sustainable native forest management;
- very limited published research on transitioning exotic plantations to native forest, resulting in knowledge gaps and lack of established management practices⁵³; and
- the limited number of people with skills in native afforestation, transitional forestry, and continuous cover forestry systems.

However, it is important not to ‘throw the baby out with the bathwater’. **Alternative forestry regimes** – permanent forests, either unharvested or CCF regimes with native or exotic species, need to be geared as being **complementary to traditional clear-fell systems**.

⁵¹ Bergin, D.O., Kimberley, M.O., & Marden, M. (1995). Protective value of regenerating tea tree stands on erosion-prone hill country, East Coast, North Island, New Zealand. *New Zealand Journal of Forestry Science*, 25 (1), 3-19. https://www.scionresearch.com/_data/assets/pdf_file/0004/59638/NZJFS2511995BERGIN3-19.pdf

⁵² Bloomberg, M., Cairns, E., Du, D., Palmer, H., & Perry, C. (2019). Alternatives to clear felling for harvesting of radiata pine plantations on erosion-susceptible land. *NZ Journal of Forestry* 64(3), 33–39. http://www.nzjf.org.nz/free_issues/NZJF64_3_2019/5D9ABDDD-40ED-494f-BE1F-BE5BE4AF5A64.pdf

⁵³ Forbes, A., & Norton, D. (2021). *Transitioning Exotic Plantations to Native Forest: A Report on the State of Knowledge*. Contract report prepared by Forbes Ecology Limited for MPI. <https://www.mpi.govt.nz/dmsdocument/47521-Transitioning-Exotic-Plantations-to-Native-Forest-A-Report-on-the-State-of-Knowledge-2021-22->

Clear-fell radiata-pine regimes are problematic only on a subset of the current forestry estate, and they are economically the ‘bread & butter’ of the forestry industry, employing a large percentage of NZers, particularly in rural areas. **Forestry is a significant employer in the Tairāwhiti region**⁵⁴.

Anecdotal reports suggest close to 1,000 forestry employees in 2021. Approximately 80% of forestry workers identify as Māori⁵⁵. In 2020, forestry and logging were the biggest contributors to GDP in the Tairāwhiti region, earning \$180.7 million⁵⁶. This represents 8.2% of total GDP for the region.

There is an opportunity to work with the forestry industry to upskill a subset of the current workforce, on native forest restoration and management, and CCF systems (with native and exotic species). This could also help the forestry industry restore its social licence to practice.

Getting the agricultural industry on board is also imperative.

Manaaki Whenua Landcare Research’s Survey of Rural Decision Makers⁵⁷, which is conducted every 2 years, shows that (i) there is a strong interest in planting trees, particularly native species (2019 survey), and (ii) the large majority of rural landowners believe that climate change is already affecting the frequency and intensity of weather-related events (2021 survey).

Tane’s Tree Trust and Pure Advantage hosted a conference at Te Papa, Wgtn, in October 2022 - **O Tatou Ngāhere - Regenerating our landscape with native forest**. Over 1000 people attended, breaking records for a forestry conference in NZ. Attendees included farm catchment group leaders, Maori landowners, scientists, academics, government officials, conservationists and ecologists, foresters, and 33 schools - reflecting enthusiasm across a wide cross-section for native afforestation to address the pressing existential crises we are facing.

Many speakers highlighted the need to urgently recalibrate our policy settings to incentivise the protection of existing native forests, and the establishment of new indigenous forests.

It was clear from the conference and many other engagements, that we have the commitment of landowners, iwi, and community groups, but **funding is a critical issue**. Te Kapunga Dewes spoke for many, not just Iwi, when he stated - *“We want natives but we need finance”*.

Those of us who are regularly engaging with farmers are consistently hearing the same message across the motu - there is a strong appetite across the entire sector to establish native forest, **but farmers are crying out for incentives** to help them do so. This is warranted given that most of the benefits of native afforestation accrue off site.

At the end of the OTN Conference, **we ran a poll to rank the top ‘where to next’ themes** that came up at the conference. **The top theme by a strong margin was** *“Encourage urgent action by Govt to establish a Biodiversity credit - ‘standard’”*.

Landowners need to be able to access enough support to establish natives and also to maintain existing native forest. Financially viable models are needed to incentivise indigenous afforestation. Incentive schemes need to be fair and equitable, and not overly complex. We are not sure whether

⁵⁴ <https://www.mbie.govt.nz/dmsdocument/18735-tairawhiti-update-february-2022>

⁵⁵ <https://www.mbie.govt.nz/dmsdocument/18735-tairawhiti-update-february-2022>

⁵⁶ <https://www.mbie.govt.nz/dmsdocument/18735-tairawhiti-update-february-2022>

⁵⁷ <https://www.landcareresearch.co.nz/discover-our-research/environment/sustainable-society-and-policy/survey-of-rural-decision-makers/>

this could be achieved via new policy, or through amending the existing ETS provisions, or a combination of both.

Recently published research, based on Tane’s Tree Trust’s national database of planted native forest, demonstrates that **planted and managed indigenous forest is better at sequestering carbon than commonly considered**⁵⁸. Some exotic species, particularly radiata pine, initially sequester carbon at a faster rate than indigenous species. However, after 20 to 30 years in managed planted stands, several native species are capable of sequestering carbon at a similar rate and can continue to do so for many decades.

Tane’s Tree Trust’s carbon calculator⁵⁹, based on our database of planted native forest, predicts that though a stand of native trees planted at 1,250 trees per hectare has an average CO₂ removal rate of only 6 tonnes over the first 30 years, this increases to 20 tonnes between ages 30 and 60 years, and further increases to 27 tonnes between ages 60 and 90.

Regardless, published research undertaken by Tane’s Tree Trust on non-timber values in sustainably managed native forests⁶⁰, **recommends that government and corporate grants are linked to the broader range of ecosystem services, rather than a single ecosystem service** such as carbon sequestration. However, biodiversity was identified as pivotal, i.e., actions to increase biodiversity values are likely to concurrently improve most (possibly all) other non-timber values.

Cost-Effective Establishment of Native Forest at Landscape-Scale

Currently, there are barriers to rapidly upscaling native forest cover due high costs of planting stock, lack of infrastructure and expertise, the complexity and diversity of our native forests, and knowledge gaps around indigenous forest restoration and management - due to decades of divestment. This is in contrast with the massive investment in research & development and infrastructure around exotic species, particularly one species – radiata-pine.

Addressing these issues is a major focus of Tane’s Tree Trust’s R&D work programme, as described in our recent Annual Reports^{61,62} and summarised in APPENDIX 1. Cost-effective methods for landscape-scale establishment of native forest are summarised in APPENDIX 2.

Please note that **any native afforestation project must include a long-term animal pest control programme to be successful**. There are native species that are relatively browse resistant, including manuka, kanuka, and totara, but a diverse and complex (therefore, resilient) native forest is not likely to occur until there is fencing out of domestic stock and control of pest browsers and predators.

⁵⁸ <https://pureadvantage.org/carbon-sequestration-by-native-forest-setting-the-record-straight/>

⁵⁹ <https://www.tanestrees.org.nz/resources/carbon-calculator/?highlight=carbon+calculator>

⁶⁰ Aimers, J., Bergin, D., Horgan, G. (2021). Review of non-timber values in sustainably managed native forest in New Zealand. Tāne’s Tree Trust bulletin, Hamilton, New Zealand. 119 pages.
https://www.tanestrees.org.nz/site/assets/files/1099/non_timber_values_in_native_forests_-_web.pdf

⁶¹ Tane’s Tree Trust Annual Report 2021 -

https://www.tanestrees.org.nz/site/assets/files/1037/ttt_annual_report_2021.pdf

⁶² Tane’s Tree Trust Annual Report 2022 -

https://www.tanestrees.org.nz/site/assets/files/1037/ttt_annual_report_2022.pdf

Regarding native afforestation in erodible steeplands in Tairāwhiti, there is already a body of research on this^{63,64} based on a major survey of manuka/kanuka regeneration on Tairāwhiti steep hill country following Cyclone Bola in 1988. The lead researcher in this work, Dr David Bergin, currently leads Tane's Tree Trust's R&D work programme.

A major research finding was a rapid and highly significant reduction in slip damage with increasing age of the manuka/kanuka shrubland. At 95% confidence intervals, there was a 65% reduction in shallow land-slipping at shrubland aged 10 years, increasing to 90% at age 20 years.

Addressing Knowledge Gaps in Transitional Forestry

Tane's Tree Trust is pleased to have recently started a 5-year project on **Transitioning Exotic Forest to Native**, supported by the MPI Sustainable Food and Fibre Futures (SFFF) fund and forestry partners.

One of the drivers of this research is the opportunity to transition directly from exotic to native forest, avoiding clear-felling on erodible land, such as in Tairāwhiti. The commercial plantation forestry industry is looking for advice on how to retire radiata-pine stands safely and cost-effectively on remote, erodible steeplands, which are not economical to harvest and/or pose environmental risks and where the best option is a managed transition back to native forest. Another positive driver is that many Maori landowners are currently actively seeking technical advice in transitioning radiata-pine forest back to native forest.

Managing transitions from exotic forest to native is complex, subject to many variables, and very site and context dependent. There is also a conflict between maximising income from carbon sequestration and effecting a transition to native forest. The research project will establish forestry trials to collect data in existing exotic stands of various ages, on a range of sites throughout New Zealand - to determine factors and interventions that are likely to allow a transition to native forest. It will look for drivers of natural regeneration such as levels of canopy cover (light ingress), seed source proximity, climatic variables and site factors - to inform what types and levels of management are required, and identify situations where a transition is unlikely to be successful/unsuccessful, and subsequently provide guidelines and recommendations.

It will be a challenge managing and maintaining transitions to predominantly native forest through weed-infested vegetation. Active management will be essential for all forests in New Zealand.

Summary and Recommendations

Tane's Tree Trust recommends land-use and land management plans that are multi-purpose, intergenerational, locally integrated and site-responsive – which also recognise the multivalent potential that native forests bring. There is 'no one size fits all', as there is a wide range of sites, stakeholder requirements, and management concepts involved, including native afforestation primarily through planting, natural regeneration, assisted natural regeneration, sustainable indigenous forestry, CCF, carbon farming, transitional forestry, and exotic/native mixes.

⁶³ Bergin, D.O., Kimberley, M.O., & Marden, M. (1993). How soon does regenerating scrub control erosion? NZ Journal of Forestry 38(2) 38 – 42. http://nzjf.org.nz/free_issues/NZJF38_2_1993/4C4924D7-90CF-40FC-A310-B0481D74E71C.pdf

⁶⁴ Bergin, D.O., Kimberley, M.O., & Marden, M. (1995). Protective value of regenerating tea tree stands on erosion-prone hill country, East Coast, North Island, New Zealand. NZ Journal of Forestry Science, 25 (1), 3-19. https://www.scionresearch.com/_data/assets/pdf_file/0004/59638/NZJFS2511995BERGIN3-19.pdf

We believe that to be successful, cost-effective, large-scale establishment of native forest will depend on working with nature, i.e., **assisted natural regeneration, plus complementary planting where needed** (e.g., seed islands). This is described in more detail in APPENDIX 2.

Integration with supportive economic drivers is essential, i.e., investment, markets, industries, and incentives. There is an urgent need for financial incentives to bridge the gap between native trees becoming established and increasing their growth rate sufficient to earn enough carbon credits to reward landowners.

Ongoing monitoring and an adaptive management approach are recommended as all forests need active ongoing management.

We must start now but recognise that there are knowledge gaps and an adaptive management approach is needed - to help inform and refine site-specific forest/land management plans, and cater for stakeholder requirements. Ongoing applied research programmes are needed to help counter the knowledge gaps and development of appropriate management practices.

There will be job opportunities, including highly-skilled forest managers and workers. **Early career training and continuing professional development programmes are needed.** The latter will help upskill those in the traditional forestry industry who wish to transfer their skills and become involved in alternative forestry regimes with a focus on climate resilience. There is considerable interest in this, particularly via the NZ Institute of Forestry, but funding is needed to make it happen.

Tane's Tree Trust would like to see tangata whenua have a major leadership role in healing the whenua. There are already iwi-led ecological restoration and conservation programmes in the region that have been very successful in not only environmental gains, but also in positive outcomes for local people. There are already engaged and trained workforces through programmes such as Jobs for Nature, which only have a limited period of funding. We would like to see the funding extended for these groups, particularly in light of the recent destruction and the need for natural ecosystems providing climate resilience.

APPENDIX 1 - Tane's Tree Trust's Research & Development 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.

A summary is provided below. More information is available in the TTT Annual Report⁶⁵.

Normalising Native Forestry (core research programme)

This is funded by The Tindall Foundation, with 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 – 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. These web-based tools are free to access via our website - <https://toolkit.tanestrees.org.nz/>
- Adaptive Management of Coastal Forestry Buffers, with the Coastal Restoration Trust. Preliminary guidelines are available for this recently completed SFF-funded project.
- Fact sheets on forest establishment (planting and assisted natural regeneration) funded by Te Uru Rākau. These will soon be freely available on our website.
- 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.
- Demonstrating the establishment of seed islands to bring back natives and encourage natural regeneration in collaboration with Trees That Count; Waikereru Ecosanctuary, Tairāwhiti; Pāmu Farms; and other partners.
- Monitoring system for early survival and growth of plantings, in collaboration with Trees That Count, Tasman Environment Trust, Auckland Council and Pāmu Farms.
- Transitioning exotic forest to natives – a recently initiated 5-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.

⁶⁵ Tane's Tree Trust Annual Report 2022 -

https://www.tanestrees.org.nz/site/assets/files/1037/ttt_annual_report_2022.pdf

APPENDIX 2 – Cost-effective methods for landscape-scale establishment of native forest

We propose assisted natural regeneration augmented by targeted planting:

- **We advise a shift in focus from reliance on mostly planted forests to assisted natural regeneration** – where planting is part of the mix, along with management to limit factors that inhibit natural regeneration of natives, i.e., control of the most aggressive weeds, elimination of pests including predators of bird populations essential for seed spread.
- We support direct planting, but recommend that it is deployed strategically (to complement leverage natural processes), starts on a modest scale, and expands as quickly as capacity permits.
- Concurrent with this is the need to monitor the success or otherwise of planting programmes so that management changes can be made early on to improve performance with subsequent plantings.
- Fixed annual targets should be used with caution, although we understand there is a need to reach carbon sequestration targets.
- Management of natural regeneration coupled with targeted planting must be well planned, adapted to the site, supervised, and the outcome monitored and the management input sustained.
- Start with a survey to identify potential sites for natural regeneration.
- Identify any existing native forest within bird range that will encourage the spread of seeds of key native tree species.
- Our birds have a good track record, having established forests in Aotearoa for millions of years. Strategic planting of berry-producing shrub species provides an incentive for birds to visit sites. Implement control of bird and seed predators such as rodents, mustelids and possums – to protect and boost natural regenerative processes.
- There will likely be a need for enrichment planting of species no longer locally present. In addition to native forest species that are bird dispersed, this will include species with wind-dispersed seed.
- Let the birds and the wind be our natural drones in spreading seed across vast landscapes of marginal pastoral steep hill country that are a priority for native afforestation. Where there are no native forests within bird range, we can prepare a seed source for them by employing a strategy that has been developed and is being evaluated by TTT, i.e., establishing a network of seed islands comprising a diverse range of bird- and wind-dispersed seeding species.
- TTT has produced fact sheets on assisted natural regeneration and the seed island approach. These will soon be published on our website.
- Assisted natural regeneration could be done at a large scale as resources permit, and there should be no need for delay in getting this underway.
- Monitoring systems are vital as practitioners can act promptly to protect their ngahere, and also learn what does, and doesn't work, and adapt accordingly. This is particularly important in an era of climate change.
- This need not be delayed. Some of the human and financial resources available for direct planting should be diverted towards establishing a framework that supports natural regeneration – including sustainable management of the large area of existing natural regeneration, some of which is being routinely sprayed, cut back or burnt to keep marginal farmland in pasture.

Much of this is described in more detail in an article by Dr David Bergin – *The ten golden rules for establishing native forest at scale*, published as part of the O Tatou Ngāhere campaign <https://pureadvantage.org/ten-golden-rules-for-large-scale-establishment-of-native-forest/>.

Pros and cons of assisted natural regeneration

Advantages

- Scale - significant areas already exist (hundreds of thousands of hectares), that are in the process of regeneration to forest cover, and much more could be encouraged to regenerate.
- Low cost. Nature and time, assisted by the wind and birds, do the greatest share of the work.
- Less pressure. There are no fixed annual targets to be met.
- Flexibility. It is suited to a range of sites, large and small; and a range of different scenarios can be employed. There is scope here for site-specific and creative solutions.
- Plants that germinate naturally have been, by definition, ecosourced, and are therefore adapted to the site.
- Planting can be leveraged for maximum cost/benefit.
- Lower risk of dramatic failure.

Disadvantages

- Forest establishment will take longer. On the other hand, as it is low cost, it can start sooner and at a larger scale (and is already happening over large areas).
- We cannot assume that available open space will be colonised by native species alone. Over time we have introduced too many impediments for that to occur.
- We have introduced a range of weeds, some of which will be better adapted to the changing conditions of a warming climate – these can preclude natural regeneration on some sites, if there is no intervention. And then there are the introduced pests that must be controlled.
- Our remaining forests have been degraded and fragmented, and natural pathways for colonisation have been intercepted by cities, farms, and roads.
- Natural regeneration will need our assistance - weed and pest control is vital.
- All forests require ongoing and active management. There is presently insufficient financial incentive or income potential to encourage and support native forest management on private land – especially regarding regenerating native forest cover.

In summary – working with Nature for landscape-scale establishment

Successful large-scale establishment of native forest will depend on working with nature and integration with supportive economic drivers (i.e., investment, markets, industries, and incentives).

Encouraging natural regeneration should be done in tandem with pest animal control to prevent damage to the naturally established seedlings, working with Predator Free NZ, neighbouring landowners, iwi and local communities to boost bird populations and seed production for diverse forest ecosystems, selective weed control to remove or reduce the most aggressive and persistent exotic species, and undertaking strategic supplementary planting to bring back once abundant species now locally extinct or scarce.

Our recommendations:

- Enable naturally regenerated native cover that predates 1990, but that still has significant potential to sequester more carbon, to be eligible for financial returns from carbon through the ETS.
- For afforestation by planting alone, start with modest targets and build infrastructure, capability and confidence, and ‘iron out problems’, i.e., start with a smaller yearly target, upscaling gradually as capacity and competence improve.

- Look at the easiest options first - 'nature-based solutions' - assisted regeneration, building on the natural regeneration that is already happening in many hill country sites.
- Establishing seed islands amongst shrub pioneers, to help the natural succession to high-forest – let the birds do the work of spreading the seed.
- Ensure that nursery plant quality standards and infrastructure are in place to deliver quality, fit-for-purpose planting stock.
- Monitoring systems are vital and need to be a requirement of any funding for afforestation.
- Planters – are there sufficient well-trained planting gangs who know how to plant native species (as opposed to radiata-pine, which is quite different to plant)?