Thematic Summaries of Evidence for Mana Taiao Tairāwhiti Submission

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

MANA TAIAO TAIRĀWHITI

APRIL 2023

Introduction

This document has ten sections based on seven themes associated with the Terms of Reference for the Ministerial Inquiry into Land Use in Te Tairāwhiti, Tūranganui-a-Kiwa and Te Wairoa and three additional themes that Mana Taiao Tairāwhiti identified as important factors associated with the scope of the Inquiry.

The review of evidence included more than 150 peer reviewed studies, policy papers and other reference material, along with the testimony and evidence provided by residents affected by land use and weather events in Tairāwhiti. The review has been undertaken by the Mana Taiao Tairāwhiti steering group and 110 volunteer researchers working over the month of March 2023.

The document starts with whakapapa showing the links between humans and Te Taiao as the mātāmua, or senior in the relationship. This is followed by a section (B) prepared by Dr Wayne Ngata on the history of human occupation in Te Tairāwhiti.

The Second theme (C) focuses on the inherently erosion-prone landscape occupants have found ourselves living with and the impacts of storms on the landscape, before and since human occupation, and how our activities on the land have dramatically accelerated erosion.

The Third section (D) looks at the financial incentives driving land use change (from pasture to pine plantations, from production plantations to carbon farming) and touches on influences like the ETS, access to capital and potential incentives for better land use options.

The Fourth theme (E) is afforestation and its importance on erosion-prone land, the big problems evident with clear-felling and 'permanent' pine plantations on erosion-prone land, the fact that we don't know if pines plantations can transition to native forest in ideal conditions (let alone the extreme environs of Tairāwhiti) and alternative options for pine management on less erosion-prone land.

Regulatory issues in Theme Five (F) are clearly at the heart of much of these challenges – local government feels hamstrung by the NES-PF and every party seems to agree both the NES-PF and ETS are not doing what they were intended to. MTT has commissioned papers on both the NES-PF and proposed ETS changes as they relate to pine plantations in Tairāwhiti, and we strongly encourage the Inquiry team to read these two short reports.

Theme Six (G) is an overview of some of the government initiatives intended to help with the issues, but MTT figures officials will be able to offer more up to date evidence on the effectiveness of these programmes.

Theme Seven (H) derives from the Terms of Reference, and here is all about key recommendations.

Theme Eight (I) tries to cover the macro issues at play on the situation the region finds itself in and proposes some approaches to rethinking land tenure and financing and Theme 9 (J) looks at challenges and opportunities around Kaitiekitanga and the role of mātauranga Māori in this context.

The final Theme Ten (K) provides some compelling examples of how behind other parts of the world Aotearoa New Zealand is, and really challenges the claims of good local land use practice—especially by forestry companies operating our region that have somehow retained certification with FSC, but perhaps not for much longer. Nature Based Solutions and biodiverse forests are becoming the expectation internationally, and Aotearoa New Zealand needs to catch up quickly.

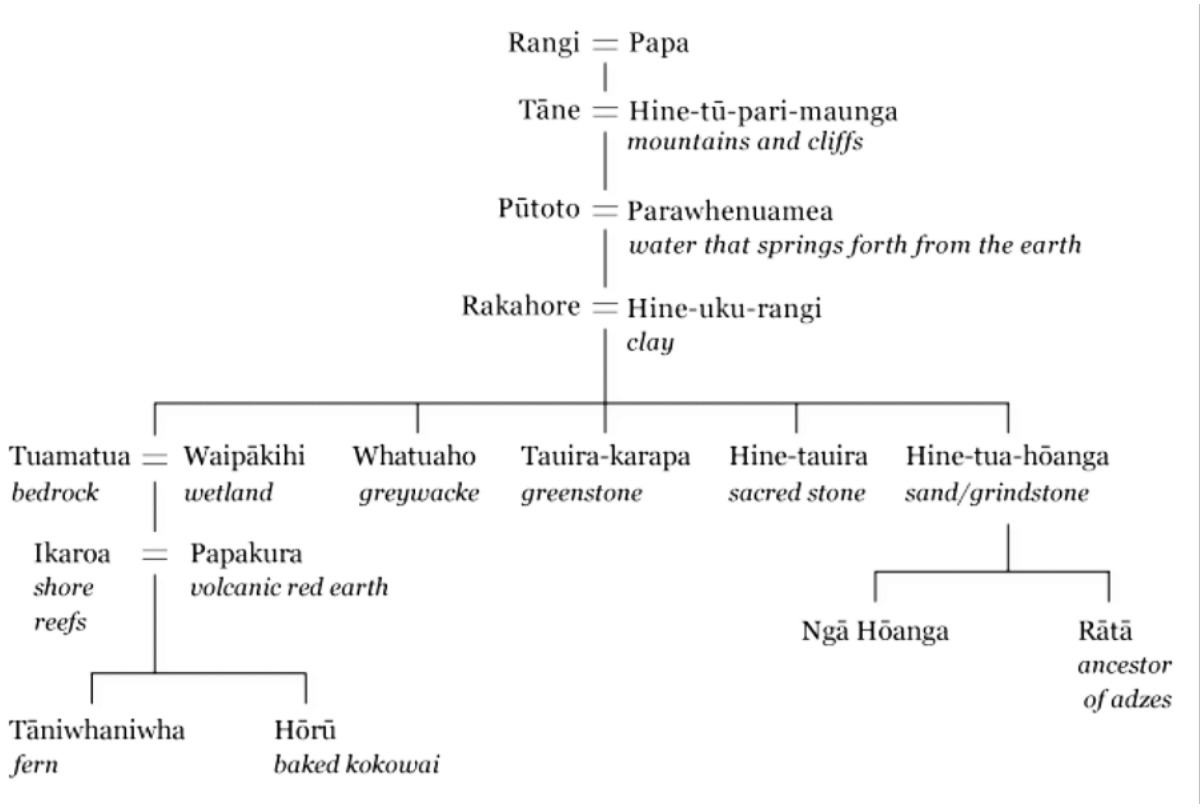
Beyond the list of references are the five papers prepared by independent experts for the MTT submission.

Contents

TE KORE WHAKAPAPA[1]

Te Kore
(the void, energy, nothingness, potential)
|
Te Kore-tē-whiwhia
(the void in which nothing is possessed)
|
Te Kore-tē-rawea
(the void in which nothing is felt)
|
Te Kore-i-ai
(the void with nothing in union)
|
Te Kore-tē-wiwia
(the space without boundaries)
|
Te Pō-nui
(the great night)
|
Te Po-roa
(the long night)
|
Te Pō-uriuri
(the deep night)
|
Te Pō-kerekere
(the intense night)
|
Te Pō-tiwhatiwha
(the dark night)
|
Te Pō-tē-kitea
(the night in which nothing is seen)
|
Te Pō-tangotango
(the intensely dark night)
|
Te Pō-whāwhā
(the night feeling)
|
Te Po-namunamu-ki-taiao
(the night of seeking the passage of the world)
|
Te Pō-tahuri-atu
(the night of restless turning)
|
Te Pōtahuri-mai-ki-taiao
(the night of turning towards the revealed world)
|
Te Whai-ao
(the glimmer of dawn)
|
Te Ao-Mārama
(the bright light of the day)

Depending on who the presenter of the information “I te timatanga” (before man) this may change however the common reference is still from Te Kore, Te Pō into Te Ao-Mārama.



Rangi and Papa begin the whakapapa of human descendants as every persons whakapapa is individual to themselves this may vary. Here the descendants of Tane and Hine-tū-pari-maunga shows the connection between stone water and soil.[2]

Sky *Earth*
Ranginui = Papatuanuku
|
Tāne = Mumuwhango
|
tōtara (Podocarpus totara)

Tāne = Pūwhakahara
|
akerautangi (Dodonaea viscosa)

Tāne = Atatangirea
|
maire *(Nestegis cunninghamii)*

Tāne = Kūraki
|
kahikatea *(Dacrycarpus dacrydioides, white pine)*

Tāne = Ōtunairanga
|
nikau *(Rhopalostylis sapida, New Zealand palm)*

Tāne = Ngāore
|
toetoe *(Cortaderia toetoe, grass, sedge)*

Tāne = Pākoti
|
harakeke *(Phormium tenax, flax)*

Tane = Kui-ū-uku
|
mataī *(Prumnopitys taxifolia)*

Tāne = Tū waerore|
_____|_____
| |
rīmu tanekaha
(Dacrydium cupressinum) *(Phyllocladus trichomanoides)*

Tāne = Huri-mai-i-te-ata
|
mānuka
(Leptospermum scoparium)

This whakapapa between Tane and Mumuwhango[3] are the tree elements. Whakapapa is not limited to the human element. Whakapapa is our interconnectedness with our world before, our world now and our world in the future.

TENEI AU

TENEI AU

KO TE HOKAI NEI

O AKU TAPUWAE

KO TE HOKAI NUKU

KO TE HOKAI RANGI

KO TE HOKAI A O TIPUNA

A TANE NUI A RANGI

I PIKITIA AI KI NGA RANGI TUHAHA

KI TE TIHI O MANONO

I ROKOHINA ATU RA

KO IO MATUA KORE ANAKE

I RIRO IHO AI

NGA KETE O TE WANANGA

KO TE KETE TUAURI

KO TE KETE TUATEA

KO TE KETE ARONUI

KA TIRITIRIA

KA POUPOUA

KIA PAPATUANUKU

KA PUTA TE IRA TANGATA

KI TE WHAI AO

KI TE AO MARAMA

This karakia which incorporates our spiritual journey of searching for enightenment is a timely reminder of reinstating the mauri of whakapapa.

Whakapapa is a framework that links all animate and inanimate, known and unknown phenomena in the terrestrial and spiritual worlds. Whakapapa therefore binds all things. It maps relationships so that history, knowledge, tikanga (custom), philosophies and spiritualities are organised, preserved and transmitted from one generation to the next. [1] Whakapapa is at the core of traditional mātauranga Māori (Māori knowledge) and the core connection between Māori people and the environment we exist within – past, present and future.

The timeless chant proclaims Tāne-mahuta's journey in search of higher knowledge and enlightenment. There are several interpretations of what each basket represents, however the late scholar and revered pakeke Māori Marsden has suggested that the basket of light is present knowledge, the basket of darkness is things unknown and the basket of pursuit is the knowledge that we presently pursue.

The efforts to bring together this submission has collected what is known, highlights some things we still do not know and identifies knowledge we now need to pursue to create a better future with our communities.

[1] Basil Keane, 'Traditional Māori religion – ngā karakia a te Māori - Ngā atua – the gods', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/speech/30768/te-kore-whakapapa (accessed 2 April 2023)

[2] Phil Moore and Bruce McFadgen, 'Kōhatu – Māori use of stone - Stone tools', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/document/8877/whakapapa-of-rocks-and-stones (accessed 2 April 2023)

[3] Te Ahukaramū Charles Royal, 'Te Ao Mārama - He ao hono', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/mi/whakapapa/7949/te-whakapapa-o-nga-rakau (accessed 2 April 2023)

[4] Rāwiri Taonui, 'Whakapapa – genealogy - What is whakapapa?', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/whakapapa-genealogy/page-1 (accessed 1 April 2023)

B. Human occupation of Tairāwhiti

Te Tairāwhiti refers generally to the eastern seaboard of the North Island of New Zealand, and more specifically, the region from Te Paritū south of Gisborne to Pōtaka in the north. Like other regions throughout the country, the stories of its settlement are a reflection of the diaspora of human civilisations since time immemorial with a mix of ancient origins, migrations from Hawaiki of Te Moananui a Kiwa, conflict and resolution, subsequent inter-regional migrations, and more recent non-Māori migrations. The need to locate, establish, and protect territory on land and sea is not exclusive to the human race, and certainly not to Māori.

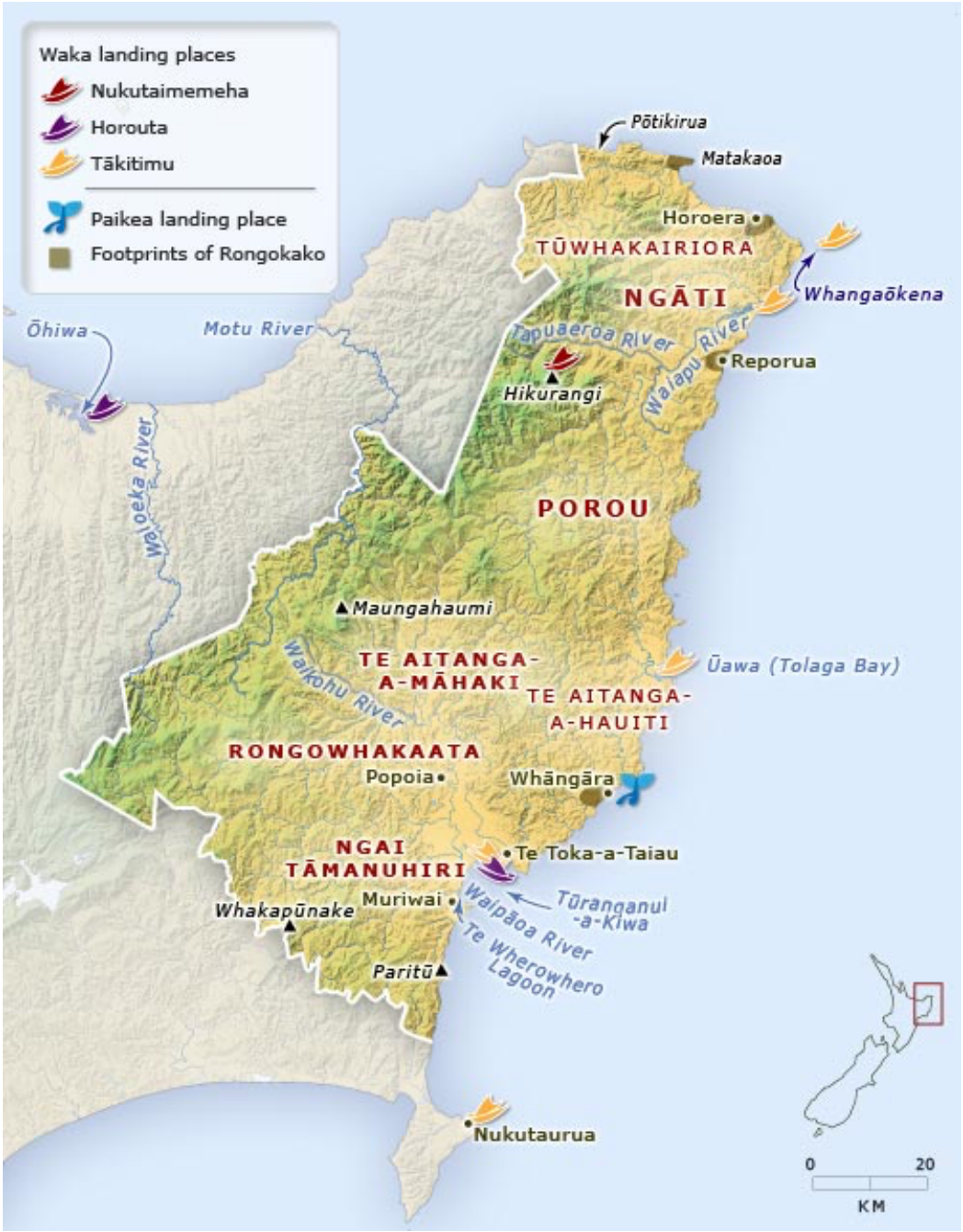
The Ruatepupuke story is one of the numerous stories that belong to hapū and iwi of the Tairāwhiti and is designed to articulate an origin story of a coastal and marine people. Māori tradition was maintained through a range of oral devices including: pure, karakia, various forms of whakapapa, pūrakau and pakiwaitara, a wide range of waiata or mōteatea, and pepeha and whakataukī, to name a few. Māori literature is replete with the full gamut of human existence; life, love, war, joy, sadness, death and more. The Māui, Tinirau, Whiro, Uenuku, Ruakapanga and Toi traditions weave the fabric of Te Moananui a Kiwa legacies into the waka migrations south to a new land called Aotearoa.

Whatever the route, mode, or cargo, and whoever was on board, it is widely accepted that Māori arrived in Aotearoa-New Zealand over a period of time between 900-1350 AD, and some even returned to those Hawaiki homelands of Te Moananui a Kiwa. Ngata refers to several landing places of waka in the Tairāwhiti as ‘pūtahi’ (Ngata, 1972, Lecture 2, p. 8) because these became staging points of exploration, settlement, expansion and refuge over time for the initial immigrants and subsequent generations. Numerous waka made landfall on the Tairāwhiti: Nukutaimemeha of Māui on Hikurangi, Nukutere of Te Whironui at Waiapū and Māhia, Horouta of Paoa at Waiapū and Tūranganui, Takitimu of Tamatea at Nukutaurua, Tereānini of Rongomaituaho at Whāngārā, Tūtepewarangi of Paikea at Ahuahu (then he eventually made his way to Whāngārā), Mataatua of Uenuku at Parinuiterā, and Te Ikaroa a Rauru of Māia at Tūranganui.

It is important to note here that our historical viewpoint of migration to and within Aotearoa has been heavily influenced by 19th and early 20th century ethnographers and anthropologists. This is not to devalue the contributions of the likes of White, Locke, Percy-Smith, Best, and the like, but rather to pause and consider how people coming to a new land responded to a different environment and its resources, and others who they encountered, and how our own story tellers articulated these responses.

Different waves of migration and settlement of the Tairāwhiti region have provided a picture of Māui origins, Toi settlement with Ruawaipū and Uepōhatu, southern contributions with Ngāti Ruanuku who according to some arrived with Tahupōtiki on his return to Whāngārā (Ngata, 1972, Lecture 3, p. 6); mixed groups including descendants of Tamateatoia and Tamateataharoa banding together to form a powerful coalition called Te Wahineiti; later Horouta, Nukutere and Takitimu contributions; and Ngāti Ira from the south. The relatively well defined tribal boundaries we advocate today were far more fluid and transient than we appreciate in the time of our ancestors. The migratory pattern of living depended on access to seasonal food, on land and sea, wild or cultivated; and the relationships with kin groups in similar situations.

Four generations after Paikea, we have the birth of Porourangi and his brother, Tahupōtiki, at Whāngārā. Whāngārā is referred to as ‘te pārekereke o te kōrero’, and ‘te pūtahitanga o te tangata’, an important homebase and refuge for Paikea’s descendants; a place from which they could expand further afield to establish new settlements and return to in times of conflict. The expansion of Porourangi and Tahu’s descendants north and south of Whāngārā have heavily influenced the current make-up of hapū an iwi groups on the eastern seaboard of the North Island, from Ngāti Porou in the north, Te Aitanga a Hauiti in Uawa south, Te Aitanga a Māhaki, Rongowhakaata, Ngāi Tāmanuhiri and Ngāti Ruapani in Tūranganui, and Rongomaiwahine, Ngāti Rākaipāka, Ngāti Pāhauwera and Ngāti Kahungunu further south.



Monty Soutar, 'East Coast region - Māori settlement', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/map/33350/waka-landings-places-of-significance-and-tribes (accessed 4 April 2023)

C. Impacts of storms on land in Tairāwhiti

The impact of storms is multifaceted and dependent on several interrelated factors including storm characteristics (usually wind and rain intensity), land use, infrastructure, underlying geology, and topography. Some of these factors, like a lack of infrastructure or poor practices associated with forestry slash, can exacerbate the impact of storms. Extreme rainfall in Te Tairāwhiti is predicted to become increasingly intense under current climate change projections, particularly towards the end of the century (Woolley et al., 2020). It is therefore essential that policies, planning, and land use activities and practices (including forestry) account for and actively manage the increasing risk from storms.

Historical context

Te Tairāwhiti is world-renowned for its severe erosion, flooding and sedimentation (Spiekermann & Marden, 2018). It has a unique erosion profile with 22% of the land very highly susceptible to severe erosion, compared to a national average of 2%, and 79% being at least moderately susceptible to erosion (Basher, Lynn, et al., 2015). Extensive deforestation between 1880-1920 was the beginning of an intensive and dramatic transformation of the landscape. A century of pastoral farming has resulted in a highly degraded environment and reforestation was seen as a way to remedy this. Exotic forestry began in the 1960s and by 2018 occupied more than 188,000 ha of the region (BDO Gisborne Limited, 2021). Te Tairāwhiti has physical characteristics that lead to high erosion and sedimentation rates, including steep to strongly rolling hills underlain by weak and highly deformed rocks; periodic intense rainstorms (a rate of one every 2.5 years between 1900-1988), and massive.

Erosion and sediment

Since the 19th century, deforestation in Te Tairāwhiti has affected hills, river systems, and the marine environment, resulting in irreversible landscape changes and soil quality loss. Reforestation can reduce hillslope sediment loss, though previously eroded stored sediment will continue to move downstream. Targeted reforestation is advised to address specific erosion types (Page et al., 2000). A study found that selectively reforesting 8% of the most unstable landscape units in the Waipaoa catchment could reduce landslide-derived sediment by approximately 40% (Reid & Page, 2003). Erosion is accelerated by storm events. One clear example is the increase in gully erosion in disturbed and undisturbed forests following Cyclone Bola, which left the Mangaoporo catchment area with 21 active gully systems, when previously it only had four. As rainfall events continued, the gullies began to show recovery signs, highlighting the influence of factors such as lithology and topography in determining the nature and location of gully systems (Parkner et al., 2007).

The clear links between sediment loading in rivers and land use practices of pasture, exposed soil, and deforestation/reforestation, support the conversion of pasture to forestry to reduce sediment loads. Comparing exotic forestry and pasture, reforestation of 12% of landslide-susceptible land or 30% of randomly selected land could reduce landslide-derived sediment in the Waipaoa by 50%. Research suggests similar success could be achieved within three decades in the East Coast region by targeting gully-mass movement complexes in high sediment-yielding river systems like the Waiapu Catchment (Marden et al., 2014). Reforestation also affects gullying and water yield in the long term[4]. It is important to note that different forest types have significantly different abilities to reduce sediment erosion. For example, an indigenous and unharvested forest will reduce erosion a lot more than a harvested pine forest. An indigenous forest will have many additional ecosystem benefits

and services (i.e. increasing biodiversity) absent from monocultural pine plantations (Salmond, 2022).

The role of closed canopy forests in reducing erosion and promoting slope stabilisation is crucial, especially in the highly erodible steep lands common in Tairāwhiti region (Marden, 2004). Closed canopy native forests played a significant role in reducing erosion during Cyclone Bola (Marden, 2011). Kānuka planting is more effective at slope stabilisation and mass movement prevention than pines for the first nine years, after which their performance is similar. High-density planting and established, closed canopy forests provide the greatest stabilisation. Long-term thinking is essential in addressing erosion and promoting slope stabilisation (Marden & Seymour, 2022).

An analysis of sediment production in the Waipaoa, Waiapu and Uawa catchments before and after exotic reforestation showed that despite reforestation, sediment increased due to ineffective and untimely planting (Marden et al., 2008). The studies highlighted that reforestation would be most successful in Cretaceous gullies, headwaters, and active gullies in pastoral land. It will take approximately 24 years to see sediment yield reduction, and until then, environmental co-benefits like reduced flood risk and improved water clarity will not occur. Timing of harvesting can result in worse erosion from pine forestry as evidenced by the June 2018 slash damage at Tolaga Bay. In an MPI report into the best options for land use in Te Tairāwhiti, authors recommend high spatial resolution assessments, which can be adjusted for management purposes, and detailed erosion risk assessments for all exotic forests, accounting for harvesting effects. Annual risk maps should be created based on harvest sites and times, and the information should be used to evaluate future forestry, including post-harvest land use, to mitigate storm damage in marginal areas (Spiekermann & Marden, 2018).

Flooding and slash

Flooding issues in Te Tairāwhiti have been exacerbated by heavy rainfall, steep terrain, inadequate infrastructure, and poor coordination among government agencies. An inquiry into severe flooding in the region from Cyclone Bola in 1988 recommended constructing new flood protection infrastructure, improving existing infrastructure, enhancing coordination, and adopting a proactive approach that includes early warning systems and emergency response plans (Office of Parliamentary Commissioner for the Environment - Te Kaitiaki Taiao, 1988). A long-term strategy for flood management must prioritise investment in effective flood mitigation measures, protection of communities and infrastructure, and improved communication and collaboration between government agencies and local communities.

Storms, such as the 2018 Queen's Birthday storm and Cyclone Cook in 2017, mobilise significant sediment and woody debris within sub-catchments. This causes landslides and changes channel morphology, ultimately exacerbating flooding and damaging crops, fences, and infrastructure. It is well-established that most of the woody debris comes from pine rather than indigenous forests. For example, after the June-July 2020 storm (Cave, 2021), 46% of woody debris on Tikapa beach was pine and 36% was Indigenous species. Pine made up only 38% of land cover so contributed disproportionally to the debris; and after the January 2023 storm, a survey of woody debris (Fox, 2023) found that pine comprised up to 81% of the debris on beaches , representing between two and ten times the proportion of native wood deposits. 'Slash events' negatively affect ratepayers, beach amenities, biodiversity, and water quality and have been blamed for the death of a child at a Gisborne beach (Nightingale, 2023).

The impacts of forestry and slash in Tairawhiti must be addressed to protect social, economic, and coastal infrastructure. Although similar events occurred prior to forestry, worsening storms and mismanagement during harvesting have significantly increased the impact of these problems. Suggestions for mitigating these issues include addressing slash before it causes damage and exploring alternatives for unstable areas.

Changes are urgently needed to the way that slash and riparian buffers are managed (C. Phillips et al., 2016). Riparian buffers can reduce the effects of forestry and floods on receiving aquatic ecosystems (Boothroyd et al., 2004). For example, having a riparian zone (i.e. not planting pine all the way to the stream edge) reduced bank erosion but maturity and vegetation composition can influence the characteristics of streams in forested areas (Boothroyd et al., 2004). Other studies have found that riparian zones reduce the effects of logging by reducing algae biomass and water temperatures (Quinn et al., 2004). Another study concluded that native fish communities were enhanced by the presence of riparian buffers in logged catchment (Rowe et al., 2002).

Impacts of selected previous storms in Te Tairāwhiti

Extra-tropical Cyclone Cook (April 2017) was a small storm following Cyclone Debbie, causing flooding and instability. Pine-dominated woody debris, mostly from stored slash piles, was found at multiple locations and was the primary source of immobilized slash. Slash material traveled downstream during floods, potentially reaching the coast in a single storm or moving episodically. In the wake of Cyclone Cook, researchers recommended improved forestry policy and practices (i.e. utilising terrain susceptibility mapping; Marden et al., 2015) to address these issues and limit the impacts of future cyclones (Cave et al., 2017). Feedback from these earlier report writers suggests few, if any, recommendations have been implemented since their reports were submitted.

The 2018 Queens Birthday storm mobilized significant sediment and woody debris within the Mangaheia sub-catchment of the Uawa catchment. Landslides deposited sediment across roads, properties, buildings, and 224+ hectares of land. A lasting sediment plume was observed at the coast. Woody debris comprised 84% pine (mostly weathered logs), 12% willow and poplar, and 4% indigenous wood, similar to debris from Cyclone Cook in 2017. The debris caused log jams, altering channel morphology and exacerbating flooding around dams, damaging crops, and fences. Logs from the Uawa forest likely reached Tolaga Bay (Cave, 2022).

Importantly, despite a long history of devastating storms and the fact that they will only become more frequent in the future, very little has been done to address the risks of forestry practices and their associated impacts in Te Tairāwhiti. For example, a ministerial inquiry in the wake of Cyclone Bola (Office of Parliamentary Commissioner for the Environment - Te Kaitiaki Taiao, 1988) highlighted the need for more sustainable land use, soil conservation, and reforestation. Similar devastation from Cyclone Gabrielle shows fundamental issues remain unaddressed. The inquiry argued that an integrated approach to flood mitigation is necessary, with a focus on identifying risk generators and bearers. It also suggested that land use decisions should prioritise soil conservation and sustainability. However, the inquiry notably omitted the potential role of Māori in leading solutions to soil erosion and best land use practices.

Impacts of storms on ecosystems

The impacts of storms can have far-reaching environmental consequences, with erosion, sediment loads, and soil conservation being major concerns. In the Waipaoa River, Cyclone Bola in 1988 caused significant land sliding and sediment loads. Research shows that 48% of sediment in the river resulted from shallow landslides upstream, and 64% at the river's

mouth. However, long-term data reveals that landslides from major rain events contribute only 10-19% of sediment loads, with the majority stemming from gully erosion, sheetwash, and stream bank erosion during smaller rainfall events (Page et al., 1999).

It is important to consider the impacts of increased sediment related to forestry practices into receiving waterbodies. Excess sediment is a pollutant in aquatic ecosystems because there are multiple implications of increasing sediment loads to the health and functioning of our freshwater and marine environments. In the marine environment, for example, sediment smothers shellfish, reduces light which reduces seaweed growth which has knock-on effects up the food web, makes it hard for birds and visual predators to hunt and reduce oxygenation, and can lead to toxic algal blooms (Green et al., 2021). Though our native freshwater species have differing responses to increasing sediment, sediment can adversely affect river ecosystems in multiple ways. For example, sediment can change water chemistry, cause temperature decreases and increase turbidity. It can fill the interstitial spaces in the riverbed, where macroinvertebrate communities live, reducing their abundances and altering community structures (Ryan, 1991). In addition to sediment associated with forestry effecting aquatic ecology, the impact of larger woody debris (i.e. slash) is also likely to significantly affect ecosystems during floods.

Hei whakakapi

The impact of storms is large in Te Tairāwhiti. Despite the potential of reforestation, challenges remain. Ineffective and untimely planting, for instance, has led to an increase in sediment production in certain catchments. The forestry industry has been slow to adopt detailed erosion susceptibility mapping and must collaborate with regulatory authorities to develop precise, usable maps for better risk management.

Flood mitigation measures need improvement, such as constructing new flood protection infrastructure, enhancing existing infrastructure, and adopting early warning systems and emergency response plans. An integrated approach to flood mitigation, which includes identifying risk generators and prioritising soil conservation and sustainable land use, is essential. The role of Māori in leading solutions to soil erosion should not be overlooked.

Ultimately, a shift in regulatory processes and long-term thinking is necessary to promote slope stabilisation, reduce erosion, and minimise the hazards posed by storms, forestry practices, and climate change. Addressing forestry-related slash is crucial to prevent damage to social, economic, and coastal infrastructure. Through a combination of approaches, Te Tairāwhiti may be better equipped to face the impacts of future storms.

D. Economic drivers of current land use practices and economic constraints on alternatives

Land use and land use change are affected by a combination of biophysical, economic, technological, demographic, institutional, and cultural/social factors. Current land use practices in New Zealand are not working for managing highly erodible hill country, which is particularly vulnerable to increasing risk from storm events (climate change). Pastoral farming, monoculture plantations and clear-fell harvesting are not optimal activities on vulnerable, erosion prone land. One possible way forward is the adoption of alternative vegetation strategies such as reverting/converting erosion-prone land to diverse indigenous forest and making some of it sustainably 'productive' rather than fully protected in reserves and conservation estate.

Land use change has been a significant feature of the New Zealand landscape since European settlement, largely driven by economic factors. Over the last 30 years, the most significant land use change has been a switch out of sheep and beef farming, with an increase in dairying and forestry (Journeaux et al., 2017).

Economic drivers (Journeaux et al., 2017) include:

- Relative profitability of the land use
- Access to capital
- Infrastructure
- Markets, commodity prices
- Access to information
- Access to skilled labour
- Land tenure

Government policy and regional and territorial government policy, primarily driven by the Resource Management Act, have also been identified as external drivers to land use change.

Relative profitability (costs and returns)

Private land use decisions depend critically on land quality but also anticipated economic returns for alternative uses. In some cases, land use has also been significantly affected by public policies such as the removal of farming subsidies in 1985.

A good example of land use change due to profit pressure are dairy conversions in Canterbury and Southland where relatively flat land was available for use. An assessment of return on equity showed a threefold advantage over arable land in Canterbury, and a twelvefold advantage over sheep farming in Southland (Thorrold, 2010). Similarly, Wairakei Estate between Taupo and Rotorua began a large-scale conversion from forestry to dairying starting in 2004 (Fischer, 2021; *Wairakei Estate Webpage*, n.d.).

Landowners and managers often use models to provide a structured way to think about land-use change and its impact on key economic and environmental values. Hendy et al. (2018) discuss the pros and cons of the two models available at national level, NZ-FARM and LURNZ, , alongside other models. Forestry-specific models include Forestry Investment Finder (Scion; Yao et al., 2019) and Forecaster (*Forecaster - Integral*, 2020), which is available in online and consultant versions.

Farm and forestry models often do not integrate well, and exclude ecosystem services (e.g., erosion control, carbon sequestering) data and values. For example, modelling the effect of

planting native shrubs has been found to reduce farm income but the modelling did not reflect the value of ecosystem services provided by the native shrubs (Wangui et al., 2021).

In contrast, a case study of a Manawatū-Whanganui hill country and steep-land farm predominantly running sheep and beef showed changing to multi-function uses that increased ecosystem services provision (soil conservation, nutrient preservation, and GHG sequestration) could increase farm profit/ha and NPV significantly compared to the base farm (Tran et al., 2023). This positive impact was due to a conversion from pasture to other land uses, including indigenous forest, mānuka, space-planted poplars, and exotic forest.

Access to capital

Landowning entities' financial capabilities are a significant determinant of whether any decision to afforest is considered or realised. Assisting landowners to secure funding could considerably improve outcomes.

Land use change is expensive, and access to capital for both investment and development is vital. At an aggregate level, New Zealand is not short of capital, but at an individual level it varies widely, particularly for Māori landowners, as Māori land cannot be used as security.

The restrictions placed upon Māori land under the Te Ture Whenua Māori Act 1993 make accessing conventional financing from banks challenging. Under this Act, Māori land cannot be alienated, sold, transferred to general title, or forfeited as collateral without a decree from the Māori Land Court. This can mean that financial institutions are hesitant to lend to Māori freehold land with multiple owners as the land cannot be used as collateral against default (Pohatu et al., 2020).

Crown funding mechanisms such as Erosion Control Funding Programme (ECFP) and One Billion Trees (1BT) are/have been available. However, they are not without problems. At its inception, the ECFP required upfront payments from landowners, which was a barrier for unprofitable land blocks and those with low or no functioning governance and management. Changes in funding approaches addressed this including more upfront funding, though application, reporting and management costs mean blocks with limited capability and capacity still struggled to access the fund before it ended in 2018 (Velarde et al., 2019).

Interviewing Māori landowners and managers in the Waiapu catchment, Pohatu et al. (2020) reported that only a small proportion of the sample land blocks had successfully applied or were eligible for funding programmes such as ECFP and 1BT. A further problem was that the funding was often not enough to adequately afforest land in many cases, with some estimates of cost ranging from $24,000 to $66,000 per hectare while the funding available was less than $2,000 per hectare.

Access to information

Forestry in New Zealand has been characterised as having systemic problems in knowledge development, dissemination, and resource mobilisation. Knowledge and financial infrastructure is inadequately resourced and currently unable to fully support the diverse aspirations of New Zealand's land owners. There is a clear need for more translation of technical knowledge into accessible formats and improved infrastructure for information storage, management, and access (Muda, 2022). There has also been a bias in forestry research and development in favour of exotic species to the exclusion of indigenous species, for both soil conservation and timber production.

More data and improved land use modelling capability and accuracy

Hendy et al (2018) found land use modelling capability could be strengthened by improved data collection, and sharing of the data more effectively and with different sectors working together collaboratively to develop transparent processes for applying common datasets, scenarios and assumptions, including more integrated modelling across environmental issues.

Access to financial advice is vital

Most of the decision-makers in a sample of Māori land owning entities in the Waiapu catchment had little detail of costs or returns in regard to establishing native forest or the returns from carbon income they could reasonably expect (Pohatu et al., 2020).

Improved carbon look-up tables (NZ ETS)

In the NZ ETS, the carbon sequestration of different tree species can be calculated using look up tables if the area planted is less than 100 ha (Climate Change (Forestry) Regulations, 2022). These data are adequate for radiata pine as a plethora of information exists on this species. However, for other species, the provided values are based on limited samples and very general.

Māori land owning entities in the Waiapu catchment are in disagreement with the NZ ETS sequestration methodology and rates being skewed towards exotic species. They felt the synergistic ways native forests sequester carbon were not fully accounted for. One person pointed out that the "models that are being presented to us are saying is that [land should] be permanently retired in pine. Because it sinks carbon and landowners can get money from that…"(Pohatu et al., 2020, p. 27). Tree science has demonstrated that mature indigenous forests sequester many times the levels of carbon stored by monocrop plantations (Kimberley et al., 2021) and a review of the official look up tables for a range of native species in a range of landscapes is well overdue (Scion, 2023).

A study of regenerating mānuka on a south Taranaki farm demonstrates the limitations of the look up tables; mean carbon storage of the mānuka was around 80% higher than the table value (Wilson, 2022). This does not necessarily mean that the carbon sequestering of regenerating mānuka and other shrub species is being underestimated countrywide, as the values differ with growth rates, which will vary according to geography. However, it does demonstrate the need to refine the look up tables. It must also be acknowledged that this will require substantial funding as it is a major body of work.

Land tenure

Tenure is the conditions under which land is held or occupied; who owns the land or has the right to make decisions about land use (for example, private land owners, lease-holders, or the Crown). According to Timar (2022), Māori freehold land tends to be underdeveloped even after controlling for land quality and location and less likely to make an active land use transition. Māori freehold land tenure is associated with a decreased probability of grazed pastoral land uses and an increased probability of forested, ungrazed grassland, and cropland uses. This trend has created opportunities for mānuka and kānuka honey and oil products to be sourced from Māori land that has begun regenerating with native species after being left fallow for 40-50 years.

Influencing land use change via financial incentives and regulations

Government, whether national, regional, or local, can directly influence land use and land use change via incentives or regulatory control.

Incentives may include cash subsidies or tax concessions for planting areas for erosion control purposes and/or carbon sequestration such as the ECFP, which led to an increase in afforestation activity beyond baseline levels (Timar, 2022).

With respect to environmental policies, results suggest the incentives of the Emissions Trading Scheme did not significantly affect land-use decisions during the sample period of 2008-2016, most likely due to low carbon prices (Timar, 2022). More recent research suggests that landowners are now being influenced by the potential revenue from the ETS (West et al., 2020). The challenge now is that these incentives are having unintended consequences as afforestation and harvesting of pine on erosion-prone land brings longer-term ecological and physical risks within catchments and marine coastal environments (Taylor, 2022).

Changing land use

There is no 'one size fits all' approach to land use change. While profit and cost are major factors, they operate within "a context of human, structural, historical, contextual, biological, cultural and geographical factors that all determine whether farmers, growers and landowners can, or will, make changes. Understanding the context, limits and/or constraints such as time, capacity and capability that landowners work within, and actively and proactively working with them to develop and implement options that enable them to manage their land sustainably, are therefore keys to effective and sustainable change (Hungerford, 2022).

Work with farmers, foresters and local communities suggests a bottom-up approach is needed, engaging landowners and managers, supporting them, providing the resources needed and evidence, evidence especially from case studies.

New Zealand needs improved data collection around different land uses and better modelling that values ecosystem services such as erosion control and carbon sequestration accurately. Long term financial support is also essential for the implementation of sustainable land use diversification. A part of this will be continuing to expand and fund research (government is still the major funder of industrial research in New Zealand).

Stricter regulatory controls are also likely to be part of the solution. Land use change will need collaboration between government, CRIs, industry bodies, and especially local communities as Aotearoa New Zealand shifts from a human-centred approach to a nature-centred one to sustain and nurture our whenua.

E. Afforestation (exotic vs indigenous / production vs permanent)

Introduction: the crucial role of afforestation

Afforestation, whether exotic or indigenous, production or permanent, plays a crucial role in addressing various environmental challenges, including erosion, climate change, and habitat preservation. The Tairāwhiti region, with its highly erodible steep lands, provides clear examples for understanding the importance of strategic afforestation efforts. The government's Erosion Control Funding Programme, acknowledging widespread concerns about erosion associated with pine plantations, has aimed to re-afforest erosion-prone land in the Gisborne District. Mānuka scrub and indigenous forestry have both been considered as alternatives to plantation forestry for harvest.

Closed canopy forests, such as indigenous kānuka, are highly effective compared to pine at reducing erosion and stabilizing slopes, especially during the first nine years (Watson et al., 1999). In contrast,

> "…the increasing concern is with pine plantations with the harvesting step of the rotation and the *changing localised climatic conditions accentuating erosion risk* with that five years after harvest. Indigenous reversion offers the best long term protection as no clear-fell harvesting will occur." (*Environmental Planning & Regulations Committee*, 2015, p. 4, section 8.1 - italics added)

Modelling results indicate that targeted reforestation could reduce sediment erosion by approximately 50%, limiting aggradation in downstream areas, protecting infrastructure, and reducing flooding. Studies in the Coromandel Peninsula (Quinn et al., 2004; Rowe et al., 2002) have shown the importance of riparian zones for preserving stream health and native fish abundance, emphasizing the need for holistic catchment restoration approaches.

Community-led initiatives in sustainable farming practices and climate action plans are essential for building resilience in areas like the Waiapu catchment (Warmenhoven et al., 2014). The establishment of a 'Model Forest' is recommended for developing strategic land use, coalitions, and new decision-making approaches. However, limited resources and conflicting interests pose challenges to such collaborative efforts. Evaluating the costs and benefits of tree establishment for carbon sequestration remains a complex task, requiring further research and development of methodologies.

Afforestation: a complex dynamic of data, strategy, practice and economic considerations

Afforestation, specifically exotic versus indigenous and production versus permanent, has significant implications for land management and environmental preservation. The balance between the two approaches and their effectiveness can determine the success of combating challenges such as erosion, flooding, and sedimentation. Soil loss from landslides contributes to gully erosion as well as increased sedimentation in streams and rivers, and is a significant issue that needs to be addressed. In contrast, native afforestation offers a myriad of benefits, including carbon revenue, erosion control, and biodiversity improvement, making it an attractive option for land use, but currently has lower financial returns to landowners and forestry investors.

Informed forestry management practices, including Terrain Susceptibility mapping (Marden et al., 2015), can mitigate hazards arising from heavy rainfall events. However, such information is sometimes absent from management strategies, despite their value in

minimising forestry-related hazards. Equally, independent environmental monitoring during harvest can minimize environmental damage and provide unbiased information for future planning.

There is a real need for better data, collaboration, and strategic policies to improve land use decisions and address the interconnected challenges of erosion, climate change, and biodiversity (Hendy et al., 2018). Targeted reforestation, especially in erosion-prone areas, can significantly reduce sediment and gully erosion (Marden & Seymour, 2022). However, progress is limited, in part due to a reluctance to prioritise future-proofing broader ecological health over short-term economic gains.

The role of forestry in reducing erosion in steep lands, such as Tairāwhiti, is also critical. Closed canopy indigenous forests offer the best protection against gully formation and stabilisation, contributing to flood resilience.

> "The future for forestry in New Zealand's steeplands is promising, but unresolved issues remain. Principally among these is first resolving where the most critical areas are in terms of the potential for post-harvest, storm-induced landsliding and debris flows, and then second, how to manage these. ... [M]ore people with geomorphology skills either within or servicing the forest industry [are needed]." (C. Phillips et al., 2018, p. 121).

Research has shown that diverse species mix plantation forests can sequester more carbon and experience faster growth compared to monocultures (Pierce, 2022). Because mature forests play a crucial role in reducing erosion and sediment in lowland river systems, they are essential for reducing future flood risk and preserving or enhancing the entire ecosystem. Moreover, expenditure associated with the targeted reforestation of erosion-prone hill country needs to be considered alongside the significant reduction in off-site damage with consequential savings in the cost of repair to structural utilities and clean-up costs associated with future flood events (Marden, 2004).

A report commissioned by MPI almost a decade ago stated:

> "If clearfelling of large areas is to continue as a silvicultural regime of choice then harvesting methods will have to be changed in the areas most susceptible to landslides and debris flows leaving the forest boundary." (Amishev et al., 2014, p. 71)

Continuous cover forestry has successfully addressed the problems with clear-cut harvesting that Cyclone Gabrielle has made apparent, but perhaps the climate change projections at the time of planting meant that the potential negative impacts were unknown and/or minimised. It is also clear that economic considerations play a significant role in regulations and decision-making:

> "In recent years, forestry has moved to steeper and more difficult terrain with associated higher roading and landing construction costs because of competition from other land uses on flat land. Some regions in the country are more difficult than others and the East Coast/Hawkes Bay (ECHB) region tends to have the highest harvesting costs in the country ($33.20/tonne)… Any additional requirement and effort that may lead to reduced landslide or debris flow risk may likely increase the cost of the delivered logs making forest plantations unsustainable in such areas. In the same instance, *harvesting operations in these forests generates huge cashflow into the local economies and to walk away from these forests would have massive implications on local unemployment and the local economy*." (Amishev et al., 2014, pp. 28–29, italics added)

There are alternatives to the dominant forestry practices of clear-fell harvesting. Non-Wood Forest Products (NWFP) can provide benefits to local communities, such as food, cosmetics, therapeutics, energy, and ecosystem services, but integrating NWFP utilisation with modern pine plantations requires access rights, shared governance, suitable sites and sustainable management practices supported by state and local communities (Sheppard et al., 2020). Equally, the conversion of excess forest biomass into outputs like biochar and electricity can have multiple benefits, such as reducing wildfire risk and improving soil quality, so finding economical methods and developing markets for these by-products is the goal of a number of initiatives underway or proposed at various sites and scale.

> "Stakeholder participation within political, governance and research groups can provide social empowerment delivering the motivation for changes at a grassroots level and pressure for legislative bodies for a transition from the status quo." (Sheppard et al., 2020, p. 32)

The impacts of major weather events over the last five years, culminating in Cyclone Hale and Cyclone Gabrielle this year, have already galvanised a grassroots pressure for change. Efforts to improve compliance with slash management and erosion control have highlighted the challenges around regulatory oversight, rule setting, voluntary changes in industry practices and the need for more research, training and education. However, profit margins and returns on investment along with historic and contemporary government subsidies and the lack of significant penalties, can hinder land-use change decisions.

Understanding global industry standards and maintaining certification for sustainable practices and products is essential for staying competitive in the wood sector (refer to final section in this document for more on international standards and certifications).

High-resolution mapping and geomorphic assessments of forestry regions are now critical for predicting downstream negative impacts, particularly after major storms. However, due to the high cost, only sites with higher Erosion Susceptibility Classes have typically undergone such detailed assessments. It is crucial that consistent and appropriate standards for forestry operations are both agreed and monitored, as current rules and practices vary across councils and may not meet international standards.

Erosion control in the hill country of Tairāwhiti can be achieved through mature revegetation of trees, as evidenced in a call to action for land management that centres on reforestation (Marden & Seymour, 2022).

Studies (Blaschke et al., 2008; Giuntoli et al., 2022; Tran et al., 2023) show that changing land use to multifunctional purposes and increasing ecosystem service provision significantly increased profit/ha and NPV compared to the base farm. This was due to conversion from pasture to land uses involving woody vegetation. Hill country farmers increasingly prefer scenarios with mānuka regeneration and landscape conservation, both improving multifunctionality, ecosystem services, and reducing environmental issues.

Changing approach, changing practice, changing outcomes

Climate change, human activities, and deforestation have resulted in the loss of ecosystem services and biodiversity, underscoring the need to shift from a human-centred approach to a nature-centred one. Decision-makers, particularly those in forest management, need to learn from local histories.

Implementing reforestation strategies usually involve collecting locally-sourced seeds and cuttings, establishing and expanding local nurseries of appropriate native species, as well as employing rural residents with employment conditions that provide a standard of living

comparable with what they could enjoy in bigger centres. The guiding concept for sustainable forest preservation should be the interconnectedness of people with the biophysical environment.

Between 1880 and 1920, deforestation in Tairawhiti's major catchments led to erosion and sediment issues (Marden & Seymour, 2022). Despite various strategies being employed since 1960, erosion control targets have not been met. Stabilising treatment using exotic species, such as radiata pine and Douglas fir, has achieved a 62% reduction in the number of gullies but only a 5% reduction in overall gully erosion area.

> "[Since 1960] gully initiation and development have outstripped mandated erosion control targets set by the East Coast Forestry Project (ECFP), for land designated as LO3A, and for the 'Restoration of the Waiapu Catchment' by 2020-22…
>
> For gullies identified in the NES-PF as high erosion risk (orange zone) or where the erosion risk is very high (red zone), we recommend:
>
> (i) a revision of remediation strategies for the larger and more actively eroding of gullies destined for future afforestation; and
>
> (ii) for gullies within exotic production forests, the replanting of species (exotic or indigenous) better suited to providing long-term stabilisation, post-harvest."
>
> (Marden & Seymour, 2022, p. 1)

Other studies (e.g. Watson et al., 1999; Marden et al., 2018) show that native tree roots, including kānuka, last longer than pine after harvest and provide crucial reinforcement during storms compared to pine. Phillips & Watson (1994) found that pine roots lose half their strength in 15 months after harvest, while two native species (beech and rata) reach the same level of decay at 33 and 49 months respectively.

The government's ambitious plan to plant one billion trees by 2028, with the largest afforestation areas expected in Tairāwhiti, and the Sustainable Food and Fibre Futures (SFFF) subsidies fund underline the political recognition of the importance of integrating trees into the landscape and diversifying land uses. However, there is an ongoing tension between commercial imperatives and conservation, biodiversity and community imperatives—and research gaps remain, particularly in understanding the relationship between trees, erosion, and slash.

"Furthermore, in light of the Government's 'Billion Trees' project, it is recommended that a detailed assessment of erosion susceptibility of areas identified as potential sites for future planting be undertaken to assess the long-term sustainability of each of the proposed planting/land use options." (Spiekermann & Marden, 2018, p. 3)

The Gisborne District Council's literature review on erosion and sedimentation recommends reforestation of gullies and managing the entire river basin. Similarly, a study in the Waipaoa catchment emphasised the success of reforestation in reducing erosion and sediment loading in watercourses. Both underscore the assessment that "prevention is significantly more effective and cheaper than cure" (Marden & Seymour, 2022, p. 19).

Forestry management needs to consider the long-term plan for forests, covering planning, harvesting, re-establishment, and canopy closure to manage post-harvest risks. As noted elsewhere in this document, post-harvest options include strategic withdrawals or species

changes (Marden & Seymour, 2022), and research areas must include alternative land use, low-impact harvesting, residue minimisation and recovery, fine-scale risk assessments, closing vulnerability windows, nutrient supply maintenance, and economic models for steep land management.

Conclusion

Addressing afforestation through a combination of exotic and indigenous species, production and permanent approaches, and targeted reforestation, can help mitigate environmental challenges, preserve ecosystems, and benefit local communities. This necessitates a shift in priorities, public and private investment, and collaboration between stakeholders.

Afforestation and reforestation policies need to strike a better balance between exotic and indigenous species, focusing on both production and permanent solutions depending on the host landscape, catchment dynamics and climate predictions. While exotic species have demonstrated some success in erosion control and carbon sequestration, indigenous species offer more long-term benefits such as improved biodiversity and reduced environmental impact. Supporting land use diversification, fostering collaboration, incentivising investment while restoring ecological wellbeing and aligning policies with sustainable practices are essential for a successful and balanced afforestation approach.

The focus should be on ensuring ecological integrity is restored as the main priority, with short- and medium-term economic benefits a secondary consideration. This approach depends on mitigating erosion, preserving biodiversity, and promoting land use that will remain viable as best as possible in a rapidly changing environment, as extreme weather becomes more frequent and intense. Collaborative efforts involving governments, researchers, indigenous communities, and land managers will be key to achieving these goals and fostering a nature-centred approach to forest preservation.

F. Regulatory issues

Introduction

> "Forestry has, since 2013, been a net emitter and is forecast to remain that way until 2025" (*Wai 2607, #1.1.1*, 2016, p. 19)
>
> "It's necessary to consider that the NES-PF may be consistent with the RMA, yet due to deficiencies in the RMA, is not adequately managing our use of the environment." (Tait-Jamieson, 2023, p. 11)
>
> "The times ahead are going to need us to focus on adaptation, and maladaptation is a significant risk if you have convinced yourselves that your carbon emissions today have been permanently offset in the biosphere by forests that are increasingly exposed to climate risk, through disease, fire and storm – and the most risky of all, must surely be: the same age, mono-species clones we call Pinus radiata." (Carr, 2022).

There are a range of regulatory issues relating to land use in Tairāwhiti and Wairoa, across interconnected concerns regarding climate change, land use rules for plantation forestry, and the rights and interests of tangata whenua. Many of these concerns are outlined in Wai 2607, which claims the New Zealand government's response to climate change breaches Treaty of Waitangi obligations. The claim outlines a range of failures and how these impact tangata whenua, natural ecosystems, health, and the economy. Regulatory issues manifest at central, local, and industry governance levels. Failures include both the Emissions Trading Scheme (ETS); which has been ineffective at reducing greenhouse gas emissions, including in the forestry sector; and the National Environmental Standards for Plantation Forestry (NES-PF), which have been ineffective in managing use of the environment.

Addressing these challenges requires an integrated, multifaceted approach that respects the rights and knowledge of tangata whenua, promotes sustainable land and water management practices, and fundamentally takes into account the local context and environment. Collaboration between government agencies, councils, businesses, and communities is essential in creating a regulatory framework that balances economic, environmental, and social needs while adapting to the challenges posed by climate change. To date, formal regulatory approaches have underdelivered with respect to this context across all levels of governance, and are disconnected from nuanced, local contexts. Regulatory mechanisms have been largely one-size-fits-all in their design, with significant shortcomings, to the detriment of communities and the environment.

Central Government

Emissions Trading Scheme (ETS)

Launched in 2008, the objective of the ETS is regulating, and ultimately reducing, greenhouse gas emissions. The scheme's present structure is problematic and ineffective in that it runs counter to its overarching objective. Companies obtain ETS units (NZU) through various means, including government allocation and purchase from forestry, and must surrender NZU in proportion to their emissions. With this structure, net emissions are all that is counted—so companies will buy forestry units instead of reducing their actual emissions if that is cost effective. As conversion of marginal pasture to forestry remains cheaper than reducing industry emissions, the ETS promotes land use change and only reduces net

emissions (i.e. total emissions minus estimated captured carbon due to forestry, rather than total, or gross, emissions) (Hood, 2023)

Therefore, a key issue with the ETS is its focus on net emissions, which disincentivises emissions reduction and promotes land use change to forestry, specifically, fast-growing plantation pine. Forestry carbon storage should not be traded off against gross emissions if the goal is genuine emissions reductions. Emissions reductions and forest carbon capture are both essential for controlling increases in global temperature. He Pou a Rangi (Climate Change Commission) has advised that: maintaining net-zero emissions after 2050 under the current ETS would require ongoing forestry conversions; other countries focus on emissions reduction/technology transitions - Aotearoa risks being left behind 'trading' emissions for forestry; and future generations will have to cope with both climate adaptation and emissions reduction. Additional problems are the country's impending oversupply of NZU (ETS credits) in approximately 15 years (Hood, 2023) and the numerous challenges associated with blanket pine plantations across much of our highly erosion-susceptible land areas.

National Environmental Standards for Plantation Forestry (NES-PF)

The NES-PF are regulations made under the RMA (1991), yet the RMA (1991) is unsatisfactory to deliver expectations for environmental outcomes for all stakeholders, and in particular those of many iwi, hapū, local authorities and environmental organisations. This considered, the NES-PF is not adequately managing use of the environment as it permits forestry activities under conditions which risk significant environmental effects (Tait-Jamieson, 2023). The NES-PF's capacity to manage erosion is a major concern. The Erosion Susceptibility Classification (ESC) model has limitations in terms of its core assumptions, and data, which experts have shown contribute to inaccurate erosion risk classification zones at the land-block (Tait-Jamieson, 2023). Further to this, the NES-PF's ESC and Annual Exceedance Probability (AEP) thresholds do not adequately account for the consequences of landslide events when calculating risk (Tait-Jamieson, 2023).

In Tairāwhiti, the NES-PF is a longstanding and contentious issue. The Gisborne District Council (GDC) raised concerns with the NES-PF as early as 2010 when it was first proposed, and actively highlighted the shortcomings of the one-size-fits-all approach of successive proposals. In 2015, the GDC's Chief Science Specialist provided a report to the Council which emphasised the shortcomings of the NES-PF for plantation forestry compared to previous resource consents. The report noted that limits on regional stringency were likely to lower environmental standards for plantation forestry activities. Forestry companies that follow the NES-PF do not need consent for most activities, which reduces consultation, context-specific tailoring, and the ability to charge for monitoring their activity was limited. This is particularly problematic in Tarāwhiti which has some of the most erodible land in the country (Freeman, 2015).

> "Clear-fell harvesting affects biodiversity and re-introduces erosion risk similar to grassland for a number of years. Forestry slash, woody debris and sediment can end up being deposited in large quantities in receiving environments – whether they be streams, wetlands or the coast ... Local communities have also recently voiced concerns over woody debris ending up in streams, rivers and beaches." (Freeman, 2015, p. 2)

In 2015, the Future Tairāwhiti Committee of the GDC began exploring options to address the escalating slash issue. They proposed solutions including retiring steep land from clear-fell forestry and introducing a levy or rate on forestry companies to contribute to clean-up costs. The constraints of the NES-PF were raised again in this forum, with emphasis on the region's

unique geographical context, susceptibility to erosion and the damaging effects of wood debris from timber harvesting, and the need for further regulatory action from central government (Gisborne District Council, 2015a). Further to this, the MPI-led review of the first year of the NES-PF identified concerns with wildling pines, slash and biodiversity. Several changes to regulations were recommended, including to clarify and strengthen the controls and improve management of slash (Te Uru Rākau, 2021).

> "Tangata whenua have identified the discharge of forestry slash from forestry activities as a significant resource management issue. Forestry slash discharge can have actual and potential adverse effects on the mauri of ancestral water and other taonga (e.g. fish spawning and feeding grounds, mahinga maataitai, taonga raranga, and tauranga ika and waahi tapu)" (Gisborne District Council, 2015a, p. 15).

> "Of particular concern is the lack data on the environmental benefits, although we expect those gains to be marginal. There is also no information on how an NES will improve firm and government performance over and above the reduction in administrative and compliance costs." (Nixon & Peterson, 2015, p. 49)

Development of the NES-PF appears to have favoured regulatory streamlining over the environment. Evidence from a 2015 cost-benefit assessment of the proposed NES-PF shows forestry stakeholders sought consistency and efficiencies in terms of resource management regulation. They viewed rules as differing widely between local authorities with inconsistencies creating the possibility of increased costs and uncertainty for forestry companies attempting to comply with varying rules (Nixon & Peterson, 2015). The assessment caveats the lack of data, and insufficient research, on environmental values and benefits (Nixon & Peterson, 2015). Assumptions are derived from interviews with the forestry industry, councils and government departments. Problems associated with variable environmental practices are considered to be of marginal significance, citing improved professionalism of forestry sector (Nixon & Peterson, 2015). The effects of climate change on Aotearoa's national and regional weather patterns have not been sufficiently considered throughout the development of the NES-PF, and future weather predictions need to inform risk thresholds when making decisions about permitting or prohibiting forestry activities (Tait-Jamieson, 2023).

> "Central government and industry approaches to forestry appear to underestimate the impact the post-harvest period has within the forestry cycle on increasing erosion risk." (Tait-Jamieson, 2023, p. 4).

In Aotearoa the cost of erosion is significant, and historically, in some instances, has outweighed prevention expenditure on a 3:1 ratio (Marden, 2003). In Tairāwhiti, it is a substantial legacy issue, largely attributed to the region's unique, steep topography, and deforestation. Erosion and sediment issues have plagued Tairawhiti's major catchments since 1880-1920, particularly the Waiapu Catchment which has seen significant and continued gully erosion (Marden, 2003). A review of gully erosion remediation attempts from 1997-2017 found that erosion control targets have not been met despite some success. The review suggested solutions including; staged replanting, harvestable crop setbacks, and transitioning to indigenous vegetation for actively eroding gullies (Marden & Seymour, 2022). Further investment and regulatory enforcement are needed to ensure landowner compliance in this area. Another contributing factor here is the mis-classification of land and erosion susceptibility due to coarse-scale mapping (Miller, 2023).

Issues have emerged at the intersection of central and local government with regard to the regulatory tools which are intended to manage and mitigate erosion. At present, these tools are rendered ineffective due to non-compliance and non-enforcement.

Local Government

From 2009, the GDC's Combined Regional and District Plan required all landowners with eroding land identified as Land Overlay 3A (LO3A) (comprising approximately 50,000 ha of the 'worst of the worst' eroding land use capability classes) to have an effective tree cover or be fenced for reversion by 2021 (Marden & Seymour, 2022). Marden and Seymour (2022) find that lack of compliance and enforcement have resulted in these erosion targets being unfulfilled, with gully initiation and development continuing. Many gullies have occurred in land retained in pastoral use. Their report recommends significant long-term investment in the prioritisation and completion of these unfulfilled targets in addressing ongoing on- and off-site impacts of gully erosion.

Regional-level regulatory mechanisms appear to be ineffective, and issues have arisen due to a lack of efficiency and consolidation of resource management components. The Tairāwhiti Resource Management Plan (TRMP) is outdated, and insufficient in meeting RMA requirements. The TMRP guides decision-making on land use effects on freshwater, coastal marine areas, soil conservation, and avoiding natural hazards. Climate change risks exacerbating these natural hazards. A report conducted in September 2019 recommended a staged review of the TRMP, encouraging the GDC's Sustainable Tarāwhiti Committee to endorse a full review, using a streamlined, engagement-based process. The review offers the opportunity to integrate land use, catchment plans, transport planning, and to protect regionally significant infrastructure (Kohere, 2020).

Concerns exist with respect to the consenting process with respect to GDC's ineffective financial management (Easton, 2015), and inability to proactively set consent conditions with respect to environmental impact (Hancock, 2018). In Tairāwhiti, forestry related resource consents approved by GDC frequently involve clear-felling, with a 10-year expiry. A typical application includes clear-fell harvest of 441 hectares of *Pinus radiata*, 17,600 meters of new road construction, 42 landings, 18 hauler pads, and replanting. Of over 230 consents granted since 2013, only three consents mention debris catchers or slash-catching devices (Gisborne District Council, 2023a). Streams undergo vegetation removal, cable hauling, and earthworks. Areas identified as red zone, protected management areas, or riparian management areas lack sufficient extra protection measures and communities around the region have subsequently experienced large scale impacts to private property and public infrastructure over recent years.

The Gisborne District Council (and Hawkes Bay Regional Council) have a significant role to play in both the immediate and long-term regulatory response to the adverse effects of land use – including forestry practices – in Tairāwhiti. The ultimate, holistic solution may take some years to design, but that is not a reason to do nothing in the meantime. There is much the Council can do to alleviate the recurring impacts of forestry slash and sediment on the communities of Tairāwhiti. The Council should, as a matter of urgency:

1. Bearing in mind that with each event the flood-carrying capacity of our waterways reduces, the impacts of severe weather events are getting worse each time, even though the severity of the weather event itself may be less. Undertake a focused review of the land use rules that present the greatest risk, rather than risking the rules relating to erosion and harvesting impacts getting caught up with the much larger process of all land use rules review.
2. Review all extant resource consents for forestry harvesting and identify weaknesses in the consent conditions, which have or will allow for the generation of adverse effects that were not foreseen or addressed when the consents were issued.

3. Instigate enforcement action under the RMA to prevent recurrence of the adverse effects that have devasted Tairāwhiti communities over and over again. This should include orders as to what can occur in the future as well as orders requiring existing risk to be reduced – for example, removing slash from all areas where that poses a risk in future weather events. This would include all erosion-prone areas and also those areas where slash now sits as a result of past events, and from which a future event will "pick it up" and transport it further.
4. Prosecute those responsible for slash and sediment-generating activities where they are in breach of existing NES-PF rules and/or TRMP rules and/or resource consent conditions.

Industry Governance

Issues have arisen with respect to the industry itself, and the capacity for forestry industry and companies alike to regulate themselves. The exposure of exploitative and environmentally damaging practices of multinational forestry companies in Tairāwhiti, such as Ernslaw One (Minto et al., 2005), has served to cultivate awareness and scrutiny in this area. An extensive review of international industry governance interventions revealed significant knowledge gaps regarding the environmental impacts of Community Forest Management (CFM) and Forest Certification (FC) interventions. FCs are a form of non-state, market-driven governance developed in the early 1990s, and CFM is a form of decentralised governance, defined as the use, management and conservation of forests by communities. While evidence generally indicates positive impacts on the ground, findings on flora and ecosystems remain inconclusive (Di Girolami et al., 2023). High-resolution mapping and geomorphic assessments are seen as being crucial for predicting environmental impacts, however at a regulatory level, due to high costs, only sites with higher Erosion Susceptibility Classes (ESC) are required to undergo such assessments (Bloomberg, 2015).

There are also questions about the legal responsibilities of company boards, directors and managers. A recent legal opinion issued by law firm Chapman Tripp concludes, "New Zealand company directors' duties to exercise reasonable care require them to ensure that their businesses are identifying foreseeable and potentially material nature-related risks that could affect their companies, and equally to take nature-related risks with material impact into account in their decision-making." (Swan & Lampitt, 2023, p. 1). The advice suggests "prudent directors in sectors highly dependent on nature and the environment for their business model should be starting on the path to ensure the business is in a position to:

- Identify direct and indirect dependencies on natural capital, ecosystem services and biodiversity that are at risk or vulnerable
- Assess exposure to nature-related risks and the financial materiality of such risk
- "Manage nature- related risks that may have a financially material impact." (Swan & Lampitt, 2023, p. 1)

A range of legal remedies may be sought from companies found liable for damages. Mana Taiao Tairāwhiti understands litigation is currently being explored in the wake of recent weather events and subsequent public and private property damage from woody debris and sediment derived from forestry blocks.

Efforts to increase industry awareness to the environmental impacts of forestry are nothing new in Tairāwhiti. A 1994 report into the value of environmental monitoring recommended increasing awareness of environmental damage consequences, industry-funded monitoring

programs, prompt action on impact reports, and designing monitoring requirements around management objectives (Marden, 1994). More recent analysis has suggested the forestry industry should collaborate with regulatory authorities to create a standard for detailed erosion susceptibility mapping, particularly in the areas prone to slash damage (Marden et al., 2015).

A question remains about the level of erosion susceptibility a regulatory threshold should be set at for prohibiting both clear-fell harvesting and pasture cover only on erosion-prone hillsides.

The precautionary principle is an approach to risk management, where, if it is possible that a given policy or action might cause harm to the public or the environment and if there is still no scientific agreement on the issue, the policy or action in question should not be carried out (Cheever & Campbell-Mohn, 2004). Another tenet of environmental law is the 'polluter pays' principle.

An objective assessment of the current situation would suggest that current threshold for clear-fell harvesting is far from where it should be and that if there is a cost to change, at present that needs to rest with an industry that has polluted large tracks of land, waterways and the marine coastal environment. The only decision consistent with the precautionary principle in this situation would be to recommend a cessation of clear-fell harvesting practices until a regime can be designed that eliminates the risk of forestry site woody debris and sediment entering waterways in the region.

Likewise, erosion-prone land in pasture continues to erode and the evidence from 60 years of erosion treatment finds that more land needs to be retired, with diverse, permanent tree species. The only decision consistent with the precautionary principle in this situation would be to recommend an urgent change in erosion treatment strategies and resourcing to greatly reduce the risk of new sediment gullies forming on pastoral farming blocks and sediment subsequently entering waterways in the region.

Conclusion

In summary, key regulatory issues exist at national, local, industry, and land block governance levels. Of particular concern are deficiencies with the ETS and NES-PF that are contributing to disastrous environmental, economic, cultural, and social outcomes. Addressing regulatory issues in the forestry and farming sectors requires an integrated and multifaceted approach that considers environmental, social, cultural, and economic aspects. Key areas of focus include fundamental emissions reduction mechanisms, filling knowledge gaps on the environmental impacts of forestry and farm management interventions, strengthening resource consent and environmental management conditions, and planning for an efficient land transition to permanent diverse indigenous forest, including establishment of new jobs and markets Engaging tangata whenua in resource management and more sustainable enterprise development, and improving monitoring and mapping practices is essential. By addressing these challenges, the forestry and farming sectors can contribute to truly sustainable development and mitigate the negative effects of historic environmental degradation and future climate change.

G. Current local and central government work programmes

Introduction

The Tairāwhiti region faces complex environmental management challenges that have been part of central and local government initiatives for a number of years. These initiatives have consistently identified the need to address erosion-prone land remediation schemes in Tairāwhiti. Central government policies impact on local communities and have been criticised for not adequately fulfilling Treaty of Waitangi obligations.

Local and central government work programmes in Tairāwhiti must address the interconnected challenges of land use, climate change, and forestry management through comprehensive planning, community engagement, and sustainable practices.

Central Government Policy & Legislation

Funding programmes through the Ministry for Primary Industries acknowledge “the Gisborne district has severe erosion problems, with 26% of the land being susceptible to severe erosion, compared with only 8% of the rest of New Zealand.” (MPI, 2023)

Deforestation in Tairawhiti's major catchments between 1880 and 1920 led to erosion and sediment issues. Since 1960, various strategies have been employed to restore East Coast gullies. Cyclone Bola in 1988 prompted new policies subsidising forestry. Government initiatives such as the Erosion Control Funding Programme (formerly East Coast Forestry Project) aimed at addressing erosion in the region show that despite some success, “regionwide, the area occupied by gullies as at 2017 (5347 ha) was only 5% less than the 5600 ha of eroding gully present before remediation treatments began 60-years ago” (Marden & Seymour, 2022, p. 14). Marden and Seymour (2022) also make a range of recommendations including the use of mānuka and kānuka, setbacks for slash, not replanting some areas as plantation forests and calling for funding and enforcement to meet unfulfilled targets.

Comparing carbon sequestration rates of mānuka and pine within the Emissions Trading Scheme (ETS) has led to recommendations for promoting more indigenous forestry options. This could include relaxing geospatial requirements and potentially offering financial incentives for non-carbon co-benefits such as biodiversity (Wilson, 2022).

The Ministry for Primary Industries (MPI) 2021-2025 Strategic Intentions document notes that they are undertaking a “multi-year programme to improve the forestry ETS [sic]” (MPI, 2021, p. 65) and will also continue to review the impact of the National Environmental Standards for Plantation Forestry (NES-PF).

Many of these government initiatives are challenged by Waitangi Tribunal Claim Wai 2670 (20 February 2023) which claims that the New Zealand’s Government’s response to the threat of global climate change represents a breach of the Crown’s Treaty of Waitangi obligations towards Māori and Māori have and will continue to suffer prejudice as a result. This claim addresses a range of international and central government initiatives and notes that “the actual and potential impact of climate change on Māori is serious and widespread.” (Potter, 2023, p. 5)

Harmsworth and Tipa (2006) and Harmsworth and Awatere (2012) provide a range of cultural monitoring and assessment tools that show how cultural values, monitoring and assessments by iwi, hapu and whanau can contribute to supporting government initiatives to achieve environmental outcomes.

Regional implications

Local government programmes are led by the Gisborne District Council, Te Kaunihera o Te Tairāwhiti. For example the Tairāwhiti Resource Management Plan (TRMP) is being updated currently which provides the Tairāwhiti community an opportunity to address current challenges (Gisborne District Council, n.d.).

In 2015 a report on Restoring the Waiapu Catchment Project and Erosion Control Funding Programme was presented to the Gisborne District Council (Easton, 2015). Discussion about this report noted the issues with erosion after pine harvesting (Gisborne District Council, 2015b, p. 4). There was no mention of the issues associated with slash.

However, in 2016 Landcare Research completed a report for Gisborne District Council (GDC) which examines the impact of forestry and slash on the environment and provides some data collection protocols for analysis. This information would help GDC, the public, and the forestry companies to understand the nature of hazards in the region and the likely landscape responses to storms of different magnitudes (C. Phillips et al., 2016). It is unclear if these recommendations were ever implemented by Gisborne District Council although a case study in the 2020 Gisborne District Council State of the Environment report analyses the forestry debris from Cyclone Cook in 2017 and identifies that approximately 2/3 of the debris was pine and 1/3 willow (Gisborne District Council, 2020). A table listing weather events recorded as causing harvest residue mobilisation in Tairawhiti between 1994 and 2018 identifies eight events that have had substantial impact (Gisborne District Council, 2020, p. 20).

The Tairāwhiti 2021-2031 Long Term Plan, Te Kaunihera o Te Tairāwhiti Gisborne District Council, was adopted by Council on 30 June 2021. This plan sets out the GDC's commitment to delivering the activities, services and infrastructure for the region. This will be reviewed in 2024 and communities will be consulted on the council's future direction. This will provide an opportunity for communities to emphasise their expectations regarding environmental priorities.

Summary

In summary, the Tairāwhiti region is facing significant environmental challenges, from erosion control to the impacts of forestry and slash. A range of reports have identified these issues over several years and provided a range of solutions. Addressing them requires a comprehensive approach that incorporates updated management plans, government initiatives, engagement with iwi, hapū and landowners, cultural assessment tools, and innovative solutions for sustainable land use.

Central government initiatives impact on regional communities and so it is essential to work collaboratively and understand local needs and solutions to overcome these challenges and create a more sustainable future for Tairāwhiti.

H. Recommendations to improve land use outcomes and employment with changes needed to regulatory settings

Extreme weather events such as Cyclones Gita (in 2018), Hale (January 2023), and Gabrielle (February 2023) may have a range of far-reaching consequences unrelated to the forestry and farming industries. However, the devastating impact that these events continue to have on our region as a direct result of the mobilisation of woody debris and sediment is undeniable; and illustrates that current land use regulations and the existing work programmes that are attempting to mitigate these effects have not yet gone far enough to protect our communities and the environment.

To address these issues, it is crucial to implement improved policy and practices across the region. A robust body of independent research and government- and local council-initiated reports are already in existence, which together make a range of well-researched recommendations on how to approach some of these issues (Marden et al., 2015; Payn et al., 2015; Basher, Harrison, et al., 2015; C. Phillips et al., 2016; Spiekermann & Marden, 2018; BDO Gisborne Limited, 2021). We have also commissioned a series of current urgent briefings from local experts who have kindly synthesised their knowledge and recommendations for positive change (Awatere et al., 2023; Hall, 2023; Hood, 2023; Miller, 2023; Tait-Jamieson, 2023).

URGENT RECOMMENDATIONS

1. **A moratorium/rahui on creation of further pine plantations on erosion-prone land until the risks and alternatives are better understood.**

Parties involved: regulatory bodies, local government, forestry companies.

It is clear that the majority of woody debris that causes such devastation across our region is forestry-related pine (Cave et al., 2017; Spiekermann & Marden, 2018) A 2016 report on current forestry practices, focusing on harvesting, residues, and mitigation of debris flow or downstream slash impact (C. Phillips et al., 2016) found that slash in the Gisborne region is nearly double the average. Post-harvest landsliding is the main mechanism through which such debris movement arises (Spiekermann & Marden, 2018)and these events are frequently associated with infrastructure construction on steep slopes and landings (C. Phillips et al., 2016). **It is essential that we do not continue to exacerbate these existing problems and that any planning or creation of new pine plantations be halted until there are clear guidelines and agreements in place between commercial entities, regulatory authorities and local communities on how to proceed.**

2. **An immediate end to clear-felling on erosion-prone land.**

Specifically, we recommend immediate cessation of all clear-fell harvesting of pine plantations in “very high-risk” (red) and “high-risk” (orange) as defined by NES-PF Erosion Susceptibility Classification (ESC) (see Awatere et al., 2023 for maps).

Parties involved: regulatory bodies, local government, forestry companies, landowners.

Current evidence from NES-PF mapping activities show that Te Tairāwhiti contains the largest concentration of “very high risk” or ‘red-zone’ land outside of the high alpine areas of the South Island (Awatere et al., 2023). Plantation forestry intended for harvest creates a ‘window of vulnerability’ that lasts for 2-8 years after clear-fell harvesting activities (Watson

et al., 1999; *Ministry for Primary Industries NES-PF Submissions: NGOs and Community Groups N-Z.*, n.d.; Awatere et al., 2023). The 28-year harvesting cycle that applies to the local dominant plantation species of *Pinus radiata* has seen communities living though such a window of vulnerability - multiple flooding, slash, and forest debris events have occurred in Tairāwhiti in the last five years following clear-fell harvesting of the 1990s planting cycle (Awatere et al., 2023). **A complete moratorium on clear-felling activities in erosion-prone areas will make a significant contribution to preventing the current cycles of storm-induced loss from continuing and increasing in scale and impact.**

3. An immediate reforesting of recently harvested areas and erosion-prone land currently in pasture

A particular emphasis should be given to reassessing the scope and strategy (species, planting density, scale) of the Gisborne District Council's Overlay 3A Policy along with the reforestation of recently harvested areas and transitioning existing "very high-risk" (red) and "high-risk" (orange) plantations to permanent diverse native forests.

Parties involved: regulatory bodies, local government, forestry companies, landowners.

Deforestation since the 19th century has impacted hills, river systems, and the marine environment, resulting in irreversible landscape changes and soil quality loss (Page et al., 2000). Reforestation can reduce hillslope sediment loss and can be targeted to address specific erosion types. For example, studies on Waipaoa, Waiapu, and Uawa catchments have shown that reforestation would be most successful in Cretaceous gullies, headwaters, and active gullies in pastoral land (Marden et al., 2008; Marden, 2011; Warmenhoven et al., 2014). Although pine trees do a good job of mitigating erosion compared to pasture, pine plantations are not as robust as permanent diverse native forests in defending East Coast landscapes (Awatere et al., 2023). For example, recent research has shown that in Tairāwhiti, converting the most erosion-prone sections of land currently used for production forestry (315–556 ha) to natural regeneration could reduce erosion by 1–2.5 $t \cdot yr^{-1}$ of sediment (Lambie et al., 2021).

A recent briefing from David Hall (2023) states that "ultimately, there can be no predetermined spatial solution, because land-use decisions should reflect the risks and opportunities of specific sites, as well as the aspirations of landowners, land managers, tangata whenua and the wider community. However, to support the above objectives, land use change in Tairāwhiti should exhibit several trends in the near future:

1. "A shift from pastoral agriculture on highly erodible soils to vegetation and forest, especially in upper catchments.
2. A shift from clear-fell harvesting of plantation forests to less intensive forest management systems, such as continuous cover forestry, or unharvested biodiverse forest for carbon farming.
3. A shift from the use of exotic even-aged monocultures for carbon farming to the use of biodiverse, uneven-aged forests – with a strong preference for native species dominance over time.
4. A greater integration of wetlands, floodplains, riparian margins and estuarine ecosystems throughout catchments to manage flood risk and flood-related impacts."

(Hall, 2023, p. 1)

A related issue in this discussion will be Māori landowner claims that any change in rules disadvantages them and is a potential breach of Te Tiriti or other agreements" including the UN Declaration on the Rights of Indigenous Peoples. Of course the financial value of land, forests and other assets is largely a result of legislation and policy set by central

government. Changes to the settings around land use are within the scope of government responsibilities, which as outlined in this and many other papers haven't been well executed and are now the subject of recent Treaty claims as a result.

ADDITIONAL RECOMMENDATIONS

ETS recommendations

Carbon farming through native tree planting on Indigenous land has gained attention, particularly with mānuka/kānuka medicinal products and honey. However, there are inherent difficulties in transitioning from current land uses to permanent carbon farming. There are currently insufficient returns through the Emissions Trading Scheme (ETS) scheme to incentivise large scale planting and regeneration of natives. The short life of *P. radiata* means that, with time, the forests will start providing a negative return, rendering the land essentially useless to future generations. This can be negated by publicly and potentially privately funding the transition of exotic plantations to gain credits, into permanent native forest. The real discussion is in the value of the transition, which has unquantified environmental, economic and health and wellbeing benefit to our vulnerable communities, and how this could be met via public schemes like the East Coast Forestry Project that was set up post Bola.

It has been suggested that altering the Emissions ETS can promote more indigenous forestry options, including coordinating smaller landowners to increase their participation, gaining a better understanding of actual carbon sequestration rates for various native species and mixed forests, and potentially offering financial incentives for non-carbon co-benefits such as biodiversity via a market-based approach or additional development contributions collected by local authorities or central government (Bendikson, 2023; Hall, 2023; Hood, 2023).

For the agriculture sector, the importance of continuous support, guidance, and tangible incentives for farmers to implement emissions pricing based on farm use is emphasised. Tailoring policies for Māori landowners is essential, as is tracking outcomes as the scheme unfolds. A review of factors driving farmers to implement land use changes before emissions pricing suggested that farmers respond well to effective communication and guidance.

Recommendations regarding community resilience

Building community resilience in the face of climate change is imperative, as exemplified by the "Climate Change and Community Resilience in the Waiapu Catchment" report (Warmenhoven et al., 2014). The study emphasises the significant impacts of climate change on the Waiapu catchment community's natural systems and social and economic well-being. To build resilience, community-led initiatives such as sustainable farming practices and climate action plans are necessary.

Recommendations include engaging the broader community in holistic catchment restoration approaches, and establishing a 'Model Forest' to develop a strategic overview of land use, coalitions, and new decision-making methods. Investment in forest infrastructure, entrepreneurship programs, and innovative forest-based value chains are recommended to support transition towards a circular bioeconomy. Public policies, regulations, and education campaigns are needed to support this transition.

However, limited resources and conflicting interests pose challenges and few, if any, of the recommended outcomes from this and other rigorous locally-led, evidence-based studies in the region over the past thirty years have been implemented. This is one of the most disappointing findings of the review of research and policy reports – so much is known but so little positive action has happened to minimise negative impacts and maximise benefits to the natural environment and our communities that rely on it.

The state government of Victoria recently banned native timber harvesting and established a $200m forestry transition package to support communities, businesses, and workers reliant on that industry. Something similar will be required for Tairāwhiti and Te Wairoa – $100m could go to support workers and business owners to retrain and/or redeploy resources into new sectors and $100m could go into R&D and establishing new businesses and industries based around the region with a far higher proportion of native trees and forest on the land.

Regulate for better assessment of land use risks

If plantation forestry is to continue, Increase efforts to accurately map terrain to a finer scale than currently available, and classify acceptable land uses accordingly. Appropriate tools already available, and in use internationally, but have not been adopted here.

Risk assessments should be carried out for all exotic forests, existing and planned. Since harvesting affects risk, there should be annual risk maps created, based on intended harvest sites and times (Spiekermann & Marden, 2018). The information should also be used to evaluate future forestry, including post-harvest land use and infrastructure decisions.

Hazards created by the combination of forestry practices and heavy rainfall events can be reduced through informed forestry management practices, such as Terrain Susceptibility mapping (Amishev et al., 2014; Spiekermann & Marden, 2018). A proactive, preventative approach is needed to minimize forestry-related hazards, requiring a shift in regulatory processes and investment in high-resolution mapping for better forest management decisions. Specifically recommended actions from Don Miller (2023) include:

1. Applying a whole-of-slope geotechnical assessment to all slopes adjacent to a major highway (e.g. SH35).
2. Treatments such as opening surface drainage channels to prevent water ponding and infiltrating slopes, triggering deep-seated movements, and possibly lining such zones with an impermeable clay where necessary.
3. If problems remain after efforts to curtail infiltration up-slope, horizontal boring for drainage could be useful in some situations.
4. Where the LUC classification of an area indicates limited units within a slope should be treated for erosion susceptibility (e.g. by afforestation) the remainder of the slope should always be assessed to determine if it also needs to be treated in some way.

(Miller, 2023, p. 7)

Slash management

Reducing generation of slash through forestry methods as demonstrated internationally appears to have proved challenging here, partly due to the cost (e.g. Amishev et al., 2014), but it is imperative that practices around slash must be modified if forestry is to continue.

A number of commentators recommend investigating the potential for on-site slash removals, such as chipping and biomass processing, and bio-energy with carbon capture and storage (BECCS). (Awatere et al., 2023, p. 4)

A small BECCS pilot plant using otherwise uneconomic pine logs is currently under development near Ruatoria at the local timber mill that will debark the logs for fence posts and use the bark waste for electricity generation to be fed into the main grid (Neilson, 2019).

I. Impacts of the political economy, land tenure system and capital on power dynamics and land use decision-making processes in the Tairawhiti region

Background

'Political economy' is a term used to describe the policies set by governments and power relations that affect the economy. Policy decisions regarding land tenure, taxation, regulation, and subsidies all have major impacts on land use in the region.

'Capital flows' refer to the movement of money for the purpose of investment, trade, or business operations. Capital flows have influenced ownership, development, and resource extraction within Tairāwhiti.

Political Economy

The Tairawhiti region is generally considered to be the area covered by unitary authority Gisborne District Council, but sometimes also includes the area covered by Wairoa District Council. The economy of the region is based on primary industries such as forestry, sheep and beef farming, fisheries, horticulture, apiculture, and viticulture, along with some innovative manufacturing, tourism, and retail. There is also some investment in electricity distribution, roading and port infrastructure and telecommunications, as well as cultural and heritage restoration. The economic development strategy for the region includes initiatives to diversify the economy and promote innovation, entrepreneurship and skills development, which have attracted some talent into the region in the past decade including organisations focused on medical research and biotechnology, automated translation services and other digital services and products. The region also has strong ties to Māori culture and identity, which is reflected in many sectors, including education, healthcare, performing arts and governance.

The forestry industry contributes significantly to the regional economy. The region is home to some of the largest forests in New Zealand, covering an area of around 250,000 hectares. Of a workforce of about 27,000, there are 970 employed in forestry and logging, i.e. 3.6% of workers in the region (Ashton, 2023). In addition, forestry-related businesses, such as sawmills, panel mills, veneer processors, and transport companies provide many forestry-related jobs in the region. There are differing views on the multiplier factors that should be used to estimate the employment contributions of the sector (Ashton, 2023).

Forestry has a major impact on roading infrastructure and generates about 90% of port activities. A balanced assessment of the industry's contribution to the regional economy would include a calculation of the costs of maintaining a fragile roading network in highly erodible landscapes for heavy vehicles used in forestry operations, versus the rating and taxation contributions made by forestry companies; and the contributions made by ratepayers to port infrastructure versus benefits to the local economy. Other calculations of this kind might include the costs of deaths and injuries associated with forestry operations compared with the tax paid by the forestry companies. Reliable calculations of this kind have not been found.

Land Tenure System

The current land tenure system in the Tairawhiti region is governed by New Zealand property laws including agencies like the Māori Land Court that determines title and occupation rights for whenua Māori. Land can be held in freehold title, multiple ownerships or interests,

and customary title. Each of these systems serve different purposes and provide different opportunities and barriers for land ownership, access, utilisation and management in the region.

The current land tenure system benefits large landowners more than small landowners. Large landowners are better able to secure leases from the government and use them to generate economic returns. Meanwhile, small landowners may not have the resources or access to the same type of leases. They may struggle to gain access to the same economic gains large landowners receive.

Capital Flows

In relation to capital flows, the current land tenure system of the region tends to benefit private individual or corporate landowners on General Title land more than collectives entities for Māori landblocks with multiple shareholders. This is because private landowners are able to access capital funded by debt, while collective entities typically do not have access to loans unless they have significant existing revenue to provide security for lenders, as the land cannot be used as security against a loan.

This has implications for power dynamics and land use decision making, as General Title landowners tend to have more resources available to them when it comes to negotiating with local authorities and other stakeholders. Furthermore, private landowners may also be able to exert a greater degree of influence over local decision-making processes due to their increased access to financial resources and well-established industry bodies associated with their particular sector(s).

In an attempt to access capital and secure some long-term revenue opportunities, many Māori landblocks in the region have entered into joint ventures with forestry companies to lease their land for up to 99 years for three cycles of pine plantations. This often means control over what happens on the whenua is taken away from landowners and their descendants for at least a century. The state of the land when it is finally returned to landowners (soil and vegetation cover, for instance) after three cycles of pine plantations is a material factor, when harvesting often involves heavy losses of topsoil, and land may be stripped back to bedrock after harvest in some locations.

Costs and Benefits of Forestry Industry

Some claim the forestry industry may make more than $90 million annually from the region. Of this, an estimated $50 million dollars may remain locally, with the other half going to non-local forestry shareholders, transport companies and other external forestry goods and services sectors. As noted earlier, significant costs for ratepayers and taxpayers are associated with this income, and reliable cost-benefit analyses are lacking.

The benefits of the financial contribution by the forestry industry in the Tairawhiti region are divided among employee households, resident and non-resident landowners, a few local forestry company shareholders and local transport and infrastructure companies in a variety of ways. Shareholders in forestry companies have recently been making between $330,000 (2022) and over $500,000 (2018) profit for every worker they employ (Macfie, 2023).

Again, reliable estimates of the distribution of financial costs and benefits from forestry between the forestry companies, their employees and the regional community are lacking.

These should include the costs of maintaining roading and port infrastructure for forestry operations; the costs associated with deaths and injuries in forestry plantations; and the direct and indirect costs associated with damage to private and public property caused by

forestry waste in successive storms, including crops, vineyards, orchards, animals, houses, farm buildings, schools, water supplies, communications networks, bridges and roads.

Other costs include the damage to topsoil, rivers and beaches and risks to public health and safety from forestry waste. The direct and indirect costs associated with damage caused by forestry waste during recent storm events are difficult to quantify, but are likely to far exceed the industry's positive economic contributions to the region over recent years.

Alternative options and benefits for Forestry Industry and the region

Current forestry industry practices also do not account for the unique ecological value of Aotearoa landscapes. Numerous alternative approaches to forestry management are available, and continue to prove successful elsewhere both in protecting forest ecology and in reducing downstream erosional impacts. These include focusing on planting and harvesting of native species, continuous cover forestry or leaving larger areas of protected forest while reducing clear-felling and the areas harvested, using selective harvesting or thinning operations instead (Amishev et al., 2014; Gresh & Courter, 2021).

The financial costs to the forestry industry in adopting alternative land use practices vary depending on the size and scope of the businesses; forest holdings' location, size and age; and the scope and details of new regulations. The costs will include higher labour costs and pest control costs associated with planting native species and costs associated with reducing areas of forest harvested.

Some specific factors that should be taken into consideration include the cost of implementing sustainable forestry practices, projected revenues from the sale of timber, potential regulatory incentives, savings from reduced land management costs, and potential environmental impacts. Additional factors such as the tree species harvested, the local environmental conditions, and the overall sustainability of the industry must be considered in order to make an accurate assessment of costs and benefits from proposed changes.

In the medium-term if the forestry industry in the Tairawhiti region chooses, or is forced to adopt, better ecological practices, the financial implications may mean less forestry work in the region – reducing the GDP and employment of the sector locally. Contributions to support the transition may include incentives and subsidies to local businesses and landowners for new industries and enterprises, as well as grants and funding for research and development initiatives that further promote good forestry practices and/or new employment opportunities in new sectors based in the region.

In the long-term the financial contribution of the forestry industry in the region could continue to be meaningful, but only if the industry adopts better ecological practices including the end to clear-felling on erosion-prone land. Furthermore, ecologically sustainable practices could also protect the area's unique biodiversity and create a healthier environment for the local community.

Likewise, the farming sector and regulators must urgently reconsider the contribution of pasture on erosion-prone land in relation to soil conservation and loss. Similar to forestry, there is a need to scale back the area committed to pasture considering 88 percent of the region is erosion-prone. Like forestry, new industries will need to be established to replace farming job losses as land is transitioned to permanent diverse native forest again.

J. The role of Tikanga, Mātauranga and Kaitiakitanga in relation to the protection and utilisation of whenua and wai

Tikanga is a system of responsibility and accountability (Menzies & Paul, 2023) that provides guidance for how we behave through an arrangement of values, codes and conventions (King et al., 2010). This helps ensure that our mauri (life essence) remains secure and we are well. Tikanga are the result of knowledge and practice formed and adapted over generations, that give rise to responsibilities of conservation and guardianship. These are relevant to the use of land and water, and the protection of their respective mauri as well, and the impacts of human behaviour and climate change on them. This includes sedimentation and woody debris moving from the steep, erodible lands of Te Tairāwhiti into its waterways.

> "Māori ethics… recognise that cultural order comes from the natural environment and hence people have a responsibility to care for these systems. Lack of respect, honour and protection of this natural order compromises the well-being of these systems on which people depend." (Te Huirangi Waikerepuru in King et al., 2010, p. 107)

It is important to understand that cultural order as presented in whakapapa (genealogy) privileges representations of the natural environment as tuākana (older siblings) to humankind as taina (younger sibling). This means that people have obligations to other parts of the whakapapa, and that these are enacted through tikanga and the application thereof. This approach fundamentally challenges the western doctrine of singular human power and domain over all things, and the subsequent behaviour, policy, process, and actions that this doctrine espouses, implements, and supports.

This plays out in terms of the use of and effects on whenua (land) and wai (water) in particular. The impacts beneficial or otherwise, of land and water uses on Te Tairāwhiti environment have changed over time, but records of the impact of erosion have identified the conversion of forested land cover to pastoral farming as a key factor. Extensive forest clearance between 1890 and 1930 together with repeated high-intensity storm and flood events as well as a catchment with unstable rock types were identified in studies as impacting negatively on land, water and people and the respective cultural values. This had led to the loss of significant resources and habitats and a decline in the mauri of land and water, and arguably people as well.

Pastoral farming gave way to plantation forestry, recommended and supported by government, in an attempt to address widespread hill erosion as a result of intense rainfall from Cyclone Bola. Storm events are forecast to become more frequent and extreme due to human-induced climate change. New strategies are sought to ensure long-term sustainability across agriculture, forestry, water resources, natural ecosystems, settlements and infrastructure, and coastal ecology and health and well-being. Sedimentation and forestry woody debris impact natural resources, and in turn affect people and their role as kaitiaki of tuākana species.

Land use changes are now being further impacted by climate change, which is likely to exacerbate many of the socio-economic disparities already facing Māori society (King et al., 2010). While Māori are experienced in dealing with climate variability, new strategies are needed to address different sectors. Proposed options such as conventional adaptation through managed retreat and relocation (Ministry for the Environment, 2008) may not be perceived as options by Māori and may put extra pressure on inter-iwi relationships.

> "Another barrier may include the high spiritual value placed on coastal land and resources which can restrict, and may even rule out conventional adaption options..." (King et al., 2010, p. 108)

A further aspect of climate change impact on Māori is the limited representation of Māori around the decision-making table, and strategies and actions to reduce vulnerability have also been suggested (King et al., 2010).

The impact of sediment mobilisation on rivers such as the Waiapu River has been the subject of studies with iwi, seeking long-term sustainable solutions through integrating mātauranga and science. The causes of severe land degradation and high sediment loading must be addressed before a community partnership for restoration can be undertaken.

> "Heavy deforestation led to years of erosion, and the Waiapu River has the highest level of sediment loading of any river in the country. The flow on effect for the community is huge with many people leaving the area to seek opportunities." (Barnard et al., 2016)

The indication that impacts will worsen makes this a complex intergenerational challenge. Options to address impacts of sedimentation include adaptation, environmental monitoring with iwi, and reviewing values and decision-making to protect and better manage rivers:

> "The river is our taonga and our life essence. Land erosion reflects how we are becoming as a people. We are losing our mana… Without this land we are nothing." (Harmsworth & Warmenhoven, 2002, p. 7)

A 2012 case study of the Waiapu River catchment and impacts on the community found that Ngāti Porou sought Mana Motuhake, self-determination over the river and catchment, and a strategy to accurately represent their aspirations and values. Fresh water management incorporating mātauranga (Harmsworth et al., 2013) fosters collaboration and engagement between iwi and governments, crucial to recognising the relevance of mātauranga in decision-making. The researchers identified mātauranga as a unique, ecosystems-based knowledge system specific to local issues, historic knowledge, and spatial and temporal contexts. Area-specific policies are able to address social, cultural, economic, and ecological values together. The Resource Management Act supports the exercise of kaitiakitanga in managing and protecting resources, which in turn is relevant to climate change adaptation.

> "A chorus of Māori voices...indicated that adaptation should focus on kaitiakitanga (environmental stewardship) - with families, and communities being involved in habitat protection and enhancement." (King et al., 2010, p. 107).

Turning to the issue of the mobilisation of woody debris, including forestry slash, a 2016 report for Gisborne District Council (C. Phillips et al., 2016) emphasised the need to address slash, by preventing mismanagement during harvest, before it caused damage to the social, economic and coastal infrastructure. Identification of alternative management options for unstable areas, and mitigation of issues were proposed. A contemporary paper on forests (Pierce, 2022) discusses the challenge of sustaining forests and emphasises the need to move from a human-centred approach to a more nature-centred one. Forestry maintenance and restoration needs priority, and decisions need to be made on harvesting and carbon sequestration, and for inclusion of Indigenous people in forest management. The author argues:

> "Local concern and care for the forest is displaced by the new commercial forests run by large corporations, whose concerns are for profits and development in distant cities and faraway countries." (Pierce, 2022, p. 28)

Monitoring of harvesting and removal of woody debris is a focus for better management and impact prevention. A paper on environmental monitoring (Harmsworth & Awatere, 2012) details an assessment method of cultural monitoring which enables iwi/hapū values and perspectives to be articulated spatially. Monitoring environmental-cultural changes through time can then provide validity and contribute to national environmental outcomes.

> "Once established, mātauranga Māori-based monitoring is used to express Māori values, monitor change (spatially and temporally), respond to issues, inform planning and policy, plan actions, and underpin the long-term management of freshwater." (Harmsworth & Awatere, 2012, p. 2)

While more thorough monitoring of plantation forest and adoption of strategies such as best management practice are important, a workshop with Gisborne District Council also considered the need to develop criteria for identifying areas that might not be replanted for plantations harvesting due to unacceptably high risk following harvest, based on factors such as poor tree growth, difficulty of harvest, and higher risk for generating debris flows (Phillips et al., 2016). As the study notes, debris flows happen because it rains, the slopes are steep, and the landscape (soils/regolith) is susceptible to mass failure. The study discussed introduction of a risk matrix for analysis, including consideration of downstream effects from any one of multiple source sites. Alternatives for land use on unstable areas, which may be sizeable within Tairāwhiti, were considered but closer investigation is needed, as site mapping has been at a coarse scale which may not identify all such areas.

The government's emissions trading scheme (ETS) provides an incentive for plantation forestry (Hood, 2023). A recent review (Hungerford, 2022) focusing on farmer values provides recommendations for support for farmers when considering emissions pricing considered what drives farmers to consider land use changes. It notes that it is important to consider the complexities involved where it applies to Māori landowners and to tailor the polices, deadlines, and timeframes to accommodate their decision-making as well as implementation processes.

In summary, research shows that values, the exercise of kaitiaki as custodians and conservators of whenua, wai, mātauranga, and tikanga are interlinked and relevant to the discussions of responsibilities, accountabilities, and use of the whenua; sedimentation affecting rivers; and forestry woody debris affecting waterways, fresh water and coastal water, ecologies, and coastlines.

Climate change will exacerbate impacts of sedimentation from run off and mud flows in steep and unstable landscapes such as Tairāwhiti. While plantation forestry provides economic benefits, including from the ETS, much greater action than 'best practice' harvesting and 'risk monitoring' is needed to move towards a healthier, more sustainable environment. This action must focus on a return to permanent indigenous forest, and as a bare minimum, should include a more proactive approach to anticipating and planning around risks of future land-use. An example could be the making of finer-scale local assessments, hapū-determined tikanga framing land use rules, and decisions that are re-evaluated based on changes to land use and external factors (e.g. Spiekermann and Marden's annual risk maps), which is more in keeping with responsibilities to the whenua than national level reliance on the prescriptive NES-PF type regulations and coarse-scale mapping of the ESC.

Prioritising permanent diverse indigenous forest afforestation (Marden & Seymour, 2022) should be done within catchment communities utilising both local and external expertise, being led by the community with a focus on ecological, social and economic wellbeing.

K. International best practice: plantation and nature-based forestry

Background

Forestry in Aotearoa New Zealand has gone through a series of phases. Prior to humans arriving about 800 years ago, around 80 percent of the whenua was covered in forest (Guild & Dudfield, 2009).

Upon their arrival in Tairāwhiti, the ancestors of Māori had to adapt to forest ecosystems very different from those in their tropical homelands. In coastal areas, where native forests were cleared for gardens and settlements on the foothills and river flats, forest stands were left for building timber, birds, bush foods and fibres (Coombes et al., 2000). Forest resources were seasonally harvested in the hinterland, where according to an early European bushfeller:

> "The steep hills and river flats were bush covered right down to the beds of the rivers, which were hard and full of huge boulders. The water was clear and sweet, and it ran fast. Children swam in the clear pools, and there were eels, native trout and freshwater mussels. The native bush was beautiful. There was tawa, with plenty of totara, white pine and matai. There was beech forest at the higher levels. There were pongas and ferns of all sorts, and the undergrowth was thick and green." (Howard, 1976, p. 4 as cited in Coombes et al., 2000, p. 11)

About one quarter of Aotearoa was cleared of native forest prior to Europeans arriving, most of it by humans burning it (Guild & Dudfield, 2009).

After European settlement in Tairāwhiti, when the land was surveyed into blocks and titles awarded by the Native Land Court in the 1880s, land clearance accelerated dramatically. Native trees were felled for houses, bridges, fences, jetties, farm and office buildings, and mills were set up to process the timber. This phase of forestry relied on native forests, but no attempt was made to manage them sustainably (Coombes et al., 2000).

Across Tairāwhiti, huge areas of bush were felled and burned for pasture for sheep farming. The plumes of smoke were so thick that people on ships out at sea thought that inland, there had been a volcanic eruption:

> "This was a first-class fire; some four square miles of felled bush were cleared off in about three hours. A ship coming down the coast reported, where it next put in, that there had been another volcanic eruption inland. And the sea was twenty-five miles from the run!" (Kenway, 1928, p. 47).

The erosion from this large-scale land clearance across the region was catastrophic. It was not until the 1950s, however, that afforestation schemes were proposed as a way forward. Although the restoration and sustainable harvesting of native forests were suggested by L.M Ellis, the first Director of Forests in New Zealand (1920-1928; Roche, 2015) this was not taken seriously. The afforestation schemes involved mass plantings of *Pinus radiata* and targeted planting of willow and poplar on erosion-prone hillsides and gullies, so a timely opportunity to explore sustainable approaches to native forestry was squandered.

At the same time, pastoral farming on steep hillsides was still causing severe erosion, leading to the formation of gullies and sedimentation in rivers, most spectacularly during Cyclone Bola in 1988. During the 1980s the pine plantations established for soil conservation through erosion control were sold by the state to private interests, and

wholesale harvesting began. This also contributed to severe flooding events, now aggravated by forestry logs and waste in the floodwaters, culminating in the devastation caused by Cyclone Gabrielle in 2023.

In the latest phase, carbon farming with pine trees, funded by the Emissions Trading Scheme, is expanding in Tairāwhiti, with highly erodible landscapes being sprayed and then mass planted with relatively short-lived, shallow rooting, highly flammable monocultures of pine trees (BDO Gisborne Limited, 2021).

Given the risks of fire, disease and increasing storm damage, this is not a credible form of long-term carbon sequestration at a time of climate change. For local communities, pest and weed ridden plantations of aging and dying pine trees are the most likely legacy of this latest ill-conceived central government policy that impacts local landscapes across Tairāwhiti.

1. Forestry Stewardship Council (NZ) standards for plantation forestry:

International best practice for plantation forestry is represented by the Forestry Stewardship Council standard (NZ). The FSC is based in Bonn (Germany), and its certification is supposed to ensure that:

> "forest operations are structured and managed so as to be sufficiently profitable, without generating financial profit at the expense of the forest resource, the ecosystem, or affected communities…. This system allows certificate holders to market their products and services as the result of environmentally appropriate, socially beneficial, and economically viable forest management." (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 5)

For regions like Tairāwhiti, the FSC(NZ) standard states that:

> "hilly and mountainous landscapes can make forestry challenging as erosion poses a real threat to NZ forest management, both in harvesting and planting. Special considerations, included in this standard, must be taken to minimize and mitigate the risk of landslides that could lead to the harm of forest workers, waterways, communities, flora, and fauna." (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 12).

Given the devastation caused by landslides and forestry waste in the wake of Cyclone Gabrielle, this requirement is clearly being breached.

The standard also states:

> "the Organisation shall comply with the legal obligations in applicable national and local laws and regulations and administrative requirements (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 16)."

Despite this, a number of the major forestry companies in Tairāwhiti have been successfully prosecuted for breaches of local laws, regulations and administrative requirements by the Gisborne District Council, and remain FSC certified.

The FSC(NZ) also states that:

> "The Organisation shall identify, prevent, and resolve disputes over issues of statutory or customary law, which can be settled out of court in a timely manner, through engagement with affected stakeholders". (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 17).

This has not happened in many cases.

In addition, the FSC(NZ) standard states that

> "Operations [shall] cease in areas while disputes exist: 1. Of substantial magnitude; or 2. Of substantial duration; or 3. Involving a significant number of interests." (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 18).

In the wake of Cyclone Gabrielle, harvesting continues, despite the sheer magnitude, scale and long-lasting impacts of the damage caused by forestry waste in Tairāwhiti, from farming to horticulture to businesses reliant on transport and water supplies, individuals, families and entire communities.

The FSC(NZ) standard also states that

> "the Organisation, through engagement with local communities, shall take action to identify, avoid and mitigate significant negative social, environmental, and economic impacts of its management activities on affected communities. The action taken shall be proportionate to the scale, intensity, and risk of those activities and negative impacts." (*The FSC Forest Stewardship Standard for New Zealand*, 2023, p. 29)

Such identification and avoidance has not occurred, and mitigation is cursory at best.

Further comment could be made on other standards, but these will suffice. According to a number of court judgements (Gisborne District Council, 2023b) it is obvious that many forestry companies operating in Tairāwhiti do not observe international best practice for plantation forestry. Given the gravity and multiplicity of these breaches, the FSC certification of such companies should be withdrawn.

2. International best practice for nature-based forestry

Over the past 140 years, extractive forms of forestry have proved ecologically, economically and socially disastrous for Tairāwhiti. It is time for new approaches to be trialled and adopted.

In recent reports, international bodies have strongly recommended nature-based strategies for responding to biodiversity losses and climate change. In 2021, for instance, in its report *Biodiversity and climate change: interlinkages and policy* options, the Royal Society (UK) advises against establishing large monoculture tree plantations as long-term carbon sinks:

> "**Policy measures to discourage**: Planting trees, either for bioenergy or as long-term carbon sinks, should focus on restoring and expanding native woodlands and avoid creating large monoculture plantations that do not support high levels of biodiversity. Simple targets such as 'numbers of trees planted' ignore biodiversity considerations, such as long-term survival of trees or stewardship, and can be misleading, potentially contributing to policy failure and misuse of carbon offsets." (The Royal Society, 2021, p. 7)

Likewise, the Report from the Joint workshop COP Panels on Biodiversity and Climate Change (Pörtner et al., 2021) recommends **discouraging** ecosystem-based approaches to climate mitigation that have negative outcomes for biodiversity, such as tree planting in inappropriate ecosystems, and monocultures, for the following reasons:

- Large-scale tree planting can be harmful to biodiversity and food production due to competition for land.

- Afforestation may reduce existing ecosystem carbon storage, cause further biodiversity loss and displace local people or curtail their access to land and its use. Single species plantations can increase pests and disease.
- Plantations of exotic species often have negative impacts on biodiversity, on adaptive capacity and on many nature's contributions to people not related to timber production or carbon sequestration, especially if the planted species becomes invasive.
- Further, their climate benefits may be offset by local warming, especially in boreal and temperate regions, which is induced by different exchanges of water and energy compared to the land cover which it replaces.

Rather, the report recommends "the protection of existing carbon-rich native ecosystems, restoration of degraded ecosystems and improved management in agriculture and forestry." (Pörtner et al., 2021, p111).

In 2022, the IPCC (AR6) report described the practice of "planting large scale non-native monocultures, which would lead to loss of biodiversity and poor climate change resilience" as among the '**Worst Practices and Negative Adaptation Trade-offs'** for temperate forests (IPCC, 2022, p. 308).

By contrast, to "maintain or restore natural species and structural diversity, leading to more diverse and resilient systems" was placed among the '**Best Practices and Adaptation Benefits'** (IPCC, 2022, p. 308), with very high potential for mitigation of climate change effects—importantly, the potential for restoration is currently still high.

International best practice in forestry now requires the restoration, expansion and nature-based harvesting of natural forests, rather than monocultural plantations.

Nature-based silviculture has long been practiced by indigenous peoples, and in places such as the Black Forest in Germany, Slovenia, and Switzerland.

Many other countries are transitioning from clear fell plantation forestry towards nature-based approaches, for instance Germany and the Nordic countries, where over the past 20 years multi-age, multi-species forests of indigenous trees closely adapted to local landscapes are being managed by selective harvesting, based on long rotations, natural regeneration and the sustainable harvesting of a range of forest products, not just timber (e.g. Amishev et al., 2014).

This is coupled with the restoration and expansion of permanent indigenous forests to sequester carbon, maintain biodiversity, enrich soils, enhance the quality of waterways and stabilise erodible land.

This is the only credible form of long-term carbon sequestration by forests. According to the Food and Agriculture Organisation of the UN (Miner, 2010), the industrial forestry supply chain emits about twice as much carbon as it sequesters, and carbon credits based on relatively short-lived monocultures in industrial plantations harvested every 25 to 30 years are not valid. The forestry supply chain in New Zealand, which largely sends raw logs to China and India for processing into very short-lived products, is likely to be on the high side of that equation.

The New Zealand Emissions Trading Scheme, which relies almost exclusively on industrial plantations for carbon sequestration, and in Tairāwhiti awards up to ten times more carbon credits for pine plantations than for restoring native forests, does not follow international best practice (Climate Change (Forestry) Regulations, 2022).

New Zealand's approach to carbon sequestration using exotic monoculture plantations is a form of 'greenwashing' that is incentivising many perverse outcomes, including those seen in Cyclone Gabrielle. In effect it is an excuse for the forest industry to continue its "Business As Usual" approach. It also excluded the possibility of using slash derived biochar for carbon sequestration.

Nature-based forestry has a number of things in common wherever it is practiced:

- A recognition by all the involved parties that a nature-based approach to forestry requires close attention to biodiversity, nutrient cycling, water regulation, carbon storage and soil health.
- It aims to promote biodiversity by developing and maintaining forest structure and composition, protecting critical habitats, and encouraging the growth of diverse tree species and understory vegetation.
- By mimicking natural disturbances such as fire and insect disturbance through controlled burns or selective harvesting, forest managers promote forest resilience and maintain ecological integrity.
- It recognises that indigenous knowledge of forests as a basis of survival evolves over hundreds or thousands of years. This knowledge is assessed, affirmed and rechecked as environments modify (Apgar et al., 2009).
- Nature-based forestry seeks to integrate social and cultural values in forest management into decision-making processes. This includes the use of non-wood forest products for food, energy, medicine, arts, crafts, and ecosystem services by local communities.
- al Access rights for local communities, shared governance, and state-supported sustainable forest management help to ensure that forest management practices are socially and economically sustainable (Sheppard et al., 2020);
- Nature-based forestry emphasizes the importance of adaptive management to evaluate the effectiveness of forest management practices under changing conditions, adjusting them as needed to meet ecological and social objectives.

Internationally there is a shift from a human-centred to nature-centred approaches for sustaining forests. These emphasize the interconnectedness of all Earth's organisms and the biophysical environment, with people as part of forest ecosystems and dependent upon them for their survival (Larsen & Nielsen, 2007).

References

Amishev, D., Basher, L., Phillips, C., Hill, S., Marden, M., Bloomberg, M., & Moore, J. (2014). *New Forest Management Approaches to Steep Hills*. MPI Technical Paper No. 2014/39, prepared for the Ministry for Primary Industries, 109pp.

Apgar, J. M., Argumedo, A., & Allen, W. (2009). Building Transdisciplinarity for Managing Complexity: Lessons from Indigenous Practice. *International Journal of Interdisciplinary Social Sciences*, *4*(5), 255–270.

Ashton, A. (11 March 2023). Questions about the one-in-four forestry claim. *Gisborne Herald*. https://www.gisborneherald.co.nz/local-news/20230311/questions-about-one-in-four-claim/. Accessed 2 April 2023.

Awatere, S., Melia, N., Bodecker, G., & Lambie, S. (2023). *Brief to Mana Taiao Tairāwhiti to support with Tairāwhiti Land Use Inquiry*, 6pp.

Barnard, T., Velarde, S. J., Warmenhoven, T., Pohatu, P., Edwards, P., Dunningham, A. G., & Wreford, A. (2016, August). Restoring the health of the Waiapu catchment. Partnership with Māori. Integrating science and mātauranga Māori for a more sustainable future. *Rotorua Daily Post*, 11.

Basher, L., Harrison, D., Phillips, C., & Marden, M. (2015). What do we need for a risk management approach to steepland plantation forests in erodible terrain? *New Zealand Journal of Forestry*, *60*(2), 7–10.

Basher, L., Lynn, I. H., & Page, M. (2015). *Update of the Erosion Susceptibility Classification (ESC) for the proposed National Environmental Standard for Plantation Forestry—Revision of the ESC.* MPI Technical Paper No. 2015/13, prepared for the Ministry for Primary Industries, 151pp.

BDO Gisborne Limited. (2021). *Report on the Impact of Permanent Carbon Farming in Te Tairāwhiti Region*. Commissioned by Trust Tairāwhiti, 44pp. BDO Gisborne Limited.

Bendikson, H. (27 March 2023). Tackling slash: A biodiversity credits scheme for Tairāwhiti? *Business Desk*. https://businessdesk.co.nz/article/primary-sector/tackling-slash-a-biodiversity-credits-scheme-for-tairawhiti. Accessed 2 April 2023.

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*. Prepared for the Ministry for Environment, iv+76pp. Prepared by Blaschke and Rutherford Environmental Consultants. https://environment.govt.nz/publications/quantification-of-the-flood-and-erosion-reduction-benefits-and-costs-of-climate-change-mitigation-measures-in-new-zealand/

Bloomberg, M. (2015). Erosion susceptibility classification and analysis of erosion risks for plantation forestry—Response to Marden et al. *New Zealand Journal of Forestry*, *60*(2), 25–28.

Boothroyd, I. K. G., Quinn, J. M., Langer, E. R. (L), Costley, K. J., & Steward, G. (2004). Riparian buffers mitigate effects of pine plantation logging on New Zealand streams: 1. Riparian vegetation structure, stream geomorphology and periphyton. *Forest Ecology and Management*, *194*(1–3), 199–213. https://doi.org/10.1016/j.foreco.2004.02.018

Carr, R. – Chair, NZ Climate Change Commission. (November 2022). *Speaking at Ō Tātou Ngāhere Conference*. https://youtu.be/lFKAnw39GCg

Cave, M. (2021). *An assessment of Woody Material on Tikapa Beach after the July 2020 storm and potential sources within the Waiapu*, 58pp. Gisborne District Council.

Cave, M. (2022). *Downstream Impacts of sediment and woody debris Inundation in the Mangaheia sub-catchment Uawa Catchment during the Queens Birthday Storm 2018,* 34pp. Gisborne District Council.

Cave, M., Davies, N., & Langford, J. (2017). *Cyclone Cook Slash Investigation,* 106pp. Gisborne District Council. https://www.gdc.govt.nz/__data/assets/pdf_file/0013/10408/cyclone-cook-slash-investigation-2017-report.pdf

Cheever, F., & Campbell-Mohn, C. I. (2004). Principles of environmental law. In *Britannica (online)*. https://www.britannica.com/topic/environmental-law/Principles-of-environmental-law Accessed 2 April 2023.

Climate Change (Forestry) Regulations, SL 2022/266 § Schedule 4 - Default tables of carbon stock per hectare for post-1989 forest land (2022). https://www.legislation.govt.nz/regulation/public/2022/0266/latest/LMS709973.html

Coombes, B., Browne, M., Irwin, J., Hawcroft, A., Hosking, P., Quinn, R., & Newman, C. (2000). *Ecological impacts and planning history—An environmental history of the Turanganui-a-Kiwa casebook area*. Prepared for Crown Forestry Rental Trust, vii+519pp. Auckland UniServices Limited.

Di Girolami, E., Kampen, J., & Arts, B. (2023). Two systematic literature reviews of scientific research on the environmental impacts of forest certifications and community forest management at a global scale. *Forest Policy and Economics*, *146*, 102864. https://doi.org/10.1016/j.forpol.2022.102864

Easton, L. (2015). *Charges for Soil Conservation Resource Consents*. Report to Environmental Planning & Regulations Committee for Decision, No. 15/269, 5pp. Gisborne District Council.

Environmental Planning & Regulations Committee Meeting Minutes No. 9. (2015). Gisborne District Council.

Fischer, E. (December 2021). Pasture on the Pumice. *NZ Farm Life*. https://nzfarmlife.co.nz/pasture-on-the-pumice/ Accessed 02 April 2023.

Forecaster—Integral. (3 November 2020). https://integral.co.nz/forecaster/ Accessed 01 April 2023.

Fox, A. (28 February 2023). Forestry waste inquiry: Pine forests by far biggest source of East Coast beach slash after Cyclone Hale—Gisborne council study. *NZ Herald*. https://www.nzherald.co.nz/business/pine-forestry-by-far-biggest-source-of-east-coast-beach-slash-after-cyclone-hale-council-study/7BDH6Z325NCXJBMMMT6Y2K4GCU/ Accessed 31 March 2023.

Freeman, T. (2015). *National Environmental Standard for Plantation Forestry Submission*. Report to Environmental Planning & Regulations Committee for Decision, No. 15/227, 19pp. Gisborne District Council.

Gisborne District Council. (n.d.). *Te Arotakenga o te Mahere Whakahaere Rauemi o Te Tairāwhiti—Review of the Tairāwhiti Resource Management Plan*. Retrieved 29 March 2023, from https://gdc-web.squiz.cloud/council/review-of-tairawhiti-resource-management-plan

Gisborne District Council. (2015a). *Minutes of the Future Tairāwhiti Committee—16 July 2015* 7pp.

Gisborne District Council. (2015b). *Minutes of the Environmental Planning & Regulations Committee—9 September 2015* 8pp. https://www.gdc.govt.nz/__data/assets/pdf_file/0018/11538/minutes-environmental-planning-regulations-september-2015.pdf

Gisborne District Council. (2020). *Our Land & Soil—Tō Tātau Whenua, One Hoki*. State of the Environment report, 27pp. https://www.gdc.govt.nz/__data/assets/pdf_file/0026/9971/soe-report-2020-land-soil.pdf

Gisborne District Council. (2023a). *Harvesting Consents.* Excel spreadsheet of currently approved forestry consents supplied by GDC via LGOIMA request, 7 February 2023.

Gisborne District Council. (2023b). *Breach of RMA - Sentencing Decisions (Forestry companies 2018 prosecutions and 2018 forestry prosecutions reports)*. Last updated 31 March 2023. https://www.gdc.govt.nz/environment/reports-and-publications/breach-of-rma-sentencing-decisions#heading-0 Accessed 3 April 2023.

Giuntoli, J., Barredo, J. I., Avitabile, V., Camia, A., Cazzaniga, N. E., Grassi, G., Jasinevičius, G., Jonsson, R., Marelli, L., Robert, N., Agostini, A., & Mubareka, S. (2022). The quest for sustainable forest bioenergy: Win-win solutions for climate and biodiversity. *Renewable and Sustainable Energy Reviews*, *159*, 112180. https://doi.org/10.1016/j.rser.2022.112180

Green, M.O., Walker, J., & Nicol, S. (2021). *Steering our waka through turbid waters: Research priorities over the next 5 years for sediments in the coastal marine area of Aotearoa New Zealand.* Prepared for the Department of Conservation, 69pp. RMA Science.

Gresh, J. M., & Courter, J. R. (2021). In Pursuit of Ecological Forestry: Historical Barriers and Ecosystem Implications. *Frontiers in Forests and Global Change*, *4*(571438), 9.

Guild, D., & Dudfield, M. (2009). A history of fire in the forest and rural landscape in New Zealand. Part 1, pre-Māori and pre-European influences. *New Zealand Journal of Forestry*, *54*(1), 34–38.

Hall, D. (2023). *Brief to Mana Taiao Tairāwhiti to support with Tairāwhiti Land Use Inquiry*, 5pp.

Hancock, F. (8 August 2018). Govt measures weaken local forest rules. *Newsroom*. https://www.newsroom.co.nz/govt-officials-weakened-local-forest-rules. Accessed 2 April 2023.

Harmsworth, G. R., & Awatere, S. (2012). *Review and evaluation of cultural monitoring approaches in New Zealand*. Landcare Research Factsheet, 7pp.

https://www.landcareresearch.co.nz/assets/Discover-Our-Research/Environment/Sustainable-society-policy/VMO/Review_Cultural_Monitoring.pdf

Harmsworth, G. R., Awatere, S., & Pauling, C. (2013). *Using mātauranga Māori to inform freshwater management*. Policy Brief, 5pp. Landcare Research Manaaki Whenua.

Harmsworth, G. R., & Tipa, G. (2006). *Māori environmental monitoring in New Zealand: Progress, concepts, and future direction: Review and evaluation of cultural monitoring approaches in New Zealand.* Report for the Landcare Research ICM web site, 29pp.

Harmsworth, G. R., & Warmenhoven, T. (2002). *The Waiapu project: Maori community goals for enhancing ecosystem health*. Project description, 10pp. https://www.researchgate.net/publication/228693884_Harmsworth_G_Warmenhoven_T_2002_The_Waiapu_project_Maori_community_goals_for_enhancing_ecosystem_health_Broadsheet_New_Zealand_Association_of_Resource_Management_NZARM_11_p

Hendy, J., Ausseil, A.-G., Bain, I., Blanc, É., Fleming, D., Gibbs, J., Hall, A., Herzig, A., Kavanagh, P., Kerr, S., Leining, C., Leroy, L., Lou, E., Monge, J., Reisinger, A., Risk, J., Soliman, T., Stroombergen, A., Timar, L., van der Weerdan, T., White, D., Zammit, C. (2018). *Land-use modelling in New Zealand: Current practice and future needs*. Motu Working Paper No. 18–16, 64pp. Motu Economic and Public Policy Research. https://doi.org/10.29310/WP.2018.16

Hood, C. (2023). *Issues with the New Zealand Emissions Trading Scheme (ETS). Commissioned Report for Mana Taiao Tairāwhiti, as input to the Ministerial inquiry into Tairāwhiti/Gisborne and Wairoa land-use*, 6pp. Compass Consulting.

Hungerford, R. (2022). *Insights into Farmer Behaviour Responses to Emissions Pricing*. Prepared for He Waka Eke Noa Primary Sector Climate Action Partnership, 34pp. Momentum Research & Evaluation Ltd.

IPCC. (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. H.-O. Pörtner, D. C. Roberts, M. Tignor, E. S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, & B. Rama (Eds.), *Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, 3056pp. Cambridge University Press. doi:10.1017/9781009325844.

Journeaux, P., van Reenen, E., Manjala, T., Pike, S., Hanmore, I., & Millar, S. (2017). *Analysis of drivers and barriers to land use change*. Prepared for the Ministry for Primary Industries, 89pp. AgFirst Waikato Ltd.

Kenway, P. T. (1928). *Pioneering in Poverty Bay (N.Z.)* (1st edition). Hazel, Watson & Viney Ltd.; Accessed via NZ Electronic Text Collection, 1 April 2023. https://nzetc.victoria.ac.nz/tm/scholarly/tei-KenPion-t1-front-d5.html

Kimberley, M., Bergin, D., & Silvester, W. (2021). *Carbon Sequestration by Native Forest—Setting the Record Straight*. Prepared for Tāne's Tree Trust, 16pp. Pure Advantage.

King, D. N., Penny, G., & Severne, C. (2010). The climate change matrix facing Māori society. *In* R. A. C. Nottage, D. S. Wratt, J. F. Bornman, & K. Jones (Eds.), *Climate Change Adaptation in New Zealand: Future scenarios and some sectoral perspectives* (pp. 100–111). New Zealand Climate Change Centre.

Kohere, K. (2020). *Tairawhiti Resources Management Plan (TRMP)*. Report to Sustainable Tairāwhiti for Decision, No. 20–135, 78pp. Gisborne District Council.

Lambie, S., Awatere, S., Daigneault, A., Kirschbaum, M., Marden, M., Soliman, T., Spiekermann, R., & Walsh, P. (2021). Trade-offs between environmental and economic factors in conversion from exotic pine production to natural regeneration on erosion prone land. *New Zealand Journal of Forestry Science*, *51*(14), 19.

Larsen, J. B., & Nielsen, A. B. (2007). Nature-based forest management—Where are we going? *Forest Ecology and Management*, *238*(1–3), 107–117. https://doi.org/10.1016/j.foreco.2006.09.087

Macfie, R. (17 March 2023). Forestry waste inquiry: Workers fearful of fallout over cyclone slash probe. *NZ Herald*. https://www.nzherald.co.nz/business/forestry-waste-inquiry-workers-fearful-of-fallout/I3ZQ65BF6VDC3DG4NRKGEMRHOY/ Accessed 02 April 2023.

Marden, M. (1994). Value of environmental-impact monitoring to forest management under the Resource Management Act: Mangatu Forest. *New Zealand Journal of Forestry*, *39*(1), 39–41.

Marden, M. (2003, Winter). Gully erosion, the cancer of Waiapu catchment: 901 reasons to act now. *Tairawhiti Conservation Quorum*, *32*, 5–6.

Marden, M. (2004). Future-proofing erosion-prone hill country against soil degradation and loss during large storm events: Have past lessons been heeded? *New Zealand Journal of Forestry*, *49*(3), 11–16.

Marden, M. (2011). *Sedimentation History of Waipaoa Catchment—Envirolink project 1015-GSDC95*. Landcare Research Contract Report LC#790 prepared for Gisborne District Council, 46pp. Manaaki Whenua Landcare Research. https://envirolink.govt.nz/assets/Envirolink/1015-GSDC95-Sedimentation-history-of-Waipaoa-catchment.pdf

Marden, M., Basher, L., Phillips, C., & Black, R. (2015). Should detailed terrain stability or erosion susceptibility mapping be mandatory in erodible steep lands? *New Zealand Journal of Forestry*, *59*(4), 32–42.

Marden, M., Betts, H., Arnold, G., & Hambling, R. (2008). Gully erosion and sediment load: Waipaoa, Waiapu and Uawa rivers, eastern North Island, New Zealand. *Sediment Dynamics in Changing Environments*, *325*, 339–350. https://www.cabdirect.org/cabdirect/abstract/20093172816

Marden, M., Herzig, A., & Basher, L. (2014). Erosion process contribution to sediment yield before and after the establishment of exotic forest: Waipaoa catchment, New Zealand. *Geomorphology*, *226*, 162–174. https://doi.org/10.1016/j.geomorph.2014.08.007

Marden, M., Lambie, S., & Phillips, S. (2018). Biomass and root attributes of eight of New Zealand's most common indigenous evergreen conifer and broadleaved forest species during the first 5 years of establishment. *New Zealand Journal of Forestry Science*, *48*(9), 26. https://doi.org/10.1186/s40490-018-0113-y

Marden, M., & Seymour, A. (2022). Effectiveness of vegetative mitigation strategies in the restoration of fluvial and fluvio-mass movement gully complexes over 60 years, East Coast region, North Island, New Zealand. *New Zealand Journal of Forestry Science*, *52*(19), 23. https://doi.org/10.33494/nzjfs522022x226x

Menzies, D., & Paul, J. (2023). *Understanding Accountability for Māori*. Housing Inquiry Discussion Paper, 61pp. Te Kāhui Tika Tangata New Zealand Human Rights Commission. https://assets.nationbuilder.com/nzhrc/pages/3539/attachments/original/1675976196/Housing_Inquiry_-_Accountability_for_housing_in_te_ao_M%C4%81ori.pdf?1675976196

Miller, D. (2023). *A Submission to the Inquiry into Forestry Related Impacts of Cyclone Gabrielle*, 8pp.

Miner, R. (2010). *Impact of the global forest industry on atmospheric greenhouse gases.* Commissioned by the Food and Agriculture Organization of the United Nations FAO, Forestry Paper 159, 71pp. https://www.fao.org/3/i1580e/i1580e00.pdf

Ministry for Primary Industries NES-PF Submissions: NGOs and community groups N-Z. (n.d.). Retrieved 31 March, 2023, from https://www.mpi.govt.nz/consultations/proposed-national-environmental-standard-for-plantation-forestry/submissions/

Ministry for the Environment. (2008). *Climate Change Effects and Impacts Assessment: A Guidance Manual for Local Government in New Zealand* (2nd edition). Ministry for the Environment - Manatū Mō Te Taiao.

Minto, J., Leadbeater, M., Barry, A., & Hughes, E. (2005). *Roger Award 2004 for the worst Transnational Corporation operating in Aotearoa in 2004—Statement from the Judges*. 6pp.

MPI. (2021). *2021-2025 Strategic Intentions* (C.5 SI; p. 85). Ministry for Primary Industries - Manatū Ahu Matua.

MPI. (2023). *Hill Country Erosion Programme for councils*. Last updated 21 February 2023. https://www.mpi.govt.nz/forestry/funding-tree-planting-research/hill-country-erosion-programme/ Accessed 2 April 2023.

Muda, R. S. P. E. (2022). *An exploration of knowledge development, dissemination, and resource mobilisation within New Zealand's forestry innovation system*. MSc thesis, Massey University, 115pp. https://mro.massey.ac.nz/handle/10179/17697

Neilson, M. (7 June 2019). Ruatoria timber yard owner gives meth addict burglar a job and a second chance. *NZ Herald*. https://www.nzherald.co.nz/nz/ruatoria-timber-yard-owner-gives-meth-addict-burglar-a-job-and-a-second-chance/D7HPR2JWF4IQSZ6Y7HICVO7HLY/ Accessed 2 April 2023

Ngata, A. (1972). *Rauru-nui-a-Toi lectures and Ngati Kahungunu origins (typescript of lectures)*.

Nightingale, M. (12 February 2023). "It's disgusting": Family mourns death of "very loving" 11yo on beach. *NewstalkZB*. https://www.newstalkzb.co.nz/news/national/gisborne-beach-tragedy-victim-oliver-shone-was-just-playing-about-family-says/ Accessed 1 April 2023.

Nixon, C., & Peterson, R. (2015). *Plantation forestry economic analysis: A further revised assessment of proposed National Environmental Standards*. MPI Technical Paper No. 2015/14, prepared for the Ministry for Primary Industries, 60pp. NZIER - Harrison Grierson.

Office of Parliamentary Commissioner for the Environment - Te Kaitiaki Taiao. (1988). *Inquiry into flood mitigation measures following Cyclone Bola.* 59pp.

Page, M., Reid, L. M., & Lynn, I. H. (1999). Sediment production from Cyclone Bola landslides, Waipaoa catchment. *Journal of Hydrology (NZ)*, *38*(2), 289–308.

Page, M., Trustrum, N., & Gomez, B. (2000). Implications of a Century of Anthropogenic Erosion for Future Land Use in the Gisborne-East Coast Region of New Zealand. *New Zealand Geographer*, *56*(2), 13–24. https://doi.org/10.1111/j.1745-7939.2000.tb01571.x

Parkner, T., Page, M., Marden, M., & Marutani, T. (2007). Gully systems under undisturbed indigenous forest, East Coast Region, New Zealand. *Geomorphology*, *84*(3–4), 241–253. https://doi.org/10.1016/j.geomorph.2006.01.042

Payn, T., Phillips, C., Basher, L., Baillie, B., Garrett, L., Harrison, D., Heaphy, M., & Marden, M. (2015). Improving management of post-harvest risks in steepland plantations. *New Zealand Journal of Forestry*, *60*(2), 3–6.

Phillips, C., Basher, L., & Marden, M. (2016). *Research and monitoring advice on environmental impacts of forestry in the Gisborne-East Coast Region*. Landcare Research Contract Report LC2466 prepared for Gisborne District Council, 30pp. Manaaki Whenua Landcare Research. https://www.gdc.govt.nz/__data/assets/pdf_file/0015/13542/research-and-monitoring-advice-on-environmental-impacts-of-forestryreport-landcare-research.pdf

Phillips, C. J., & Watson, A. J. (1994). *Structural Tree Root Research in New Zealand: A Review*. Landcare Research Science Series No. 7, 71pp. Manaaki Whenua Landcare Research.

Phillips, C., Marden, M., & Basher, L. R. (2018). Geomorphology and forest management in New Zealand's erodible steeplands: An overview. *Geomorphology*, *307*, 107–121. https://doi.org/10.1016/j.geomorph.2017.07.031

Pierce, J. (2022). Forests: A Socio-Ecological Perspective. *Journal of the Commonwealth Human Ecology Council*, *32*, 25–35.

Pohatu, P., O'Brien, S., Mercer, L., & Motu Economic and Public Policy Research. (2020). *Challenges and opportunities with native forestry on Māori land*. Motu Working Paper, 33pp. Motu Economic and Public Policy Research. https://doi.org/10.29310/WP.2020.13

Pörtner, H.O., Scholes, R.J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., Chan, L., Cheung, W.L., Diamond, S., Donatti, C., Duarte, C., Eisenhauer, N., Foden, W., Gasalla, M. A., Handa, C., Hickler, T., Hoegh-Guldberg, O., Ichii, K., Jacob, U., Insarov, G., Kiessling, W., Leadley, P., Leemans, R., Levin, L., Lim, M., Maharaj, S., Managi, S., Marquet, P. A., McElwee, P., Midgley, G., Oberdorff, T., Obura, D., Osman, E., Pandit, R., Pascual, U., Pires, A. P. F., Popp, A., Reyes-García, V., Sankaran, M., Settele, J., Shin, Y. J., Sintayehu, D. W., Smith, P., Steiner, N., Strassburg, B., Sukumar, R., Trisos, C., Val,

A.L., Wu, J., Aldrian, E., Parmesan, C., Pichs-Madruga, R., Roberts, D.C., Rogers, A.D., Díaz, S., Fischer, M., Hashimoto, S., Lavorel, S., Wu, N., Ngo, H.T. (2021). *Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change* (p. 252). IPBES secretariat, Bonn, Germany. doi: 10.5281/zenodo.4659158.

Potter, D. (2023). *Wai 2607, #1.1.1(c) Third amended statement of claim. 'A claim by David Potter that the Crown is acting in breach of Treaty of Waitangi obligations towards Maori as a result of the New Zealand Government failing to implement adequate policies to address the threats posed by global climate change.'* 37pp. Ministry of Justice.

Quinn, J. M., Boothroyd, I. K. G., & Smith, B. J. (2004). Riparian buffers mitigate effects of pine plantation logging on New Zealand streams: 2. Invertebrate communities. *Forest Ecology and Management*, *191*(1–3), 129–146. https://doi.org/10.1016/j.foreco.2003.11.013

Reid, L. M., & Page, M. J. (2003). Magnitude and frequency of landsliding in a large New Zealand catchment. *Geomorphology*, *49*(1–2), 71–88. https://doi.org/10.1016/S0169-555X(02)00164-2

Roche, M. (2015). (Re) interpreting exotic plantation forestry in 1920s New Zealand. *International Review of Environmental History*, *1*, 147–172. https://doi.org/10.22459/IREH.01.2015.

Rowe, D. K., Smith, J., Quinn, J., & Boothroyd, I. (2002). Effects of logging with and without riparian strips on fish species abundance, mean size, and the structure of native fish assemblages in Coromandel, New Zealand, streams. *New Zealand Journal of Marine and Freshwater Research*, *36*(1), 67–79. https://doi.org/10.1080/00288330.2002.9517071

Ryan, P. A. (1991). Environmental effects of sediment on New Zealand streams: A review. *New Zealand Journal of Marine and Freshwater Research*, *25*(2), 207–221. https://doi.org/10.1080/00288330.1991.9516472

Salmond, A. (13 October 2022). Dame Anne Salmond: Seeing the wood for the trees. *Newsroom*. https://www.newsroom.co.nz/ideasroom/dame-anne-salmond-seeing-the-wood-from-the-trees. Accessed 2 April 2023.

Scion. (February 2023). New approach to predict growth of forestry tree species. *Scion Connections*, *42*, 54–55.

Sheppard, J. P., Chamberlain, J., Agúndez, D., Bhattacharya, P., Chirwa, P. W., Gontcharov, A., Sagona, W. C. J., Shen, H., Tadesse, W., & Mutke, S. (2020). Sustainable Forest Management Beyond the Timber-Oriented Status Quo: Transitioning to Co-production of Timber and Non-wood Forest Products—a Global Perspective. *Current Forestry Reports*, *6*(1), 26–40. https://doi.org/10.1007/s40725-019-00107-1

Spiekermann, R., & Marden, M. (2018). *Best options for land use following radiata harvest in the Gisborne district under climate change: Spatial analysis of erosion susceptibility in plantation forests, East Coast Region.* MPI Technical Paper No. 2018/47, 43pp. https://www.mpi.govt.nz/dmsdocument/30447-best-options-for-land-use-following-radiata-harvest-in-the-gisborne-district-under-climate-change-spatial-analysis-of-erosion-susceptibility-in-plantation-forests-east-coast-region

Swan, N., & Lampitt, A. (2023). *Summary of NZ Director duties to manage nature-related risk and impact on natural capital—Legal Opinion 2023*. Prepared for the Aotearoa Circle, 1p. Chapman Tripp. https://static1.squarespace.com/static/62439881aa935837b9ad6ac9/t/642266d35f7c0f70322ff460/1679976147834/TAC_Biodiversitylegalopinion_summary.pdf

Tait-Jamieson, W. (2023). *NES - Plantation Forestry: Development and workability analysis to support Mana Taiao Tairāwhiti submission to the Ministerial Inquiry into Land Use*. 28pp. Jamieson Consulting.

Taylor, G. (8 September 2022). Forestry needs an urgent reset. *Newsroom*. https://www.newsroom.co.nz/forestry-needs-an-urgent-reset Accessed 1 April 2023.

Te Uru Rākau. (2021). *Report on the Year One Review of the National Environmental Standards for Plantation Forestry*, 69pp. Te Uru Rākau - Forestry New Zealand.

The FSC Forest Stewardship Standard for New Zealand (2023). FSC-STD-NZL-02-2023 Plantations EN, 115pp. Forest Stewardship Council.

The Royal Society. (2021). *Climate change and biodiversity—Interlinkages and policy options*. 14pp.

Thorrold, B. S. (2010). The future landscape of New Zealand agriculture. *Proceedings of the New Zealand Grassland Association*, *72*, LXIII–LXV. https://doi.org/10.33584/jnzg.2010.72.2803

Timar, L. (2022). *Modelling private land-use decisions affecting forest cover: The effect of land tenure and environmental policy*. Motu Working Paper No. 22–12, 44pp. Motu Economic and Public Policy Research. https://www.motu.nz/our-research/environment-and-resources/emission-mitigation/emissions-trading/modelling-private-land-use-decisions-affecting-forest/

Tran, D. X., Pearson, D., Palmer, A., Dominati, E. J., Gray, D., & Lowry, J. (2023). Integrating ecosystem services with geodesign to create multifunctional agricultural landscapes: A case study of a New Zealand hill country farm. *Ecological Indicators*, *146*, 109762. https://doi.org/10.1016/j.ecolind.2022.109762

Velarde, S. J., Sharma-Wallace, L., Warmenhoven, T., Pohatu, P., Edwards, P., & Barnard, T. (2019). Policy design lessons from the Erosion Control Funding Programme—Afforestation through an adaptive governance lens. *New Zealand Journal of Forestry*, *64*(1), 11–16.

Wai 2607, #1.1.1 In the Matter of The Treaty of Waitangi Act 1975 and in the Matter of a claim by Cletus Maanu Paul, David Potter and Andre Paterson on behalf of the Mataatua District Maori Council that the Crown is acting in breach of Treaty of Waitangi obligations towards Maori as a result of the New Zealand Government failing to implement adequate policies to address the threats posed by global climate change. (2016). Statement of Claim, 25pp. Ministry of Justice.

Wairakei Estate webpage. (n.d.). Retrieved 3 April 2023, from https://www.wairakeiestate.nz/

Wangui, J. C., Kenyon, P. R., Tozer, P. R., Millner, J. P., & Pain, S. J. (2021). Bioeconomic Modelling to Assess the Impacts of Using Native Shrubs on the Marginal Portions of

the Sheep and Beef Hill Country Farms in New Zealand. *Agriculture*, *11*(10), 1019. https://doi.org/10.3390/agriculture11101019

Warmenhoven, T., Barnard, T., Pohatu, P., Garrett, L., Porou, T., Fitzgerald, G., Harrison, D., Barry, L., & Ruru, W. (2014). *Climate Change and Community Resilience in the Waiapu Catchment*. MPI Technical Paper No. 2014/25, prepared for the Ministry for Primary Industries, 76pp.

Watson, A., Phillips, C., & Marden, M. (1999). Root strength, growth, and rates of decay: Root reinforcement changes of two tree species and their contribution to slope stability. *Plant and Soil*, *217*(1), 39–47. https://doi.org/10.1023/A:1004682509514

West, T. A. P., Monge, J. J., Dowling, L. J., Wakelin, S. J., Yao, R. T., Dunningham, A. G., & Payn, T. (2020). Comparison of spatial modelling frameworks for the identification of future afforestation in New Zealand. *Landscape and Urban Planning*, *198*, 103780. https://doi.org/10.1016/j.landurbplan.2020.103780

Wilson, T. P. (2022). *The identification of unproductive hill country for planting carbon farmed vegetation and the economics of doing so*. MSc thesis, Massey University, 112pp. https://mro.massey.ac.nz/handle/10179/17675

Woolley, J.-M., Eager, C., Jozaei, J., Paul, V., Paulik, R., Pearce, P., Sood, A., Stuart, S., Vincent, A., Wadhwa, S., & Zammit, C. (2020). *Climate change projections and impacts for Tairāwhiti and Hawke's Bay*. Hawke's Bay Regional Council Publication Number: 5531, prepared for Envirolink, Gisborne District Council and Hawke's Bay Regional Council, 247pp. NIWA.

Yao, R., Palmer, D., Hock, B., Harrison, D., Payn, T., & Monge, J. (2019). Forest Investment Framework as a Support Tool for the Sustainable Management of Planted Forests. *Sustainability*, *11*(12), 3477. https://doi.org/10.3390/su11123477