Chapter

Drivers and New Opportunities for Woody Vegetation Use in Erosion Management in Pastoral Hill Country in New Zealand

Ian McIvor, Thomas Mackay-Smith and Raphael Spiekermann

Abstract

Increases in the magnitude and frequency of rainfall events in New Zealand due to climate change, coupled with existing concerns about sediment and nutrient contamination of waterways, are changing policy and practice around erosion management and land use. We describe the challenges around slope erosion reduction, cover current legislation and management practices, illustrate how modeling can inform erosion management and describe new opportunities, whereby native species can become a new active management tool for erosion control. Passive erosion management depending on natural revegetation by slow growing woody species is used on land retired from grazing but is much less effective than active erosion management in reducing shallow slope erosion. Active erosion management using exotic fast-growing poplar and willow trees strategically placed on hillslopes is effective in reducing erosion, but these trees can be hard to establish on drier upper slopes. An endemic woody tree, Kanuka, grows on drier slopes and is being tested as an erosion control tool. Kanuka seedlings have been successfully established on pastoral slopes, including drier slopes. A spatial decision support tool developed to identify pastoral hillslopes at high risk of erosion has improved decision-making when positioning appropriate trees on these slopes.

Keywords: erosion management, landslide susceptibility, poplar, native vegetation, kānuka

1. Introduction

Following arrival by European settlers in the 1800s, extensive deforestation for pastoral farming resulted in a geomorphic landscape response consisting of high erosion and sedimentation rates [1–5]. Increased erosion rates have led to a variety of adverse consequences, including i) reduced land productivity, ecosystem services, and food security through loss of productive soil; ii) increased damage to infrastructure; iii) adverse impacts on water quality and aquatic ecosystems from increased sediment delivery to streams; and iv) negative impacts for cultural values related to soil and aquatic environments [6–13]. Erosion processes in New Zealand remain very active [14], due to a predisposed natural environment with steep slopes, weak sedimentary rocks, and a climate featuring high annual rainfall and relatively frequent high magnitude rainfall events [15–17]. Climate change is predicted to result in large increases in sediment loads, primarily due to increasing storm magnitude-frequency of mass movement erosion in soft-rock hill country [18].

Mass movement processes are geographically the most widespread type of erosion in New Zealand [15]. The most common types of mass movement in New Zealand are shallow, rapid slides and flows involving soil and regolith [1, 19]. Such landslides are generally triggered either by high-intensity-rainfall events or by small rainfall events on top of saturated soil moisture conditions [18]. Shallow landslides make up the largest source of sediment from pastoral hill country in New Zealand [20]. In these steep and highly dissected pastoral landscapes, bioengineering—either through widely spaced trees, blanket afforestation, or through natural reversion to indigenous forest—has been the most common method to increase slope stability and reduce soil erosion [21–23]. Tree roots are more effective than pasture roots in binding soil and preventing shallow landslides in pastoral landscapes [21].

Sheep and beef production depends on hill country for the supply of breeding stock as well as prime animals for meat processing. Wool has been a significant commodity product of hill country farms in the past and may well regain importance in future. Converting native forest to farmland was seen as a necessary activity to provide livelihoods for new immigrants and generate national wealth from the supply of essential export products, wool, and meat. The conversion happened quickly without an awareness of the inherent instability of the slopes and their vulnerability to landslides when the soil becomes saturated.

Hill country landscapes in scope for this chapter include those low altitude lands (<1000 m a.s.l.) that feature rolling and steep slopes (>15°), are not regularly cultivated on a large scale, are dominated by diverse pasture systems (but may include various woody vegetation components), and are managed for mixed livestock operations (mainly sheep, cattle, and deer) [24]. The area covered by this loose definition is about 5.2 million ha [25] or approximately 20% of New Zealand. Most of these landscapes have been developed into productive pastures from indigenous broadleaf-podocarp forest over the last century, but in many cases, the prevailing vegetation has seen cycles of reversion to scrub, or establishment of plantation forestry as the economic and social drivers have shifted over decadal scales [23]. While active measures to reduce soil erosion in pastoral hill country have been undertaken at central and local government level, the land remains in private ownership, and as such, erosion management is dependent on individual landowners carrying out erosion control measures to stabilize their pastoral slopes.

The key contaminants for hill land waterways are sediment, P, N, and fecal microorganisms. Sediment loss from large-scale erosion events, in terms of both the immediate and ongoing quantities of soil loss, is the biggest environmental management issue for hill country [23]. Phosphorus is included ahead of N as most surface waters in New Zealand are more P-limited than N-limited [26], and total P losses in hill environments are strongly linked to sediment [27]. In general, relative to waterways in forested catchments waterways draining pastoral-dominant catchments have greater water yields, peak flows, nutrient concentrations, suspended sediment concentrations, and fecal coliform concentrations [28].

2. Drivers for erosion management in pastoral hill country

2.1 Water quality

In common with the rest of the world, New Zealand rates water quality of its natural waterways with high priority. Both P and N are considered contaminants of natural waterways, and enrichment does generate eutrophication conditions particularly during periods of low flow. Likewise, sediment sourced from land is detrimental to aquatic life, reducing clarity and contributing P.

2.2 Soil loss

Soil fertility is largely held within the topsoil. Recovery of soil fertility once topsoil is removed from pastoral slopes in shallow landslides is a very slow process [29] and has serious consequences for soil health, pasture growth, carbon storage, and rural livelihoods.

2.3 Asset protection

Shallow landslides can be very damaging to pasture, farm tracks, drainage channels, fences, and possibly buildings. Stock losses may also occur, though the financial costs are much higher for infrastructure. Public assets such as roadways, bridges, and communication infrastructure are also threatened by severe slope erosion. Our warming climate has increased the risk of tropical weather systems reaching New Zealand. Cyclone Gabrielle devastated parts of northern and eastern North Island in February 2023, transferring large volumes of silt and water from hills to valley floors, destroying homes and livelihoods, and severely disrupting infrastructure. It was preceded by a tropical rainstorm just two weeks prior and saturated soils from an unusually wet spring and summer.

2.4 Carbon credits

New Zealand operates an Emission Trading Scheme (ETS), whereby landowners can gain tradeable carbon credits by planting trees in their landscape to sequester carbon. The requirements (30% canopy cover, tree species height at maturity >5 m, treed area at least 1 hectare, mean width at least 30 m across) (https://www.mpi.govt.nz/forestry/forestry-in-the-emissions-trading-scheme/) provide sufficient tree densities to both gain credits and be effective in preventing shallow landslides.

2.5 Societal sensibility

There is a strong social stigma associated with any action or inaction that damages the natural environment. Rural landowners are held responsible for environmental damage from soil erosion and waterway contamination, and this is a significant driver for erosion management. Many community groups supported by government bodies are planting public areas such as streambanks with native woody vegetation, and rural landowners are being challenged to demonstrate the same environmental awareness.

3. Current approaches to erosion management in pastoral hill country

3.1 Government legislation requirements for erosion management

The Water and Soil Conservation act of 1941 mandated statutory bodies to manage erosion control and flood management. However, under this Act, landowner response to erosion control was largely voluntary.

The Resource Management Act 1991 (RMA) is now the main piece of legislation that sets out how New Zealand should manage its environment. The RMA is based on the idea of the sustainable management of resources and encourages communities and individuals to actively engage in environmental protection.

More recently, the 2020 National Policy Statement for Freshwater Management (NPS-FM) has required regional authorities to manage freshwater in a way that considers the effects of land use, including the effects on receiving estuarine environments (New Zealand Government, 2020). Moreover, Freshwater Farm Plans (FFP) have been established as a legal instrument under the RMA to identify environmental actions on farms in consideration of objectives for the catchment. The Act specifies that an FFP must "*identify any adverse effects of activities carried out on the farm on freshwater and freshwater ecosystems*" and "*specify requirements that (i) are appropriate for the purpose of avoiding, remedying, or mitigating the adverse effects of those activities on freshwater and freshwater ecosystems; and (ii) are clear and measurable*" (Section 217F, RMA). Therefore, understanding the impact of erosion and sediment control is important to achieve the desired environmental outcomes and—more specifically—sediment standards."

The Resource Management Act 1991 and National Policy Statement for Freshwater Management 2020 both require and assist landowners to carry out erosion control and freshwater quality measures on their properties using farm plans and on farm advice and through the provision of woody vegetation planting materials (poplar and willow poles, native plant seedlings) and financial assistance for plant protection.

3.2 Passive erosion management

Financial incentives (e.g., fencing) may be provided to retire steep land with low productivity and high erosion vulnerability [30] from active grazing and allow natural regeneration of woody native vegetation. Native forested catchments have been shown to generate lower soil erosion loads to rivers compared to pasture catchments [31–33]. Quinn and Stroud [33] reported suspended sediment loads of 988 kg ha^{-1} yr.$^{-1}$ in a pasture catchment and 320 kg ha^{-1} yr.$^{-1}$ in a native forest catchment. Furthermore, when compared suspended sediment in a pastoral catchment (180 ha) and native forested catchment (10 ha) on similar topographies and soil types ~8 km apart, Bargh [31, 32] measured loads of 1400 kg ha^{-1} yr.$^{-1}$ in the pastoral catchment and 120 kg ha^{-1} yr.$^{-1}$ in the forested catchment.

Native vegetation regeneration is likely to be a slow, incremental process and of itself leaves the slope no less vulnerable to erosion until any establishing woody vegetation with appropriate root systems can stabilize the slope. In a study on Oashore Station (farm property), Banks Peninsula, 3.3% of the retired area showed observable increase in natural revegetation between 2003 and 2016 despite the property being managed to support natural regeneration [34]. Significant factors influencing natural regeneration were the distance to existing woody vegetation ($p < 0.01$), woody vegetation within 25 m ($p = 0.008$), and years without cattle ($p < 0.01$) with other nonsignificant factors being topographical wetness, years without sheep, solar radiation, slope, elevation, and aspect [34]. These findings are consistent with studies on natural woody regeneration in tropical regions of Brazil where tree cover was found to increase by 0.3–0.4% per year (e.g., [35]).

Passive regeneration, while being slow and incremental, goes some way to satisfying societal aspiration to reduce soil erosion, increase ecosystem biodiversity, improve water quality, and restore parts of the rural landscape to primeval native forest with its incumbent birdlife. For instance, it is estimated that landslides reduced by 65% in hill country with 10-year-old regenerating scrub (mānuka (*Leptospermum scoparium* and kānuka (*Kunzea* spp.)) compared to open pasture, and there was an estimated 90% reduction in landslides for 20–year-old scrub [36]. However, to achieve this protection, scrub density was 20,000 tree ha^{-1} at age 10 years and estimated at 10,000 tree ha^{-1} at age 20 years [36], reducing grazing pasture considerably. In the meantime, the pastoral slope may be invaded by woody exotic species such as barberry (*Berberis* spp.) or gorse (*Ulex europaeus*), which colonize much more readily but which may improve conditions for establishment of native species. Because of small size and slow growth of the woody vegetation, passive natural regeneration is unlikely to generate income from carbon credits under the ETS.

Research is needed across all climatic zones on rates of passive regeneration, and ways to blend passive and active approaches in erosion management.

3.3 Active erosion management

The objective of active erosion management is to target potential sediment source areas with tree planting to increase slope stability and thereby prevent landslide initiation and deposition of debris into adjacent streams. Active erosion management operates at a policy level (e.g., local authorities offering financial assistance to counter erosion, particularly slope erosion, and promoting/producing environmental farm plans as a tool to guide landowners in identifying areas where management activities can effectively reduce erosion) and at an operational level (e.g., providing advice, providing woody plant materials, placing and planting woody plant material, assessing success of planting projects, forming catchment groups of landowners).

3.3.1 How modeling landslide susceptibility informs active erosion management

The policy and operational level represent different scales at which erosion mitigation is planned and implemented. At both levels, the aim is to design and implement cost-effective, targeted erosion control measures to conserve soil and meet water quality targets. Spatial modeling can help make the connection between catchment erosion sources, sediment loads in rivers, and sediment-related water quality. In particular, statistical landslide susceptibility models based on empirical observations of previous landslides (landslide inventories) can help determine where landsliding can be expected in future heavy rainfall events [37, 38]. Statistical models assume that locations with similar physical characteristics to where past failures have occurred are also likely to fail in future. This assumption is tested through validation of models by training in one area and testing in another or by splitting the landslide inventory into train and test sets. By coupling landslide susceptibility models (probability of future landslide occurrence) and sediment connectivity models (probability of sediment-delivery to adjacent streams), potential source areas of landslide-derived sediment can be identified and targeted [39]. The importance of targeted approaches to erosion control was demonstrated by Spiekermann et al. [39] who found a 10-fold increase in cost-effectiveness of targeted mitigation of landslide-derived sediment compared to a non-targeted (random) approach.

Scale considerations are important at different levels of erosion management (policy and operational). Models that use national data inputs are of greater utility at catchment to regional scales in determining where the problem areas are within a particular catchment (**Figure 1**) [37]. Increased spatial refinement of models (e.g., including data on individual trees) can support planning at farm to slope scale by identifying specific locations on a farm that are prone to landslide erosion and/or potential sources of sediment [38].

Following careful erosion mitigation planning, the key activity is planting of woody vegetation within the pastured area, usually on slopes where erosion events are expected to occur in future. Other operational activities exist to support the key activity. Choice of planting material is determined by its compatibility with future use of the land, whether continued pastoral farming or retirement.

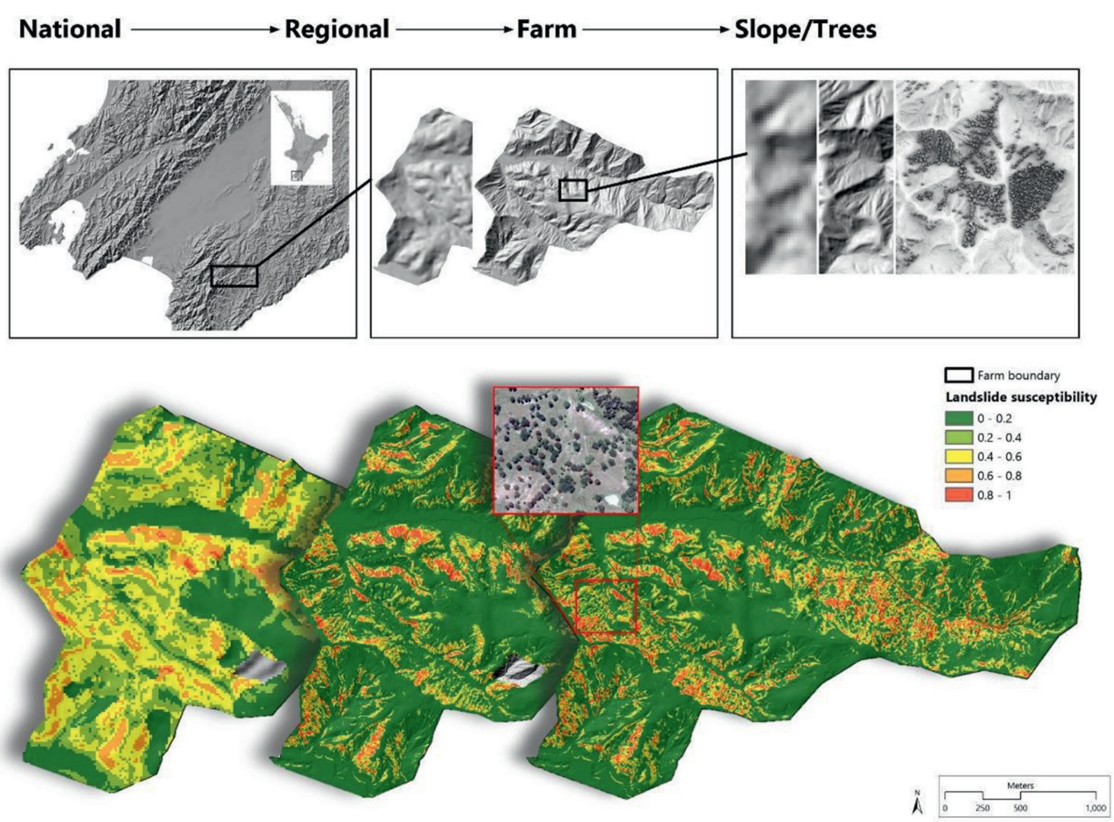

Figure 1.
Scale considerations: Different data products available at different scales can serve different purposes to support decision-making for erosion and sediment mitigation. Shown above are shaded relief maps of digital elevation models (DEMs) at different scales: From left to right: 15-m (based on topographic contour lines), LiDAR-based 5-m and 1-m ground-sampling-distance (GSD). Below are landslide susceptibility models using topographic variables derived from the differently scaled DEMs (15 m, 5 m, 1 m) shown above. The 15 m and 5 m DEM-based models using the land cover database of New Zealand (LCDB) are based on Smith et al. [37], the 1 m model using individual trees based on Spiekermann et al. [38]. Other issues determined by the scale of data used for modeling include its impact on the accuracy/performance of models, as well as requirements of computing power.

3.3.1.1 Spatial decision support for targeted erosion mitigation

3.3.2 Spaced planting of poplar and willow

Poplars and willows have been the species of choice within pastoral systems since the early days of active erosion management. They are planted as 3 m vegetative stem poles in winter when soil moisture is high, and at distances of 8–15 m apart, with the closer spacings applied particularly in gullies with high erosion risk. Each pole is planted in such a way as to capture surface runoff, avoid stock paths, and promote root development (https://www.horizons.govt.nz/HRC/media/Media/Land/Growing-poplars-info-sheet-2014.pdf). The pole is protected from any browsing activity by sheep but vulnerable to browsing by larger animals. For this reason, it is recommended that cattle be excluded from planted areas for two years. Survival rates for poles are >90% in good years, and annual height growth from poles can be 2–3 m (**Figures 2** and **3**). The practice has limitations in that higher positions on the slope are more difficult for poplars to establish because of shallow soil depth, low soil moisture, greater exposure to wind, or little topsoil resulting from a previous erosion event.

Mature poplars and willows planted at low densities (<70 tree ha^{-1}) reduced landslide occurrence in pastoral hill country by 95% [21] compared with pasture-only protection.

3.3.3 Change of land use to commercial forestry

Whole farm conversion from traditional pastoral farming in hill country to either production forestry or carbon forestry has accelerated in New Zealand since 2011 (https://www.rnz.co.nz/news/country/473898/overseas-firms-buy-more-sheep-beef-farms-for-forestry-conversion), prompting a change in regulations for foreign investors. The primary forestry species that is planted is radiata pine (*Pinus radiata*).

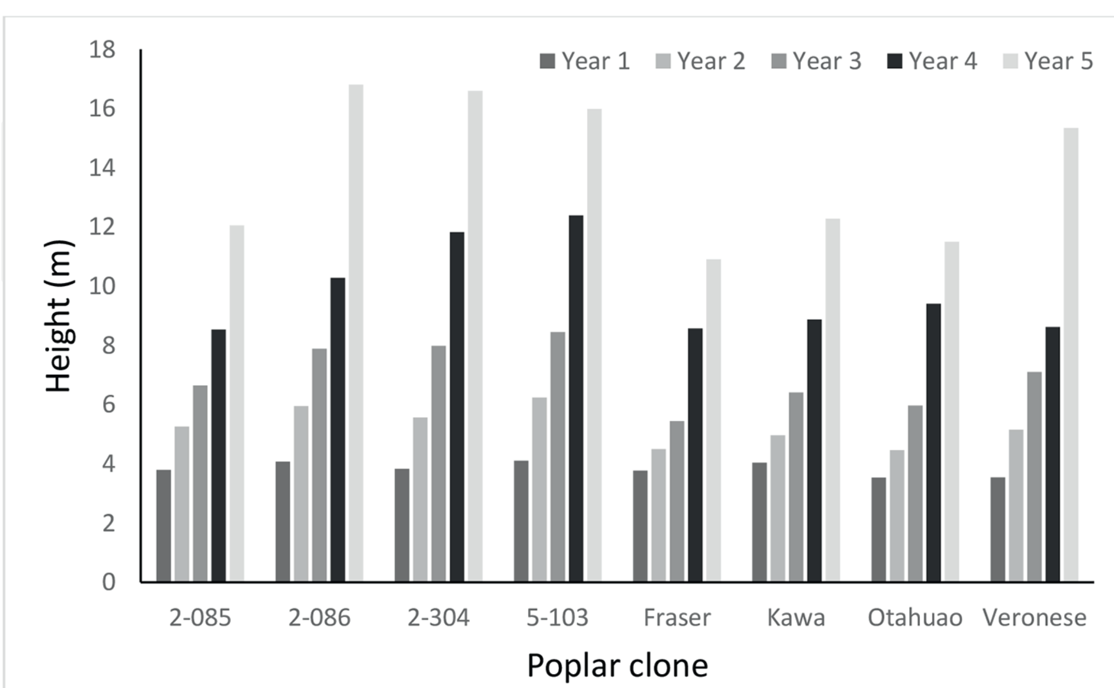

Figure 2.
Mean height (m) in the first five years of poplar clones growing on a pastoral hill slope.

Figure 3.
Mixed clone poplars at age five years and planted as 3 m poles.

Carbon forests are expected to be profitable within the carbon market, without the market uncertainties associated with pastoral farming and without the risks of slope erosion associated with harvesting. Since this trend is recent, there is much debate about the future consequences of establishing permanent forests of fast-growing pine trees on valuable pastoral land. Furthermore, there are concerns with the downstream effects of 'slash' (the woody material left behind after the trees are harvested) after storm events, which is deposited in rivers and beaches (https://environment.govt.nz/what-government-is-doing/areas-of-work/land/ministerial-inquiry-into-land-use). Close planted forests have been shown to be more effective than space-planted poplars or willows in reducing slope erosion, moderating runoff, and improving water quality [15]. An alternative approach promoted by New Zealand Farm Forestry Association is to plant slopes vulnerable to erosion with close-planted timber tree species while retaining gentler slopes and less erosion-prone land for pastoral farming.

3.3.4 Planting native vegetation

Another option that is used less frequently than commercial forestry is planting high density (> 1000 tree ha^{-1}) stands of native vegetation. Instead of natural regeneration, mānuka is intentionally planted, providing an alternative opportunity for income from either honey or essential oil production [40]. Climax forest species can also be planted, but this is expensive, costing ~NZD$10,000 per ha compared to ~NZD$1650 per ha for establishing radiata pine [41]. A cheaper alternative to both these options is letting the land regenerate passively, as discussed in Section 3.2.

4. A novel approach of space planting with native woody vegetation

Native vegetation already grows on many parts of grazed hill country [42], having established naturally via seeds, and provides a valuable slope stabilization role (**Figure 4**). Native trees are typically not planted in space-planted systems in hill country. One likely reason for native trees not being regularly planted in space-planted systems is the difficulty of planting and protecting native seedlings in the presence of livestock. Despite this, there has been a growing interest in using natives in hill country silvopastoral systems [43, 44], although there still remains a paucity of methodology on establishing native trees in space-planted systems in hill country. Considering this, an establishment trial was undertaken to learn whether it is possible to protect and grow kānuka seedlings in the presence of livestock, with kānuka being one of the most common natives already growing in hill country [42]. This research is ongoing, but this chapter presents preliminary results from this trial.

Figure 4.
Mature kãnuka trees growing in hill country (top left), spaced kãnuka seedlings on erosion-prone N slope at Gladstone (top right), a kãnuka seedling enclosed in its protector (bottom left), and a kãnuka seedling a t0 (bottom right).

4.1 Case study establishing space-planted kanuka on pastoral land

In July 2021, 30 kānuka seedlings (*Kunzea ericoides*) were planted on two aspects (North and South) on three hill country pastoral farms with contrasting rainfall (**Table 1**). Seedlings were grown in root trainer pots and at planting were on average 52 cm tall (minimum: 29 cm; maximum: 69 cm). The seedlings were protected using a plastic mesh tube and supported by two steel Y-posts and a steel rebar (**Figure 4**). Weather stations were installed on both aspects at each farm to measure rainfall. The weather station rain sensors at the Gladstone sites malfunctioned on both aspects, so rainfall data for this farm was used from a local weather station. Livestock (sheep, cattle) were continuously grazing at all sites. There have been three measurements so far on the trees (**Table 1**), although the third measurement (t3) was not undertaken at Ahuriri because a recent storm event (Cyclone Gabrielle) had made the site inaccessible. Any seedling deaths between the planting date and measurement 1 (t1) were likely related to root desiccation following planting.

Rainfall at the Ahuriri north and south slopes was 1447 and 1417 mm in 2022, respectively, and it was 1807 and 1828 mm at Taumarunui north and south, respectively. The rainfall at the Gladstone site was 1230 mm in 2022. The mean heights at t1, t2, and t3 for all the seedlings over all the sites were 62.7, 93.3, and 153.1 cm, respectively (**Figure 5**). This represented an average growth of 9.9, 40.8, and 100 cm at t1, t2, and t3, respectively. Seedling survival was varied. At t3, 70% of the seedlings survived at Gladstone north, 90% survived at Gladstone south, 96.4% survived at Taumarunui north, and 93.3% at Taumarunui south. At t2, 83.3% of the seedlings survived at Ahuriri north and 72.0% survived at Ahuriri south. There were 0% shock deaths at Taumarunui, 8.3% at Gladstone, and 21.8% at Ahuriri. Livestock damaged the protectors of 0% of the seedlings at Gladstone, 8.3% at Ahuriri, and 4.8% at Taumarunui.

It is likely that the higher rainfall at Taumarunui resulted in the higher growth rate of kānuka at this farm at t3 compared to Gladstone. Kānuka growth was higher on

Site	Location	Elevation (masl)	Average rainfall (mm, 2002–2022)	Planting date	Measure1 (t1)	Measure 2 (t2)	Measure 3 (t3)
Gladstone north	175.74° E, 41.05° S	300	898	27/07/21	04/01/22	11/10/22	21/02/23
Gladstone south	175.74° E, 41.05° S	300	898	27/07/21	04/01/22	11/10/22	21/02/23
Ahuriri north	176.791° E, 39.479° S	48	817	22/07/21	18/12/21	13/09/22	n/a
Ahuriri south	176.779° E, 39.475° S	116	817	22/07/21	18/12/21	13/09/22	n/a
Taumarunui north	175.281° E, 38.904	333	1773	13/07/21	21/12/21	04/07/22	21/03/23
Taumarunui south	175.281 E, 38.897 S	328	1773)	13/07/21	21/12/21	04/07/22	21/03/23

Table 1.
Site information, planting and measurement dates for the kānuka establishment trial.

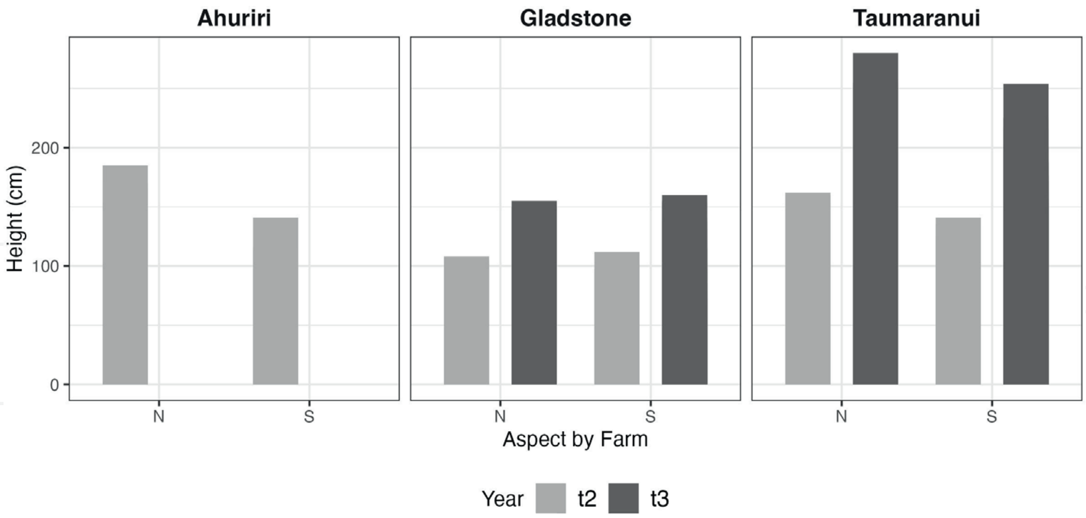

Figure 5.
Kānuka heights after measurements t2 and t3 for each aspect (north and south) and the three farms (Ahuriri, Gladstone, Taumarunui).

the drier and warmer North facing slopes, though the two drought-prone sites had exceptional wet summers in both 2021–2022 and 2022–2023. Further analysis after the trial has finished will compare rainfall data with morphometric data (e.g., slope) to provide a better understanding as to the drivers of seedling survival and growth. The average growth rates for the poplar clones in **Figure 1** after year 2 were between 2.0 and 6.2 m. The kānuka seedlings grew on average 1.5 m at t3, although will likely grow slightly more until the end of year 2 (July 2022). This gives evidence that the kānuka would stabilize slopes more slowly than poplar. However, kānuka may take a similar time to reach maturity height because kānuka is a smaller tree (10–20 m) than poplar (25–35 m) when fully grown. Rate of root extension of young kānuka or root biomass and distribution of mature kanuka in space planted systems, features important for erosion control, are yet to be researched.

5. Pros and cons of different space-planted approaches

There are important reasons why poplar and willow have been adopted as space-planted trees for erosion control in New Zealand. They are highly effective at reducing landslides, generally grow 2–3 m per year, and they can be planted as 3 m unrooted poles in the presence of livestock. The plastic protection sleeves are easy to apply, are durable, and split apart as the tree grows. However, few of the discarded sleeves are recycled, so they are being reviewed as a pollutant and not sustainable. The trees provide a highly palatable drought fodder source, and shed leaves are consumed by stock. Tree shading reduces pasture production considerably as the trees age [45], but this effect was less significant on poorly grassed slopes, and pasture production per hectare reduced by only 7–12%. (https://www.poplarandwillow.org.nz/documents/influence-of-shading-by-poplar-trees-on-pasture-production-rb02.pdf). Removing lower branches to create a timber tree or pollarding for fodder production are management techniques employed to reduce shading and promote pasture production under the trees.

The preliminary results of the kānuka trial show that it is possible to establish native seedlings in hill country; however, survival rates were mixed, and the best current protection method is time-consuming to use. Forming a better understanding as to why survival rates were low on some of the aspects and improving on the current protection method will be essential for the uptake of native silvopastoral systems with kānuka in New Zealand. Also, it is important to extend research to other native species in space-planted systems to assess the viability of native space-planted systems more generally. These considerations are very relevant to the indigenous Maori wanting to develop their pastoral land use to include spaced plantings of native woody species used for traditional medicines. Research initiatives that strengthen Maori culture and livelihoods are encouraged by the New Zealand government.

In terms of other co-benefits of trees, a recent study has reported pasture production to be over 100% greater under isolated and mature kanuka trees compared to open pasture at two hill country sites [44]. Although these results are preliminary and require further validation on other sites, they indicate there could be advantages when using kānuka in space-planted systems in New Zealand when compared to poplar and willow, with research finding that poplars greater than 15 years old negatively impact pasture production between 12 and 65% [45]. It is likely there will always be a place for faster growing space-planted trees such as poplar and willow, especially in areas that are highly susceptible to erosion. However, when they can be established more easily, other native species could provide other benefits to areas that are less susceptible to erosion and that do not require immediate erosion protection. Mature kānuka can be found growing higher up drier north-facing slopes, locations generally too dry for poplars and willows to establish with the current methods. It may be that kānuka seedlings will establish in these locations. Further research will test this hypothesis.

Spatial decision support tools for targeted erosion mitigation are of particular benefit to regional land managers advising landowners on species choice and location of plantings and providing landowners with a reasoned cost/benefit assessment when planting tree in high risk, low survival positions on the slope.

6. Support for landowners to reduce erosion

6.1 Institutional support

New Zealand Government One Billion Trees Fund, due to end in 2028, targeted at tree planting projects to help meet international climate change commitments, among its broader aims, funds trees planted for erosion control on pastoral land. Extensive areas of native woody species are being planted for active erosion management by this fund. The Hill Country Erosion Fund allocated from Central Government and administered by Regional Authorities supports both passive and active erosion management by co-funding planting and retirement initiatives by landowners.

6.2 Technology support

Researchers provide high-quality baseline data (understanding of erosion processes, tree-soil interactions, state of water resources) and develop new approaches to overcome economic and environmental conflicts. Extension support through publications and on-site advice are offered at the local level to encourage active erosion management. Regional Authorities provide planting materials and protectors to best practice specifications, and success is the highest when this extends to on-site placement, planting, and subsequent tree management as happens in some regions.

6.3 Demographic support

Landowners traditionally think in terms of their own properties without considering landscapes or catchments. The formation and funding of Community Catchment Groups is proving effective in reducing this barrier as landowner collectives who identify with a geographical area, usually a local catchment, use the group funds to cooperate to plan activities, monitor water quality, and plant woody vegetation to reduce erosion and sediment transfer. "Many of us sheep and beef farmers hadn't really connected with our dairy neighbours because there was no reason to. We now know each other, and it feels like we have a rejuvenated community. The Catchment Group has helped us form relationships I know will last forever." Geordie Eade, Pourakino Catchment Conservation Trust.

Author details

Ian McIvor[1*], Thomas Mackay-Smith[2] and Raphael Spiekermann[3]

1 Plant & Food Research, Palmerston North, New Zealand

2 Verdantia Research, New Plymouth, New Zealand

3 GeoSphere Austria, Vienna, Austria

*Address all correspondence to: ian.mcivor@plantandfood.co.nz

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