FARMING with NATIVE TREES

A GUIDE for FARMERS from NORTHLAND to WAIKATO

Edited by
Mike Dodd and Helen Ritchie

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Front cover: New native plantings and mature trees on a Taupiri bull farm.

FARMING WITH NATIVE TREES

A Guide for Farmers from Northland to Waikato

Edited by Mike Dodd and Helen Ritchie

New Zealand Indigenous Tree Bulletin No. 5

Ensis, Private Bag 3020, Rotorua, New Zealand
2007

Foreword

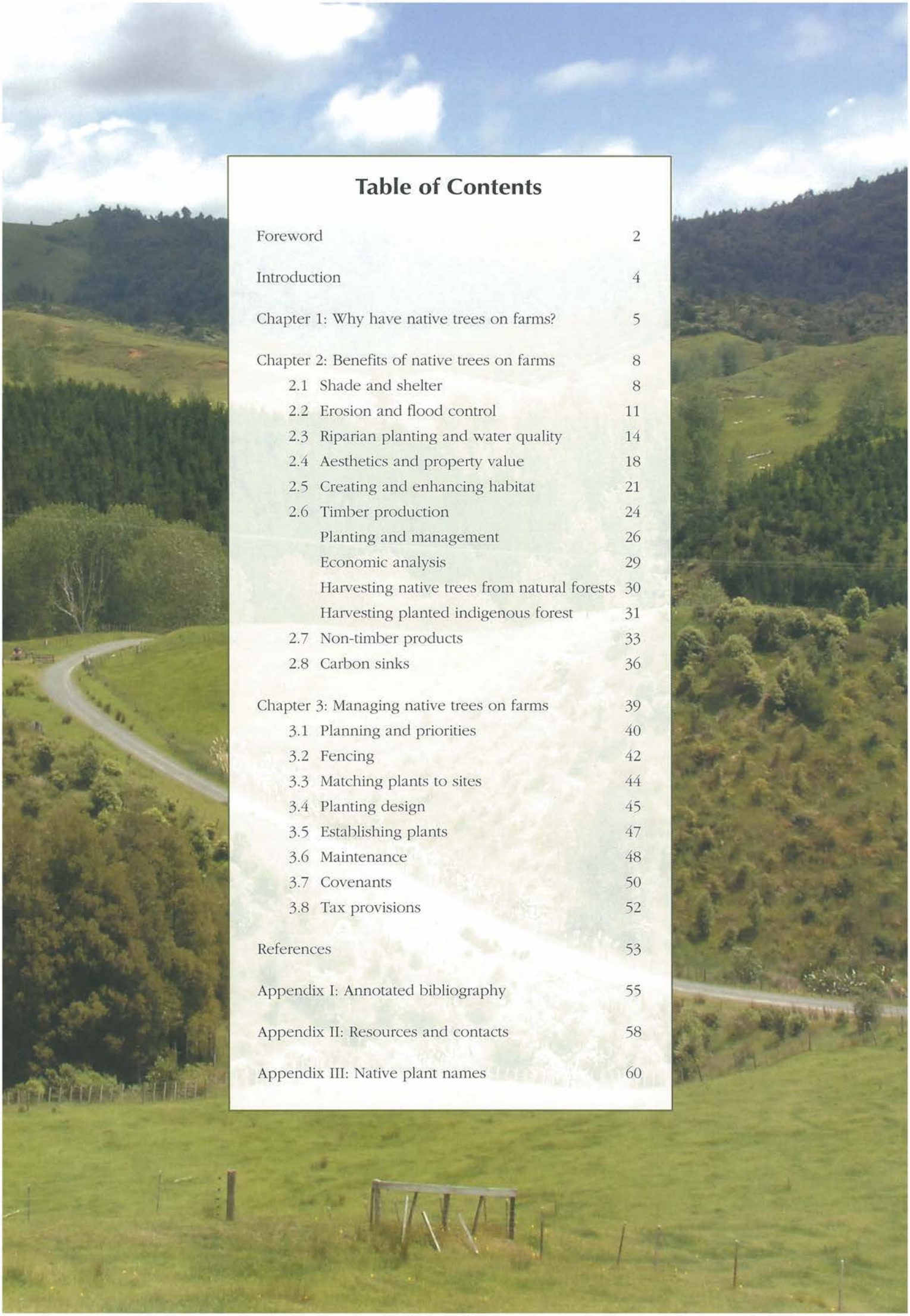
Historically, the attitude of New Zealanders toward our native forests could only be described as ambivalent. Some forest areas were used wisely and sustainably by Maori, but vast tracts were burnt during the moa-hunting period. The arrival of the European settler saw these early conflagrations pale into insignificance as huge areas of forest were cleared to create the privately owned farms for which the settlers had journeyed from the other side of the world. This land-clearing exercise, beginning before 1840, continued for a century and a half. It has been only in the last few years that landowners have come to understand the intrinsic values of our remnant native forests.

And foresters were little better than the farmers, spurred on by Governments who had little knowledge of the true worth of our native forests but who had decided that native trees grew too slowly. They disregarded the tradition of 70-year or longer rotations in Europe, and continued the clearance of native bush to make way for the ubiquitous *Pinus radiata*.

In recent times more and more New Zealanders have come to recognise the value of our native forests. This goes beyond conservation objectives, and protecting small remnants to enhance biodiversity and improve the landscape. It is now recognised that native trees can grow quite fast when managed correctly, they produce timbers of world class, and can be used for a variety of purposes on the farm — beyond just filling in that dirty gully out the back.

This Bulletin helps to close the circle from bush clearance, through neglect and disdain, to planting for conservation purposes, and finally to making full use of our unique native plants. Their qualities and uses are immense. Go and use the valuable insights in this Bulletin to enhance the value of your land and environment.

Ian Barton
Chairman, Tāne's Tree Trust
June 2006



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INTRODUCTION

There is a widespread assumption in New Zealand farming circles that agriculture and native plants don't mix. The purpose of this Bulletin is to combine the experiences of farmers and researchers to demonstrate that they can and do mix well.

In 2001, the Parliamentary Commissioner for the Environment, Morgan Williams, challenged us to *"contribute to the actions needed and ... keep open a robust debate about the roles of native plants on private land"*. The actions needed were in three areas: questioning current mindsets; overcoming lack of knowledge on sustainable use; and changing legal and policy frameworks. This Bulletin is a response to that challenge.

The vision of Tāne's Tree Trust is "*To see the majority of New Zealand landowners successfully planting and sustainably managing indigenous trees for multiple uses by 2020*". The majority of New Zealand landowners (by area at least) are farmers, and so this Bulletin is designed for farmers.

Throughout the Bulletin, farmers' ideas on the useful functions that native plants play within their farm system are highlighted alongside case studies and information from researchers, consultants, and agency staff, to blend experience with up-to-date knowledge.

The Bulletin begins with a general section looking at why native plants are valued by farmers and what challenges farmers encounter when managing native plants on their farms. The second section follows up on the "why" theme by discussing in more detail the various specific purposes for native trees on farms.

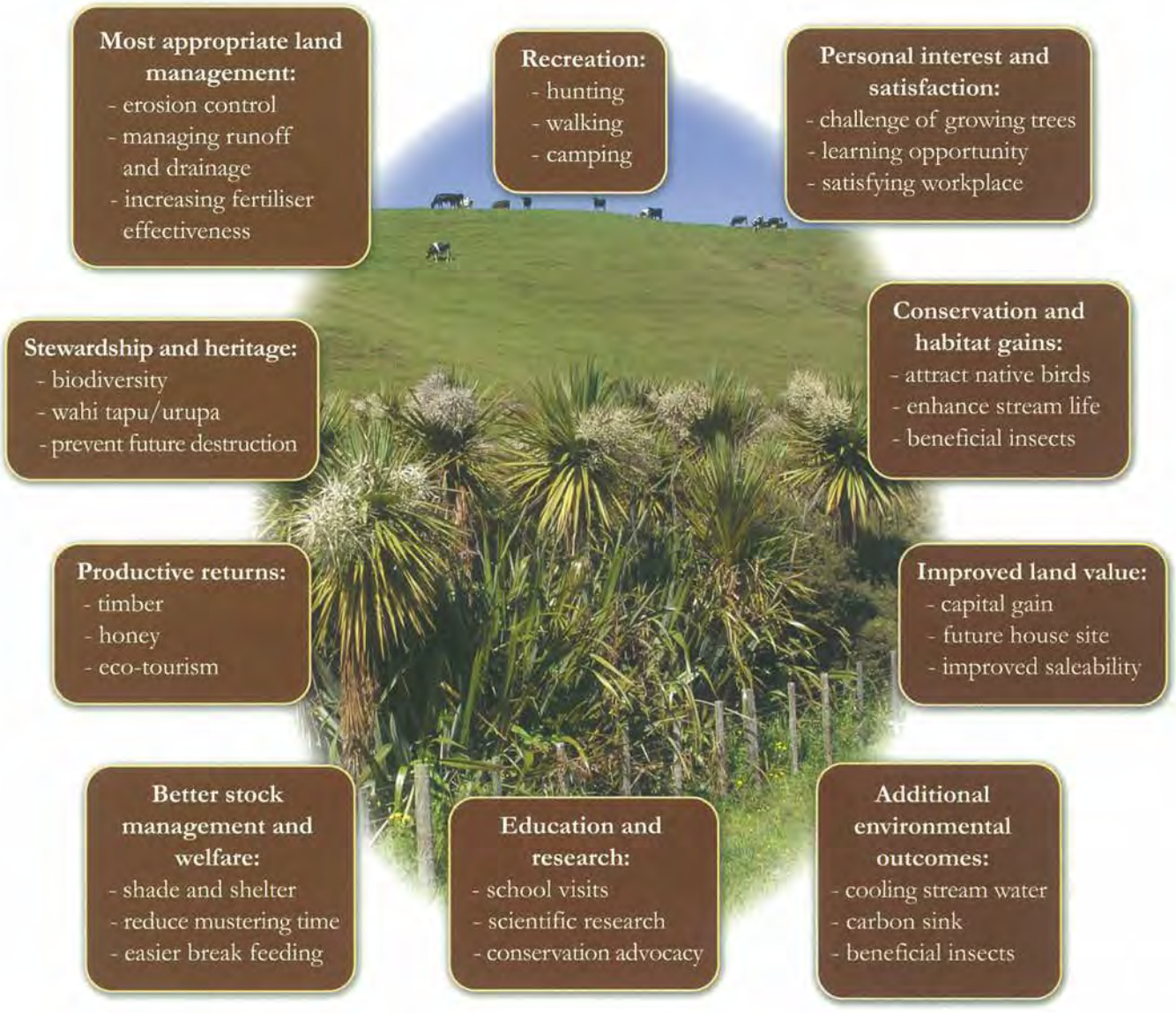
The third section has more of a "how" theme and presents a guiding framework for managing native plants in a farm landscape. At the end there is a supplementary section on where to get more information amd a glossary of scientific names for the plants mentioned in this Bulletin, since we have used common names throughout.

The information collated in this Bulletin has come out of a Tāne's Tree Trust project called "Opportunities for Native Trees on Farms", funded mainly by the Ministry of Agriculture and Forestry's Sustainable Farming Fund. While the project was limited to the northern North Island, it is anticipated that many of the concepts and applications will be more widely relevant.

Developments are occurring all the time — in emerging tax law and regulations about timber harvest, in new products being developed from native plants, and in techniques for establishing native trees for various purposes. This Bulletin provides the most current information available at the time of printing.

CHAPTER 1 – WHY HAVE NATIVE TREES ON FARMS?

New Zealand native forests are unique. They are attractive and provide habitat for our native fauna. Native plant species are well adapted to local climate and soils and, under the right conditions, are often found to regenerate naturally in many retired or less intensively managed areas.



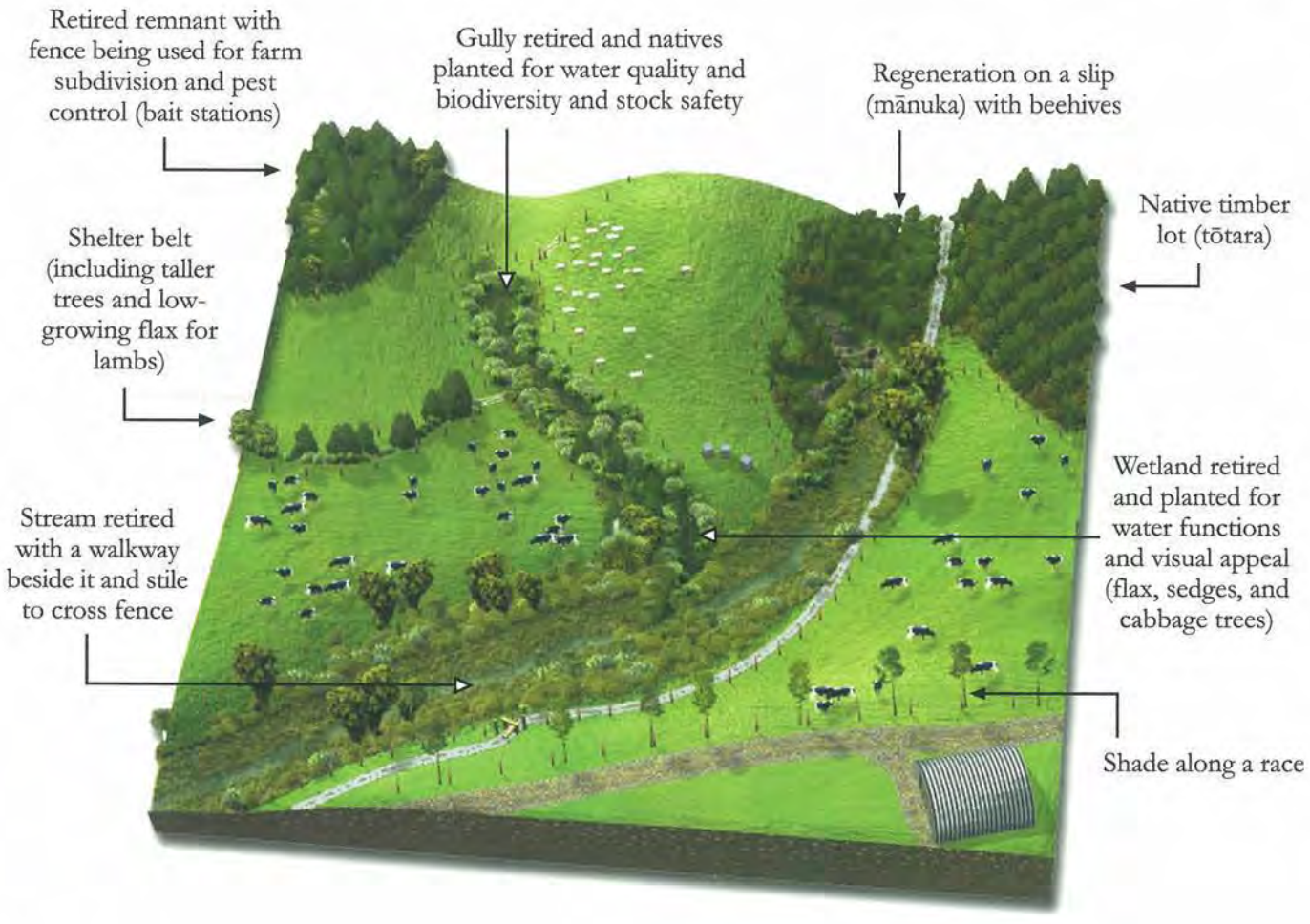
But what are the values of native trees from a farmer's perspective? As with most land-use decisions on farms, there are multiple reasons why farmers choose to plant or maintain existing native trees. When asked for their reasons, farmers at the workshops mentioned a wide range of motivations.

KEY ISSUE: **If I retire land from grazing to plant or protect natives can I get a productive return?**

Farmers said:

- The best use for some land is to have it in native bush because it is marginal land for grazing. Either it is too steep and erosion-prone to grow good grass, or it is too wet and difficult to drain.
- These same areas are often dangerous to stock and by fencing them you can protect stock and save time mustering.
- The fences are also useful for farm subdivision, giving better grazing management and pasture utilisation. Stocking rates can often increase as more grazing pressure can be applied when dangerous areas are fenced off and fertiliser use and weed control are focused on the better land.
- The environmental spin-off is that there is cleaner run-off from the farm when erodable land is retired and wet areas are fenced to act as filters.
- There is also personal satisfaction in having native trees on the property. They look good and add variety to the farm and value to the property.
- They bring back birds, and are a way of preserving nature for the future.
- They give shade and shelter for stock and a visual screen for deer.
- They provide for recreation such as hunting and shooting or bush walking and educational visits.
- They also give good protection for wāhi tapu or urupā.
- Natives can be planted for a future timber harvest.
- In the meantime there can be other values gained from native bush — things like honey, firewood, ecotourism or homestays, and medicinal benefits for people and for stock.

There are many opportunities to use native plants on farms for different purposes. Here is a range of ways in which native plants can be incorporated into a working farm landscape.



Why have native trees on a dairy farm?

Brett and Gayle Farrell own and run a dairy farm at Parakao, west of Whangarei. They admit they are not foresters — "we grow grass to sell milk, and do it well, so we're sticking to it" — and so their enthusiasm for native plants has to fit in with their farm productivity goals. For them the key considerations relate to waterways, good subdivision, and shade and shelter.

Brett says there is "nothing good about having animals near creeks". They have lost stock in the lagoon, and the coliform levels in the streams are high enough to restrict how they use the water to wash the milking plant. So now all waterways are fenced with 2-wire electric fencing. Recent improvements in technology mean that all the fences stay on permanently, and seem to keep the long grass from growing into the wires. Even the boundary fences are electric, making it less trouble to repair them after floods or branch falls.

Brett says their first fences were too close to the stream edge and there was some bank erosion, so now they fence further back. This does lead to rank grass growth, which Brett doesn't like — hence the need to plant the banks. Gayle says that so far they have used kahikatea, tītoki, taraire, and some exotics. She is definitely looking to plant more flax in future, and thinks that "if you plant flax, you get other trees". Ongoing maintenance is the big issue, so the Farrells prefer to fence out only a small amount each year, planting densely for weed control.

Brett likes to keep the cows out of awkward corners and loops in the streams, so he puts in straight fences and plants up the corners. For him, improved pasture utilisation and less damage to soil more than compensates for any loss of grazing area. With their odd-shaped tōtara remnants, the Farrells put a fairly straight fence around the core area of trees, inevitably leaving a number of extra shade trees in the paddock. However, they find that dry cows winter grazing in these paddocks start damaging the trees as well as the soils.

The Farrells value shelter for livestock in winter and, to a lesser extent, shade in summer. They use the sheltered paddocks next to the bush in bad weather, breaking the rotation if need be. But Brett is not in favour of shelterbelts along races as they prevent the race drying out in wet periods and may slow down cow flow. He observes that cows do produce less milk on hot days from unshaded paddocks, but thinks they make up for it over the night grazing. Still, he'd rather see cows have access to shade if they need it.

Brett and Gayle bought the property for its potential, and the existing native trees were a factor in their purchase choice. They fully expect that their efforts to manage the native trees well will enhance the value of the farm over time.

Farrell's dairy farm features exisiting fenced stands and new plantings.

Leaving the odd tree in paddocks provides extra shade for stock.

CHAPTER 2 – BENEFITS OF NATIVE TREES ON FARMS

When asked their reasons for managing native trees, farmers came up with a wide range of useful functions for native trees on their farms. Many of them reflected that their motivations had changed over the years, from conservation to reasons based around useful functions in the farm system. From this list, the most common purposes for native plants on farms expressed by farmers are explored in detail in sections of this chapter. For each aspect, the latest research is presented along with comments from farmers. A case study from a working farm from either the Northland or Waikato regions is also used to illustrate each function of native plants.

2.1 SHADE AND SHELTER

KEY POINTS:

- Shade and shelter are of benefit to animal production and health despite some loss in pasture growth
- Shelter improves animal welfare and can future proof the farm system toward anticipated industry quality assurance standards and policies
- Shelter can improve landscape values
- Planting design is important to achieve the desired function
- Natives, exotics, and mixtures can be used, but natives enhance the natural character of our landscapes and often require lower maintenance in the long term

KEY ISSUE:

Shelter is good for stock but native trees shade my pastures and reduce production

Farmers said:

- There is higher milk production when the cows have shade
- You can see from stock behaviour that they prefer to be shaded on a hot day
- There is an increase in productivity because of sheltering — e.g., better lambing percentages
- There is less stress during calving (due to privacy and shelter)

A low-growing flax shelterbelt.

Cows without shade suffer heat stress and produce less.

Cows enjoying the shade of established trees.

Using natives for farm shelter

Roy Dench started 50:50 sharemilking on his father's Paterangi farm in 1966. There were more trees then, but his father had a block (about 5 acres) of kahikatea trees milled for timber. Since owning the property in 1971 Roy has planted hundreds of native trees, and the farm is twice the size, with Roy's daughter Janice and her husband Peter now 50:50 sharemilking 220 cows.

Roy planted shelterbelts of native trees, and he also fenced paddocks with awkward corners and sidelings and planted natives and fruit trees. The species he chose for mixed shelterbelts along the race to the cowshed were totara, lemonwood, and kōhūhū. Roy says the cows now appreciate the shade in summer and the shelter from wind in winter, as they walk nearly 2 kilometres to the milking shed.

The shade and shelter are not just along races, but also between paddocks. Roy has designed the majority of these tree belts to run north/south so as to limit shading and inhibiting of pasture growth. But the trees are also there to protect stock from exposure to certain winds, such as a lemonwood hedge planted to keep the southerly wind off some paddocks.

Prior to Roy taking over the farm in 1971, several long rows of Lawson cypress had been planted, and these are now approximately 30 m high. The downside of these shelterbelts is that in dry conditions the trees take moisture from the pasture for about 20 m either side, reducing grass growth. Roy has found this is not such a problem with natives.

In recent years Roy has been taking out swamp cypress which he planted for drain stabilisation, but found were a poor choice in that they have very heavy leaf fall in the autumn/winter which blocks culverts. He is now replacing these with kahikatea.

There are existing kahikatea stands on the farm protected by QEII National Trust covenants. In these stands Roy has set traps and bait stations for animal pest control. He has caught over 200 ferrets in a single trap since he started this programme.

Peter says "farms without trees look so naked", but he believes attitudes are changing and farmers are more likely to plant nowadays. One tree that Janice and Peter say that they would not want to plant is an oak tree, as oaks allow weeds to grow under their wide branches. Besides, Peter says, "if we don't plant natives on our farms we won't have any left".

A lemonwood shelterbelt provides shelter and shade on the Dench farm.

A tall belt of mixed natives provides shelter to neighbouring paddocks.

Mike Dodd, AgResearch, Ruakura.

The evidence of shelter benefits on livestock condition and productivity comes largely from overseas — *see* Gregory (1995) for a comprehensive review — as there have been few New Zealand studies. Research that has been done in New Zealand's variable climate has not always coincided with extreme weather, giving mixed results.

Effects on Pasture

A shelterbelt in Canterbury showed an increase in pasture production of ~60% (Radcliffe 1985). However, more recent shelterbelt studies have shown no overall benefit to pasture production on the North Island East Coast (Fig. 1) (Hawke *et al.* 1999) and even a slight decrease of ~8% in production in the central North Island (Hawke & Tombleson 1993). Although shade has been shown to reduce pasture production under a number of tree species (Fig. 2) (Power *et al.* 1999; Dodd *et al.* 2005), farmers in a 2004 survey observed no loss in animal production from hill country paddocks with spaced plantings of poplars and willows (A.Mackay unpubl. data).

Effects on Grazing

It is a common misconception is that the provision of shade and shelter will encourage stock to rest under trees rather than graze. In fact, cattle have depressed appetites and graze less under heat stress (Bennett *et al.* 1984) and in cold wet conditions (Tucker *et al.* in press). Recent research indicates a compensatory effect whereby cows with shade will reduce consumption during the day but make it up at night (Kendall *et al.* 2006).

Effects on Animal Health and Productivity

In overseas studies, shelter of various types has been shown to:

- Increase ovulation rate in sheep by ~20% (Griffiths *et al.* 1970; Doney *et al.* 1973);
- Increase lamb growth rates by ~7% (Alexander & Lynch 1976);
- Increase wool growth (Lynch & Donnelly 1980); and
- Reduce lamb mortality by 70% in one study (Egan *et al.* 1972), 30–50% in another (Alexander *et al.* 1980).

In hot conditions, shade has been shown to:

- Improve dairy cow milk yield by 11% (Roman-Ponce *et al.* 1977), 27% (Ingraham *et al.* 1979), 12% (Davison *et al.* 1988), and 6% (Muller *et al.* 1994);
- Reduce mastitis rates (Davison *et al.* 1988); and
- Increase conception rates (Roman-Ponce *et al.* 1977).

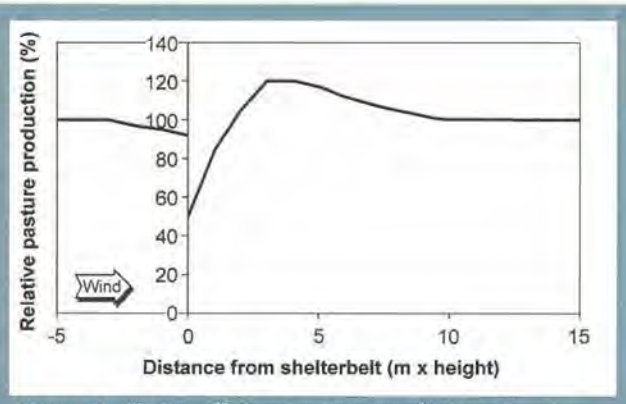


Figure 1. *Shelter effect on pasture production showing suppression of pasture close to the belt and enhancement of growth at intermediate distances (from Hawke et al. 1999).*

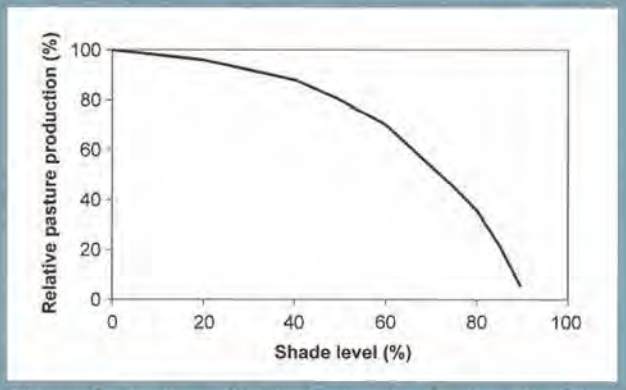


Figure 2. *Shading effect on pasture production showing low levels of pasture suppression up to ~50% shade (from Dodd et al. 2005).*

In New Zealand research, shelter has ben shown to increase the growth rate of dairy heifers by 20–40% (Holmes *et al.* 1978) and reduce lamb mortality by up to 40% (Holmes & Sykes 1984). However, a Southland study conducted under mild conditions indicated no difference in mortality or production gain from providing shelter at lambing (Pollard & Littlejohn 1999).

Recent research has shown a 3–8% increase in milk production from dairy cows with access to shade, over those without shade, during a mild summer in the central North Island (Kendall *et al.* 2006).

The effects of shelter thus appear to depend on region, site, weather, and animal type. In general, mature animals with good body condition are better able to cope with adverse conditions, and therefore may show little production response to provision of shelter. However, recent trends in the livestock industry have seen greater emphasis on young, fast-growing animals, which are likely to be more sensitive to their immediate environment. In any case it is clear that livestock of all classes and ages benefit in numerous physiological, behavioural, and productive ways from the provision of shade and shelter, even in temperate environments.

2.2 EROSION AND FLOOD CONTROL

KEY POINTS:

- Native plants have high tensile root strengths but most have shallow roots
- Mixtures of native species or mixtures with exotics will be most effective
- It takes 5–10 years to provide a significant level of soil stabilisation
- A wide range of natives are suitable for gullies and headwaters
- Carefully selected native trees planted in the right place can grow quickly.

KEY ISSUE:

Natives grow slowly, making them harder to establish than exotics and unsuited for erosion control or bank stabilisation

Farmers said:

- One reason for bush protection was to protect stream headwaters from erosion
- Natives are the best use for gullies and steep lands and to repair scars
- Native bush helps with rain capture and water flow management
- Native trees heal scars quickly and are flood resistant for bank protection
- Our stream and river life has evolved with native plants.

CASE STUDY – WAIKATO

Native trees protect eroding gullies

John and Jenny van Woerden have combined native plantings with dairy and forestry operations on a 400-ha farm at Waitekauri, near Waihi. Their farm is roughly a third each of native bush, forestry, and pasture and borders a bush reserve. They have been farming in the area for 28 years and walked over the farm when they first arrived, allocating sections of erodible land to native plantings and deciding where to put fences.

One of the first areas fenced was a steep sidling that was covered in gorse. John made the decision it was uneconomic and impractical to clear the gorse and convert the marginal land to pasture, as it had high potential to erode. Instead, the area was fenced and left to regenerate, and now 8 years later it is covered in tree ferns, with the gorse unable to prevent the natives coming through.

Another gully was fenced to avoid erosion and aid stock flow around it, rather than having stock end up in a corner. As John says, "There's never only one reason for doing it, we've always been trying to attract native birds too and this gully was good because it was close to the house". Jenny adds, "The bottom of the gully is really wet so we're helping improve water quality as well".

Jenny grows native trees from seed and the gully is her project where she enjoys seeing the progress, although it is slow. If the van Woerdens were going to do things differently, they would have done the gully faster and put a budget aside for plants earlier. The cost of plants can be an issue and natives do need a little more care initially than pines. "Plant the biggest plants you can afford", says Jenny.

Other issues include the time and cost of fencing and keeping the fences maintained. The van Woerdens use single-wire electric fencing and checking the fence after bad weather or when plants short it out takes time. However, Jenny says "most of the time taken is because we've chosen to use the single-wire electric fencing as a cost-effective and practical option for our dairy farm".

Flax planted on an eroding face.

For the van Woerdens, the benefits far outweigh the negatives. For example, there is a huge saving on fertiliser and weed spray that is not going on to marginal land, and erosion has been prevented by their strategic fencing and planting. Stock safety was also an issue, and John has had to fence a cliff where he lost an animal. Trees provide additional shelter and enhance land values for potential subdivision in the future. "We have no plans for subdivision, but it is a huge issue in the Waihi area where everyone wants a lifestyle block up against the forest park with good views". John and Jenny also find the attractiveness of the farm makes for a very pleasant working environment.

EROSION AND FLOOD CONTROL — RESEARCH

Chris Phillips, Landcare Research, Lincoln.

Native plants are well adapted to the soil and climatic conditions of New Zealand. Some can establish or colonise bare or disturbed sites through a series of stages (succession). However, only a few of New Zealand's species can be regarded as highly efficient or effective colonisers, i.e., having the attributes required for rapid erosion control.

How Does Vegetation Control Erosion?

Root systems of trees and shrubs can contribute to reducing soil loss from slopes by forming a dense network of intertwining roots, or by anchoring the upper layers of the soil mantle to lower substrates by deep penetrating roots such as tap or peg roots. In addition to stabilising soil by its root system, vegetation provides a ground cover that improves microclimate and soil conditions as well as protecting bare soil against rain splash (Greenway 1987). It may also enrich the soil by fixing nitrogen in its roots, and it may act as a filter to sediment-laden run-off. For erosion control, achieving fast canopy closure and root development at all levels of the soil profile is critical.

How Effective are Native Trees at Erosion Control?

Any closed canopy forest (native or exotic) gives greater protection against shallow landslides (slips) than pasture (Marden & Rowan 1993). There is much less soil lost from areas in native forest cover than from areas in pasture (Fig. 3). However, young trees will not provide protection from slips until the canopy closes (when plants are around 10 years old), meaning the investment in planting may be lost if a slip carries young trees away.

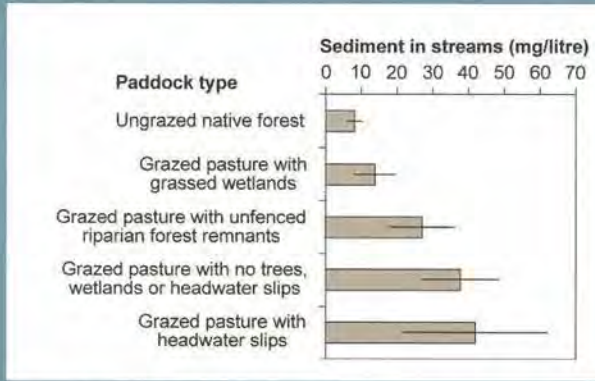


Figure 3. *Comparative sediment concentrations in streams draining paddocks with differing vegetation cover (source: Slassar & Kemperman unpubl. data)*

The most significant contribution to knowledge of native plants for soil conservation was in a volume of the *Plant Materials Handbook for Soil Conservation* (Pollock 1986). In recent times, detailed investigations have produced limited data for a number of species, mostly on growth rates and root development, indicating that the rooting depth for most of New Zealand's native species, including tall podocarps, rarely exceeds 2 m.

In a trial of woody native riparian colonisers (Marden *et al.* 2005) on an alluvial terrace soil near Gisborne, root systems at 5 years were typically shallow and confined to the uppermost 31 cm of soil. Cabbage tree, ribbonwood, karamū, and tutu performed well, with cabbage tree roots reaching depths of 40 cm after 5 years. Root spread (mean maximum diameter) reached between ~1 and 2.5 m by age 5 years, depending on species. Lemonwood roots spread widest (at ~3 m) while the very compact root systems of māpou and rewarewa barely attained a mean spread of 1 m. Roots of plants spaced 2 m apart were beginning to intertwine by year 4. The roots of kowhai and tutu extended to a maximum of twice the diameter of their canopy widths.

An erosion-prone gully — natives are now out-growing the gorse.

Earlier research on root depth of older (13–50 years) mānuka trees showed that the root system penetrated to a depth of 50 cm on stony soils and 80 cm on sandy soils (Watson & O'Loughlin 1985). In another study, kānuka roots reached a maximum depth of 2.2 m between 6 and 32 years of age (Watson *et al.* 1999). The conclusion was that root depth was correlated not to tree age but rather to the stoniness and depth of soil material.

The studies suggest that, in general, native species have higher tensile root strengths than exotic species (other than willows), but they are slower growing, and have shallower root systems (Phillips 2005). Therefore, on bare sites with a high risk of erosion, exotic species may be a better option. However, a range of native species can still be effective in providing a measure of erosion control.

How Can Natives be Used for Erosion Control on Farms?

Fencing of remnants on eroding areas is recommended as the first step. If natives are to be planted, then the site needs to be relatively stable first. Incorporating some fast-growing exotics such as poplar or willow poles with natives is one strategy, where the exotics can ultimately be removed. It can take 5–10 years before native plants provide a significant level of soil stabilisation. This is dependent on the spacing between plants, so trees should be planted no more than 2 m apart.

In summary, with careful planning, species selection, and maintenance (*see* Chapter 3) it is possible to imitate natural succession and establish a permanent native plant cover for erosion control.

Cabbage trees have relatively fast root growth that can help stabilise eroding slopes

2.3 RIPARIAN PLANTING AND WATER QUALITY

KEY POINTS:

- Riparian buffers can improve stream conditions within 2 years
- Getting stock out of waterways has a positive effect on improving water quality, with less damage to stream banks and fewer stock rescues and losses
- Native trees provide shade that lowers water temperatures, and the leaf litter is food for aquatic fauna which benefit from a variety of evergreen species
- Planting natives with timely and appropriate post-planting care will help suppress weeds in fenced riparian zones.

KEY ISSUE:

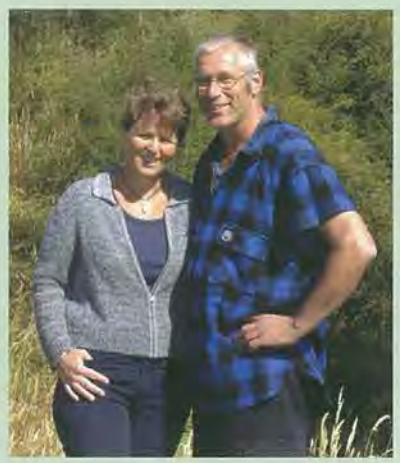
As soon as I put up a fence around a riparian area I lose good grazing, get weed problems, and have to provide alternative water for stock

Farmers said:

- We wanted to stop sending brown water into the bay
- Our native trees help protect the drinking water source
- Trees provide shade for cooling water used in the milking plant
- We use fences to restrict access to liver fluke problem areas
- Planting native trees at wide spacing creates the worst weed problems in riparian areas.

Fenced plantings and plenty of long grass filter farm run-off (left) *while exposed streams without fencing become polluted by stock* (above).

CASE STUDY – WAIKATO



Riparian protection is part of farm policy

Hans and Anita Nelis' vision is to "operate a commercial dairy farm with the least negative impact on our soil, air, and water environment". The land was "plain and boring with hardly any trees" when they first arrived on the 107-ha farm near Tirau 6 years ago. All waterways were open to stock and six cows drowned in the first season. Four streams run through the Nelis' farm, and these are now all fenced (mainly 3-wire electric), along with some springs. Initially it was a financial struggle and they needed help from the South Waikato Environmental Initiatives Fund to fence the first two streams.

Hans finds that fenced drains do not need regular upkeep with diggers as stock do not upset the banks (saving $1000 a year on drain clearing). For Hans and Anita, there are also good reasons to plant inside the fenced areas — to remove nutrients from run-off, provide shade for stock, and control erosion. They prefer natives because they are the original New Zealand flora and natives make the farm a more attractive place and encourage bird life. However, on one of their fenced drains next to the race they have left long grass rather than plant with natives, so that thistles and ragwort won't grow and to ensure good access for the drain digger.

All in all, over the last 3½ years they have planted about 10 000 plants. It hasn't all been easy going as they weren't always given the right advice, but they "don't give up easily". They have learned which plants are suitable for local conditions, including heavy frosts (having recently lost some 4-year-old akeake). However, there are frost-free pockets and microclimates that seem to suit certain species, and rimu have done well in a sheltered position, despite wet feet. They hand-release young trees 2 or 3 times a year, as blackberry is a problem and they find that spraying knocks the natives around too much. With six children in the family, "when it comes to planting and releasing, there is always somebody keen to earn extra pocket money".

In their most recent plantings, they planted straight into ryegrass bordering a farm track as it was late in the season and they didn't have time to spot spray. They have been pleasantly surprised to see no losses in these trees — better survival than in their sprayed plantings. They put this down to the existing ryegrass swath preventing the invasion of weeds. The tall ryegrass may also protect trees from hard frosts to a certain degree.

With the benefit of hindsight, Hans & Anita say they would have:

- Used stakes straight away to mark the plants
- Done only hand-releasing rather than spray-releasing
- Planted straight into ryegrass pasture rather than spraying first
- Sourced taller plant material (at least decent PB 2s or better still PB 3s)
- Been in contact with the local Streamcare group — they didn't realise there was one!

On this farm, pre-spraying has promoted weed regrowth (left) *while planting straight into ryegrass has meant less releasing work.*

Overhanging native vegetation provides ideal stream habitat.

NATIVE TREES FOR RIPARIAN MANAGEMENT — RESEARCH

John Quinn, NIWA, Hamilton

A riparian area is the land next to a waterway. Many farmers are planting trees to create buffer zones between the waterway and their grazed land. Their objectives include preventing bank collapse, filtering farm run-off, or improving stream conditions, as well as enhancing the environment. But how effective are these strips of land along the edges of the farm system in achieving all these aims? Are native trees a better option than exotics?

Effectiveness of Riparian Strips in Improving Stream Conditions

In an assessment of nine North Island streams, Parkyn & Davies-Colley (2003) compared fenced and planted areas with unfenced areas on the same or a nearby stream, looking at the macroinvertebrates (aquatic bugs) as an indicator of stream conditions. They also measured temperature, water quality, and water clarity.

Overall, they found riparian buffers enhanced streams in a number of ways, and conditions could improve in as little as 2 years after stream protection. But there was a lot of variation among the streams they tested, and only three of the nine sites showed a really marked shift towards "clean water" bugs. The main reason for these improvements was a drop in water temperature due to shading. They concluded that stream conditions can improve, but it will take time until trees are large enough to give shade across large streams. It helps if plantings are continuous along the banks and begin at the headwaters, where small unshaded streams are highly prone to heating.

Other studies looking at the effectiveness of riparian buffers in trapping faecal microbes that can cause disease found that on steeper hill country it is difficult for streambank vegetation to trap and retain the microbes, especially under intense rainfall (Collins 2004; Collins *et al.* 2004). Their recommendation was that farmers instead focus on excluding stock from the numerous seeps and wet areas in these paddocks, where faecal matter will be trapped if thick vegetation is present.

Streamside buffers can be effective on flatter dairy land, as long as polluted water is not getting into subsurface drains (e.g., mole and tile drains) which then discharge straight into streams. Direct run-off from tracks and races to waterways also needs to be prevented.

How Does Vegetation Help Water Quality and Stream Habitat?

Any fencing will help a stream, and any vegetation can provide extra benefits. Fencing will prevent direct inputs of effluent from stock and stabilise the streambed and banks. Rank grass beside the stream helps to filter runoff from paddocks. Tree planting provides more bank stability and shades the stream, though trees may not be such a good filter of overland runoff as thick grass. Actively growing plants can take up nutrients from shallow groundwater, but this is a temporary effect since their leaves then fall and rot, unless plant material is harvested and taken away. However, in wetland soils, plant leaf litter can provide the carbon needed by soil microbes that remove nitrogen from soil water and release it to the air. Streamside trees also provide leaf litter and sticks and branches as a source of food and hiding places for in-stream creatures.

Are Native Trees Better than Exotics for Riparian Areas?

Some native trees have tough leaves (e.g., rewarewa, tawa, and kauri) that will last longer in a stream than deciduous exotic trees. Others have soft leaves that decay quickly (e.g., māhoe, hohere, and wineberry) and provide a readily available food resource for stream invertebrates (Quinn, Burrell & Parkyn 2000; Quinn, Smith, Burrell & Parkyn 2000). A varied litter-fall is expected to benefit stream insects.

Most native trees supply leaves throughout the year to the stream system and drop more leaves during summer, rather than in one big flush of deciduous litter over autumn (Scarsbrook *et al.* 2001; Quinn & Scarsbrook 2001). Native trees also provide a humid and sheltered streamside habitat throughout the winter (Meleason & Quinn 2004) which may benefit some of the adult forms of native water insects. There are also native plants with drooping and overhanging form that enhances habitat values for in-stream creatures.

Willows are often favoured over natives for their fast-growing root systems and are often recommended as the first step in stabilising severely eroding stream bends. Native plants can be interplanted on the stabilised stream banks. For less serious situations, natives offer a good first choice to shade streams and filter runoff, while improving biodiversity and visual appeal on the farm.

Split flaxes are a low-cost option for a planted gully system where protection of waterways is of concern as they help to filter runoff

2.4 AESTHETICS AND PROPERTY VALUE

KEY POINTS:

- Native trees add a unique New Zealand character to the landscape and provide variety and beauty
- Native trees on farms can add to the capital vaue of a property and appeal to a larger segment of potential buyers
- Some districts provide incentives to protect native bush or plantings through subdivision rights and rates relief.

KEY ISSUE:

Aesthetics are all very well, but does it make a difference to property value?

Farmers said:

- We live in New Zealand, not France or England — we want the farm to look and feel like New Zealand
- A property sells more easily if it looks good — the ads always mention native bush
- Trees make a difference to capital gain
- The natives provide a stress break and a chance to reconnect with nature
- There is variety in your everyday farming.

Well-maintained plantings can enhance the farm's appeal to buyers — as well as creating a stunning visual effect

Native trees adding value to the farm

When the Government valuation of his farm consigned the covenanted bush areas a nil value and termed them waste land, Peter Levin contested the appraisal. With no value assigned to the area, Peter couldn't get any rates relief for them. But for him, it was also a matter of principle: we need to value our bush areas more highly.

Peter believes there is a trend towards increasing appreciation of out native flora, reflected in real estate advertising. "They put in 'lovely bush blocks' or 'considerable plantings of natives' as a selling point", he says. And he thinks it is important for a nation to develop what sets it apart from others. "We have to look at what makes us different as a country, and emphasise that". On Peter and Gael's 265-ha Taupiri bull farm, they have made a very good job of it, planting some 12 000 native trees over 20 years and covenanting existing remnants of tōtara and kahikatea.

Peter says that while he prefers deciduous exotic trees for shade in the paddocks, natives look best around waterways and gullies. For him, having a farm that is not flat offers opportunities to plant following the contour of the land, creating a natural visual effect. "First impressions matter, so we give the landscape appeal some thought," he explains. He found good advice in the Mortimers' book "Trees for the New Zealand Countryside".

While property value and aesthetics are important for the Levins, the primary motivation for retiring their gullies was to keep the bulls from making a mess of areas near the farm drainage channels, in order to protect soil and water values. This involved fencing both sides of the two main gullies that stretch over 4 km of the farm. "Fencing is not too expensive on a cattle farm, as 2-wire electric is sufficient", says Peter. "The trees are more costly, so it's important to be patient —only take on what you can afford and make a success of each year". Peter prefers to plant and forget, planting quite densely (1.5 m apart), and not returning to release in spring. "I'd sooner put in a lot and lose some", he explains, "because in springtime the farm is busy and we don't tend to get back to them".

Lately, Peter has worked with eco-sourcing experts Peter Morris and Wayne Bennett to ensure the trees he plants are of local origin. It goes both ways, with Wayne collecting seed from Peter's mature remnants to grow trees in his nursery for other local farmers.

And as for the valuers? Peter said he "made some progress with them", but for him the main satisfaction is personal. "You get pleasure from the aesthetics and the feeling you are doing a public good — to me it's part of the responsibility of land ownership".

The Levins' plantings follow the contour of the land for best landscape effect, as well as protecting soil and water on the high-producing farm.

Mike Dodd, AgResearch, Ruakura.

Whether the existence of native forest on farms enhances the value of farms is a subject of hot debate. There has been little formal research on the topic, with anecdotes often the only source of information (e.g., Young 1996; Davis & Cocklin 2001). Rapidly increasing rural land values and the accelerating rate of rural property turnover during the last decade make it difficult to determine the impact of native bush on land value. Informal discussions with Real Estate agents suggest that it affects not so much the capital value (as reflected in selling price) but more the attractiveness of a property to potential buyers, and the size of the pool of buyers. If that benefit could be reflected in a shorter time on the market, then it would be relatively simple to quantify the value in terms of the opportunity benefit of capital. For example, a million-dollar property that sold 30 days earlier because of its aesthetic appeal, assuming an interest rate of 6%, would represent a $5000 gain. Other typical comments from Real Estate agents are that the value of native forest on farms is highly dependent on factors such as the type of native bush (e.g., large block *vs* small groves), or the type of buyer (e.g., corporate *vs* lifestyler).

Farmer and real estate agent attitudes

A recent study exploring the relationship between the presence of native bush on farms and aspects of market value (Trinh & Kaval 2005) found that the top three factors influencing the sale price of farms were location, production level, and contour, and the top three factors influencing time on market were price, location, and presentation. Only 24% of agents thought that native bush was important to farm buyers, but 45% of farmers thought that native bush was important. When asked to select the most valuable farm of three options (A = no native bush; B = scattered small bush blocks; and C = one large bush block, the farm being equal in all other respects) 47% of farmers chose A and 35% chose B. Analysis of farmer characteristics and their attitudes toward native bush indicated that older farmers and multiple owners have a lower opinion of the importance of native bush, while those farmers with more formal education and higher income had a higher opinion of the importance of native bush.

Subdivision rights

A number of local authorities offer reciprocal incentives to formally protect native bush on private land. For example, the Western Bay of Plenty District Council policy allows a "Protection Subdivision" right to be granted for an additional lot, either on-site, or transferable. This means the right can be sold to someone else in the Rural Zone, provided it meets certain conditions. The District Council also works with Environment Bay of Plenty to boost the grant-rate for fencing bush, wetlands, and riparian areas, up to 50–75% of the total cost, depending on the catchment.

2.5 CREATING AND ENHANCING HABITAT

KEY POINTS:

- Native wildlife can be experienced more often on farms when native forest habitat is improved and expanded
- The first priority is improving existing native bush by fencing and pest control
- Planting trees that flower and fruit in winter can attract foraging birds — tūi and kererū
- Reducing pest densities (ship rats and possums) at nesting times can increase bird populations
- Diversity of habitats on farms will lead to diversity of species (including reptiles, invertebrates, fish, etc.)

KEY ISSUE:

Native trees seem to provide extra habitat for possums and other pests rather than native species

Farmers said:

- Native bush creates habitat to bring back native birds, but pest control is important
- We wanted to protect orchids
- Native plantings enhance stream life
- The native forest brings beneficial insects
- We are controlling pests anyway on the rest of the property.

CASE STUDY – NORTHLAND

Kiwi habitat enhanced around farming operations

Kiwi are a part of the farm wildlife for Northland dairy farmer Murray Jagger and his wife Helen. Kiwi can travel surprisingly long distances — up to about 6 km a night. According to Murray, if kiwi are out grazing in the middle of a paddock when dawn comes, they will make camp — crouching down in rushes or burrowing into long grass for a snooze. "They don't necessarily head home to their burrows each day. They are quite nomadic", he says.

Murray has two farming operations, running 450 dairy cows on 160 ha, and about 95 dairy beef cattle on another 180-ha block. His land is in the spectacular setting of Whangarei Heads, with the mainly clay and peat land stretching out to Ocean Beach from the slopes of the mountain Manaia. He also leases Department of Conservation land at Smugglers Cove.

With the backdrop of the bush reserve, the land is prime kiwi country that has been subject to major animal pest and predator control operations by the Department of Conservation and Whangarei Heads Landcare Forum.

A specialist trapper employed by the Forum, Todd Hamilton, targets the difficult animal pests such as mustelids. Kiwi chicks raised to maturity on nearby Matakohe/Limestone Island are often released in the area once they are big enough to be able to fight off most predators.

Murray has developed a good working relationship with the Department of Conservation and particularly the Landcare Forum's trapper, and takes part in the kiwi listening programme during the mating season. "It's not until you're out in the bush at night listening for

calls that you realise how noisy the bush is. It's not just kiwi. It's a real symphony", says Murray. This means kiwi are very much a part of the community. "We listen to them at night. The male has a high-pitched call, the female has a lower tone. Sometimes we can hear them high up in the bush and later there'll be one right across the road. They can certainly move around".

Murray says all the landowners in the community are aware of the kiwi in the area, and there are signs notifying visitors they are in a kiwi zone. His growing awareness of the kiwi has brought about some changes to his farming practices. "I've changed the way I use my dogs. They are not left loose once they have finished their work; they go back in their kennels. When I'm working in the DOC reserve, I have muzzles to put on the dogs in case they encounter a kiwi".

While he hasn't seen a possum in a long time, Murray has noticed an explosion of rabbit numbers as a result of other predators being controlled. He is happy to be involved in helping kiwi survive. "I've always felt we are just custodians of the land. The bush is the same".

Helen and Murray Jagger welcome more kiwi to the Whangarei Heads community

Retaining fallen trees enhances habitat in the forest

IMPROVING HABITAT VALUES ON FARMS — RESEARCH

Bruce Burns and John Innes, Landcare Research, Hamilton.

For many farmers, wildlife contributes much to the quality of rural life, and increasing birdlife is a common reason for planting natives. Effective management for this goal focuses on improving the quantity, quality, and diversity of habitat present for wildlife.

How Far Will Birds Fly?

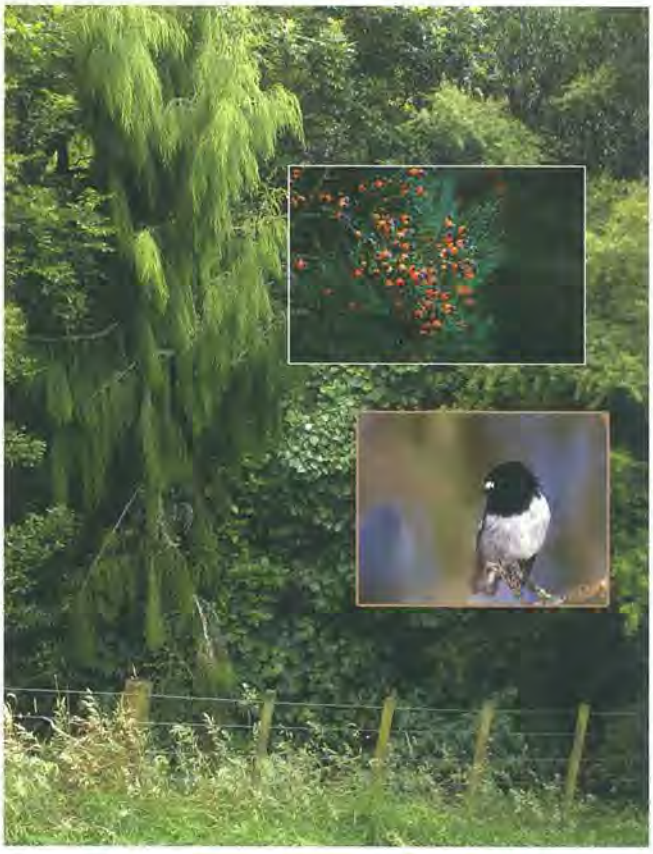
Farms close to large natural areas are likely to have more wildlife than more distant farms, but birds will travel considerable distances to preferred food sources outside the breeding season (autumn and winter). Tūi routinely fly 20 km daily for seasonal nectar sources such as kowhai (Bergquist 1985); kererū have been known to fly 35 km (Clout *et al.* 1991). Therefore, farmers can hope to attract some birds to their farms even if the nearest native forests are at some distance.

Although tūi and kererū don't need forest or shrubland corridors to access farms, some birds such as robins probably do (T. Lovegrove unpubl. data). Kiwi also use forest fragments as stepping stones to travel further afield. While corridors for other fauna (e.g., insects and snails) also make sense, as yet there is no scientific evidence that corridors enhance native bird populations in New Zealand.

What Are the Most Important Steps to Take?

To increase wildlife, the first priority is to improve existing bush, trees, or wetlands on farms to increase food resources for wildlife. Fencing protects natural areas so that bush and wetland health improves, and the understorey thickens. Pest control, particularly of possums and ship rats, will increase nectar, fruit, and insect availability for wildlife. If the species of plants present don't provide preferred food resources at particular times of the year, supplementary planting around the edges may help attract birds. For example, tūi strongly seek rewarewa when it flowers in spring in the Waikato.

Increasing the quantity of habitat by planting is also important, though restored areas take time to develop significant food resources. Plant as many trees as possible to enlarge existing remnants, riparian strips, or wetland areas. Trees can also be planted along roads or tracks, or in low productivity areas such as steep faces or gullies. Plant trees that provide food for different times of year, but particularly those that flower or fruit in the winter (non-breeding season) to attract tūi and kererū that range widely at that time. Food sources may not be the limiting factor for bird population size; however, providing sources of favoured food may draw more birds into view. In addition to fruit or nectar, consider also that trees may provide roost and nest sites and habitat for invertebrates, another source of bird food.



Native bird populations can be increased by reducing predator densities when and where the birds nest. The main predators of small native birds in the North Island are ship rats, possums, feral cats, and kāhu (harriers) (Brown 1997; Innes *et al.* 1999). Ship rats and possums can be targeted together using bait stations. Feral cats are most often trapped, and chimney traps have been found effective for this species. Kāhu are a native predator and a protected species.

Magpies are conspicuous chasers of birds, but pest mammals are the secretive killers. Magpie control on farms won't help increase bird populations, but may allow more frequent visits of birds to some farm gardens or other places farmers wish to see them (Morgan *et al.* 2006).

Different species need different habitats, so the more varied the habitats on a farm, the more species a farmer can expect to see. As well as bush, wetlands, ponds, streams, and riparian habitats, different species (e.g., reptiles, invertebrates, fungi) will use rock outcrops, logs (both standing and fallen), and stumps. Forests that have a range of layers provide more opportunities for different species than forests with a more simple structure.

2.6 TIMBER PRODUCTION

KEY POINTS:

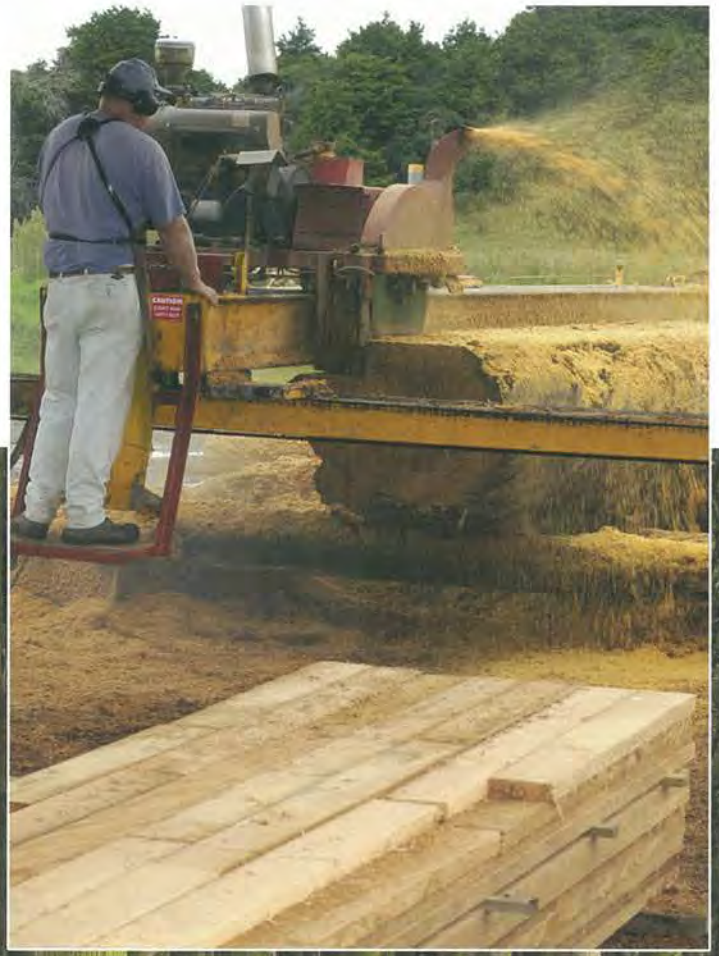
- A range of native tree species, with good potential for timber production, have excellent wood quality and growth rates and are amenable to silviculture
- Expected relatively long rotations of natives compared to pines means that the non-timber benefits of growing natives should be considered in any economic evaluation
- Harvesting trees from existing natural forests requires a MAF-approved management plan or permit; there may be restrictions in regional and/or district plans
- Improved systems for tax deductibility and security of harvest are required
- Native trees have excellent scope for selective harvesting or continuous cover forest management so that other forest values can be retained.

KEY ISSUE:

Natives are uneconomic for timber production and I'm not certain I will be allowed to harvest them

Farmers said:

- Planting trees for timber is a good investment but we need better systems for tax deductible expenses and for security of harvest
- Native trees have a high commercial harvest value
- You can reduce maintenance costs by planting kauri as it is a self-pruner
- Maintaining future management flexibility is very important.



Managing tōtara regeneration for a farm timber crop

Amongst the scrub-covered hills close to Kaeo in the Far North, Paul and Katharina Quinlan have a 6-ha property where they graze sheep, cattle, and horses across open paddocks and an area of scrub re-growth in a steep gully.

As in many parts of Northland, tōtara here are so prolific they are considered weeds. The Quinlans find that tōtara are remarkably stock-proof and consequently can become dominant. "We don't plant any tōtara, they come by themselves, we just encourage them and tend them as they grow, and light grazing seems to work to their advantage".

Six years ago Paul and Katharina tagged and measured 400 trees as part of a detailed forest inventory and to measure growth. "The vigorous trees are growing at better than 1 cm in stem diameter every year despite some severe form-pruning, but the trees that are suppressed by competition are only doing millimetres". Clearly there is potential to significantly increase growth rates and form with timely intervention.

In contrast to plantation forestry, the trees are often in sporadic groups with mixed ages, and variable densities and form. Therefore any silvicultural work needs to consider each individual tree within its immediate context and future growth. Paul favours form-pruning rather than conventional lifts and removes only the double leaders, and heavy or steeply angled branches. Branch stubs are successfully callousing over and 6 years on from the earliest pruning, there is still no apparent rot or insect damage, even where relatively large forks and branches have been removed. Thinning to date has been conservative in order to encourage good tree height and stem form. Ring-barking is a strategy used on large mongrels, and sometimes kānuka or tree ferns are felled if they adversely affect the form of good young poles.

The Quinlans have a MAF-approved Sustainable Forest Management Plan for their immature tōtara forest and this is registered on their land title. Paul explains: "It was really a bit of an experiment. I found the Forests Act applies to all natural regeneration and so I have applied it. Also I saw it as the only way to secure the legal rights to future harvests. Without that confidence it would be hard to justify my input".

At present their young forest has few trees of merchantable size so the focus is on developing the forest structure for the future. Paul acknowledges that realising any financial value from their tōtara forest will have its own marketing challenges. However, he considers the abundant tōtara on Northland farms may amount to a sizeable regional resource and therefore hopes that the potential for sustainable management and supply may attract market attention. Sustainability is a concept that Paul fully supports and he sees management of the emerging tōtara forest areas as part of a gradual transition in land-use emphasis from purely pastoral farming to a mix of grazed areas and continuous-cover indigenous forestry. "Our management objectives are broader than just timber production and we have long-term outcomes in mind" says Paul.

Even severe form pruning such as removal of double leaders does not seem to affect tree health where stem scars show no apparent rot or insect damage (far right).

David Bergin, Ensis, Rotorua

Native timber species provide future generations with the option for specialty timber production while at the same time contributing to a range of biodiversity objectives and improved land use values on the farm. As regeneration of native species on retired farmland is unpredictable and may be limited by the lack of a local seed source and the dense competition of rank grass, planting is likely to remain the major method for establishing a native timber resource on farms.

Choice of Species

The best native tree species for planting and managing as a wood resource are those that are amenable to silviculture, occur naturally in the area, are relatively fast-growing, and have desirable wood properties. These characteristics for each of the major timber species are reviewed by Bergin & Gea (2005). The key conifer timber species include kauri, tōtara, and rimu while other conifers include kahikatea and tanekaha. Key hardwood species for potential timber production on farms include rewarewa, pūriri, and kohekohe for northern regions, and beech for upland and more southerly locations. More detailed information on planting and management has been given by Bergin (2003) for tōtara, Bergin & Steward (2004) for kauri, and Wardle (1984) for the beeches.

Kauri trees, planted and carefully tended by the Suttons on an ex-kiwifruit farm in Te Puna, Bay of Plenty, have shown phenomenal height growth of 6 m over 6 years!

These 6-year-old puriri on a fertile lowland South Auckland site are now 7 m high with an average diameter of 10 cm.

Tending and Tree Form

There are clear indications from both planted and natural stands that stocking (density) can influence stem form and branch development. Lack of side competition in farm plantings of native trees such as in shelterbelts, low-density stands, or scattered specimens in paddocks will encourage poor form with large multi-leadered crowns, compromising wood quality. Farm-planted natives therefore require removal of multiple leaders and steep-angled large branches over the first one or two decades.

Intensive pruning of tōtara and pūriri has been carried out successfully (although coppicing can be a problem with pūriri where light levels increase below the canopy if stands are opened up too quickly). While other native trees such as kauri, kahikatea, and tanekaha have strong apical dominance (a tendency for a single stem), multiple leaders can still occur and will need to be removed at an early stage. Although rewarewa has a columnar crown shape, many trees have several leaders and need early intervention to maintain a single straight leader.

Growth

In a survey of native plantations throughout the country, annual growth rates of 30–50 cm in height and 5–10 mm diameter were found for most native conifer and hardwood tree species (Pardy *et al.* 1992). There are indications that where there is appropriate matching of species to site, and good management practices are undertaken, farm plantings will give considerably faster growth rates. Established plantations of kauri and tōtara indicate stems in excess of 35 cm diameter can be produced within 60 years on good sites (Herbert *et al.* 1996; Bergin 2003). Hardwoods inter-planted within a nurse crop on retired farmland also have relatively fast growth rates.

Management of Second-Growth Tōtara Stands

Unlike the other major native timber species, tōtara is successfully regenerating on farms throughout the country. In addition to regenerating in riparian areas along with kahikatea, tōtara can successfully colonise steep slopes of pastoral farmland, often mixed with other unpalatable species such as mānuka, kānuka, and gorse.

Evaluations of these naturally regenerating tōtara-dominant stands in Northland show that, with natural thinning, semi-mature stands develop where trees are relatively uniform in stem size and form (Bergin 2003). These can be opportunistically managed for timber without compromising existing pastoral land use.

Wood Quality of Planted Native Trees

Until the late twentieth century, native timber was derived from trees several hundred years old where heartwood comprised the bulk of the stem. In contrast, for native conifers in particular, planted and second-growth stands fewer than 100 years old appear to have a high proportion of sapwood (Bergin 2003). In planted and natural second-growth kauri stands, Steward & Kimberley (2002) found heartwood formation to be strongly correlated with stem diameter — larger stems had more heartwood. For native hardwoods (e.g., pūriri, rewarewa), heartwood formation is likely to occur considerably sooner than with native conifers.

Despite the high proportion of sapwood, opportunities exist for utilising wood from semi-mature trees harvested from plantations. For example, farm-grown tōtara wood comprising mostly sapwood is easily worked for carving and cabinet making; it is as hard as heartwood and has similar finishing properties. Dining tables, stools, interior and exterior doors and architraves, wall panelling, railings, and posts have all been produced from farm-grown totara, and its use for framing and exterior cladding of farm buildings continues (Bergin 2003). Preliminary wood quality studies suggest that relatively young kauri plantations have potential as a valuable solid wood resource and are not necessarily inferior to natural second-growth stands containing heartwood (Steward & McKinley 2005).

Long-Term Management

Extraction of selected stems, rather than clearfelling, will be required for most, if not all, farm planting and will retain the other forest values for the landowner. The planting of native trees over a range of farm sites is likely to offer considerable flexibility in managing stands whereby stems in small blocks can be felled into paddocks for transporting to the sawmill or for on-site milling. Scope therefore exists for developing a considerable regional resource of farm-grown native timber on a range of sites. Using continuous cover forestry practices (selective harvesting) a permanent forest cover can be maintained that will continue to contribute to environmentally sustainable farming practices.

This naturally regenerating tōtara stand was thinned from 3225 stems/ha (left) *to around 1325 stems/ha and residual trees were pruned to at least 4 m* (right). *This is one of a series of trials recently established by the Northland Totara Working Group.*

Above: *Paul Quinlan and baby Jessie looking to future harvests*

Left: *Tōtara tended for wood production*

Marilyn with Heidi and Joel

Establishing a kauri woodlot on a dairy farm

Gray and Marilyn Baldwin own a 187-ha dairy farm near Putaruru. It accommodates 410 dairy cows, and areas of forestry as well. The farm was expanded recently from 120 ha with the addition of ex-forestry land purchased from Carter Holt Harvey.

Rather than attacking all the cutover radiata pine stumps with diggers, bulldozers, fertiliser trucks, and maize planters, Gray and Marilyn decided to leave areas of north-east-facing slopes to establish one of the first commercial native forests in the district.

Choice of species was the first major consideration. "While tōtara does grow naturally around our place, we wanted to plant an icon timber species that would be easy to market and have minimal silvicultural input", Marilyn says. "We were not concerned about rotation length as we regard wealth creation for our children to be of equal importance to that for ourselves". For the Baldwins, the mighty kauri was the obvious choice.

They decided to plant at 3 × 3-m spacings to allow for natural mortality and the opportunity to thin the trees in future. This meant a total requirement of 5500 trees. They grew 2500 kauri to PB 2 size over 2 years in an irrigated nursery they set up on their own farm, and the remainder were sourced from Annton nursery in Cambridge.

"We agonised over the autumn *vs* spring planting decision", says Gray. "Kauri can be vulnerable to frosts at establishment time, but all natives can suffer from dry summers as well". A spring planting was opted for in the end as the South Waikato has reasonably reliable summer rainfall, but can have hard frosts. Planting was completed in September to allow a good 8 months of establishment time before the first frosts could be expected in May.

Gray and Marilyn view site access and preparation as the most important things to get right as they "stack the odds" in favour of successful kauri establishment. "Prior to planting we helicopter-bombed the site with high doses of glyphosate and metasulfuron followed by a big burn-off. That was 12 months ago and I haven't seen a blackberry, barberry, or buddleia poke its nose out of the ashes to compete with the kauri yet", Gray explains. "The digger was in there for days making a network of tracks which will enable us to undertake the inevitable releasing and tree-tending work much more easily".

Marilyn is philosophical about ever seeing a financial return from the trees, which are likely to take 60 to 80 years to mature. "In the meantime I look forward to sitting up on the ridge in a forest of New Zealand's greatest tree enjoying the beautiful view over the Pokaiwhenua stream. That's got to be worth something".

Young kauri have been planted into areas previously in pine on the Baldwin's dairy conversion, which has been planned with steep-contour slopes planted in trees and inputs focused on the better class of land.

G.P. Horgan, MAF, Rotorua.

There has been some rekindling of interest in native timber prompted by environmental concern, a search for higher value niche timbers, and debate about relying on a plantation timber estate dominated by a single exotic species. Reports of native sawn timber retailing at $2,500 to $3,000/m^3 have helped maintain this interest, despite the relatively long rotations of native timber crops. Does this mean that the conclusion of the 1913 Royal Commission on Forestry that "analysis shows the utter absurdity of suggesting a tree such as the tōtara for afforestation purposes" no longer applies today? Unfortunately, if the evidence is limited to timber production value, the answer is no — it still applies.

Over the period since 1921, inflation has meant that the price of $9.19/m^3 in 1921 is equivalent to a 2005 price of around $350/m^3. Current prices for sawn timber from kauri, rimu, and beech range from $1,500/m^3 to $3,000/m^3. These figures still indicate a real increase in the value of native timber over the last 85 years but suggest this has been of the order of 6- to 7-fold rather than the 326-fold that might be indicated by simply using the raw unadjusted price data. Doing the same exercise with stumpage (i.e., log prices, rather than sawn timber) produces a similar result — the economics of a plantation producing only native timber are much the same today as in 1913.

The Dilemma of Time and Discount Rates

An economic analysis of an investment requires consideration of the time value of money and discounting — and discounting over a long period has a dramatic impact on any income, even a high one. For example, at a 6% discount rate, an income of $3000 in 50 years' time is worth only $162.86 in today's terms. For native timbers the rotation length is at least 50 years, with a typical rotation likely to be 100 years or more. Also, many of the costs for a crop occur in the early years where the impact of discounting will be least, while the revenues are in the later years where its impact will be maximised.

Whenever one carries out an economic analysis of investing in growing a longer-rotation native species the outcome is generally comparable to the 1913 Royal Commission's findings or the kauri results reported by Barton & Horgan (1980), Herbert *et al.* (1996), and Horgan (2000). These all showed a typical return from plantations of native species of between 1.5% and 2%.

Costs and Benefits

For the investor a 2% real return, on a risky proposal, is insufficient to justify investment. However, not every value or output from productive activities is necessarily recognised and priced in the marketplace. Nor are all the costs of a particular activity necessarily borne by the person carrying out that activity. In economics there are the costs and benefits (referred to as externalities) of an activity that those doing the activity are either not held accountable for (costs) or are unable to collect revenue for (benefits). Benefits can be specific and personal, such as a person planting native trees for personal pleasure, while others are more widespread such as absorption of greenhouse gases that helps combat global warming. The difficulty is determining how large these benefits might be and whether inclusion of these in the analysis might change the conclusions reached.

Non-Market Benefits

Non-market benefits of indigenous plantation forests include the diversity that they bring to our environment, their value as a repository of genetic material or as a home for other indigenous species, or their value as a carbon sink (*see* Carbon Sinks section). There could also be recognition that growing this sort of crop can be much less damaging than other land uses such as the impact of forestry on water quality, compared to intensive dairying.

Valuing what may appear to be a relatively small benefit can, however, have a dramatic impact on the overall worth of investing in longer rotation species. For instance, Barton & Horgan (1980) demonstrated that, for kauri forestry on a 100-year rotation, if non-market benefits specific to that species were of the order of $420/ha annually, this would be more than sufficient to tip the balance in favour of kauri over radiata pine.

While it is widely acknowledged that, in addition to their potential high-value as a specialty timber, indigenous species add to the aesthetic, amenity, biodiversity, cultural, heritage, and other values of our farmscapes, the challenge is in determining what these benefits are worth. The relevant values and the weights accorded to them will be quite specific to each species and each site, and the costs and benefits will therefore need to be quantified on a case-by-case basis.

Ian Platt, MAF Indigenous Forestry Unit, Christchurch

Part IIIA of the Forests Act 1949 provides opportunities for owners of existing indigenous (natural) forests to harvest native timber. Specific options include:

- Sustainable Forest Management (SFM) Plans;
- Sustainable Forest Management (SFM) Permits;
- Personal use;
- Milling statements.

Sustainable Forest Management Plans

SFM Plans enable owners to manage existing forests for long-term timber production while also protecting natural, amenity, and other values. The term of a plan is normally 50 years and the plan must be registered against the land title(s) to which it relates. Harvest rates are established as a sustainable annual or periodic yield according to the growth rates of the different species being targeted for production. Plans must include measures for protecting the forest from pests and weeds. Up to 20% of the forest area may be set aside as a representative area, unavailable for harvesting.

Podocarp (e.g., rimu, matai̅, miro) and kauri species can only be harvested by single tree or small groups using low-impact harvesting techniques and considering selective removal of trees predisposed to windthrow or early death. Shade-tolerant/exposure-sensitive broadleaved hardwood species (e.g., tawa, rewarewa) must also be harvested by single tree or small groups. The beeches and other light-demanding hardwood species can be harvested in coupes of up to 0.5 ha. An approved Annual Logging Plan is required prior to any harvesting.

Where there is insufficient replacement growth present at the time of harvesting any podocarp, kauri, or shade-tolerant hardwood species, replanting is required. Replanting is also required where regeneration of light-demanding species fails after harvesting.

Sustainable Forest Management Permits

SFM Permits have a 10-year term and are ideally suited to smaller areas of forest. Permits, like plans, have requirements for forest protection including the option for protection of a representative area.

In contrast to plans with their annual harvest, permits have a capped maximum harvest volume for the term. The harvest volume can be up to 250 m^3 of podocarp, kauri, or shade-tolerant hardwood species and 500 m^3 of beech or other light-demanding hardwood species, or 10% of the standing timber volume (by species) of the permit forest area, whichever is the lesser amount. The approved volume can be harvested at any time during the term of the permit. Like plans, permits require an approved Annual Logging Plan.

The process for approving plans and permits includes consultation with the Department of Conservation, and with the Ministry of Māori Development (Te Puni Kokiri) where the land involved includes Māori land.

Low-impact helicopter harvesting of a high-value indigenous timber crop

Personal Use

A landowner who does not have an approved SFM Plan or Permit may apply to harvest and mill indigenous timber for personal use to a maximum of 50 m^3 of roundwood, made up of one or more species, over a 10-year period. Prior to approving any application the Ministry must consult with the Department of Conservation.

Milling Statements

Where there is no approved and registered SFM Plan or Permit, milling statements confirming the source and classification of the timber may be issued for milling windthrown, naturally dead, and salvaged timber. Milling statements are also issued for timber removed for construction and/or maintenance of an accessway, construction of a dam, a mining operation, a public work, and for bona fide scientific research.

All sawmills milling indigenous timber must be registered with the Ministry of Agriculture and Forestry – Indigenous Forestry Unit, and may only mill indigenous timber for which a relevant approval or milling statement has been issued. The harvesting of tree ferns is also covered by the Forests Act.

The Forests Act is administered by the Indigenous Forestry Unit of the Ministry of Agriculture and Forestry with offices in Christchurch and Rotorua. Further information, including contact details, is available on the Ministry's website www.maf.govt.nz.

HARVESTING PLANTED INDIGENOUS FORESTS — RESEARCH

Input by Chas Perry (MAF), Roger MacGibbon (Natural Logic), and Phil Martelli (Western Bay of Plenty District Council) to this section is gratefully acknowledged.

Planted indigenous forests (on land that was not under the cover of indigenous forest prior to planting) are exempt from the sustainable forest management requirements of the Forests Act. However, a statement confirming the status of any timber harvested from a planted indigenous forest is required before milling can take place. It is likely that a diverse understorey of indigenous shrubs and ground cover will develop as planted trees mature, and the plantation may look similar to a naturally occurring forest. Therefore, early documentation of indigenous tree planting is essential. District and/or regional plans may also have provisions that impede harvest of native trees.

District Plan Provisions

A review of the impact of District Plans on what a landowner can do with planted trees (Klepack & Stoecklein 2003) found that of plans from 23 North Island District Councils, all had sections relevant to forestry but only 17 distinguished between indigenous and exotic forestry, and only seven distinguished between planted and natural indigenous forest. With the exception of four councils that distinguished between exotic and indigenous trees *and* planted and natural indigenous forest (Gisborne, Hastings, Rotorua, and South Taranaki), most Plans do not distinguish planted natives from natural vegetation so that the planted trees are effectively included in rules preventing the felling of natural stands. In these cases, any removal of planted trees for farm management purposes would require resource consent, a process many farmers would prefer to avoid, and one that might not be necessary if pines were planted instead.

Irrespective of the district rules applying to the planting, management, and harvesting of native trees, it is recommended that landowners who wish to plant natives for any productive purpose record as much evidence as they can to prove that the trees were planted and did not establish naturally. A copy of this information should be retained to pass on to future owners of the land. It is also recommended that this information is deposited with your district council to be placed on your property file. (Some councils will accept this material on property files and others will not). MAF is also developing a register for Certifying Statements on the condition of the land at planting.

A kauri plantation, planted for timber. Many district plans do not currently differentiate between planted and regenerating native forest.

MAF Certificates for Planted Indigenous Forest

After consulting with representatives of the indigenous forest industry, MAF is drafting regulations that will enable its Indigenous Forestry Unit to issue certifying statements for Planted Indigenous Forests. These would certify that a defined area meets the definition of a Planted Indigenous Forest under the Forests Act 1949.

The certificate will provide verifiable evidence at time of harvesting and milling that the planted area meets the definition of Planted Indigenous Forest. This information is required under the sawmill and export controls of the Forest Act for the issuing of the Timber Milling Statement by MAF at time of harvest. Once the regulations are in place, MAF will need to work directly with local authorities to ensure they are aware of the planted indigenous forest provisions under the Forest Act and the availability of the new certifying statements.

Considering the long-term nature of indigenous forestry, the safekeeping of these certificates is an important issue. This can be catered for through:

- The MAF register
- The landowner registering a Forestry Right (which could refer to the certificate) under the Forestry Right Registration Act, if desired
- Placing a certificate on the property file at the local council, where this is permitted.

Creating a Forestry Right

A Forestry Right is registered against the land title and can record the purpose of the planting. This is an existing mechanism that provides secure safekeeping of the information with Land Information NZ. A Forestry Right would still benefit from a Certifying Statement on the condition of the land at the time of planting, so that when an Indigenous Timber Milling Statement is required at harvest, there is evidence that enables MAF to certify the forest is a "Planted Indigenous Forest".

A critical part of a Forestry Right is the management plan that goes with it. This specifies the management regime for the planted trees and can therefore provide documentation that the trees were planted. The management plan may cover aspects such as tending and replacement of harvested trees and the timeframe for the forest to exist (e.g., a sustainable harvest in perpetuity can be specified).

Landowners' ability to manage and harvest a planted indigenous forest could still be affected by controls on indigenous forestry in Regional and/or District Plans under the Resource Management Act 1991.

There is also no guarantee against future legislation changes affecting the status of planted indigenous forest — but then this is true of any legislation!

Registering Planted Forests in the Western Bay of Plenty District

Western Bay of Plenty District Council encourages landowners planting native trees for production purposes to send in a plan, which is placed on their property file along with other information pertaining to the property. On the plan, landowners show the date and what has been planted, and state that the purpose of the planting is a production woodlot. GPS technology is a cost-effective way to accurately plot the areas planted. Aerial photos are also helpful to show that the area was not in native vegetation prior to planting. Such documentation will help secure future harvesting options.

2.7 NON-TIMBER PRODUCTS

KEY POINTS:

- There is a range of non-timber products that can potentially be sourced from native tree blocks.
- There is a growing range of niche products from native plants — including cosmetics, herbs, and foods.
- The commonly known ones are honey and oils
- Native plants provide services that enhance other business activites on the farm — including eco-tourism and livestock health

KEY ISSUE:

How can I get some income from native tree blocks, since I have to pay rates on them?

Farmers said:

- Flax can be grazed for parasite control
- Rongoā (medicinal plants) can be gathered from native bush
- Eco-tourism and homestays are more attractive because there is native bush on the farm
- Native bush provides honey

CASE STUDY

Making money from mānuka

Robert and Suzanne Carter farm 333 ha of moderate-steep hill country in the Kirikau Valley to the south-west of Taumarunui. They winter 16 stock units/ha and have about 25 ha of pines. The farm also has 60 ha of mānuka scrub in several blocks, which Robert estimates have been reverting to mānuka for anywhere from 17 to 35 years. On most farms this sort of scrubland would be a liability, and the local discussion group has encouraged the Carters to look into removing it. But on this farm, there's another factor to consider.

Robert and Suzanne Carter farm 333 ha of moderate-steep hill country in the Kirikau Valley to the south-west of Taumarunui. They winter 16 stock units/ha and have about 25 ha of pines. The farm also has 60 ha of mānuka scrub in several blocks, which Robert estimates have been reverting to mānuka for anywhere from 17 to 35 years. On most farms this sort of scrubland would be a liability, and the local discussion group has encouraged the Carters to look into removing it. But on this farm, there's another factor to consider.

In 2004 the Carters went into partnership with a local beekeeper to establish 24 hives amongst the mānuka scrub on the property. They harvested over 450 kg of honey which, when tested in the lab had a UMF level of 13. This UMF test (Unique Mānuka Factor) rates the antibacterial properties of the honey for use in the treatment of infection, and UMF 10 is the recognised minimum standard. Robert gets 20% of the honey produced and plans to market it locally, where he reckons he should be able to gross $40/kg. Not a bad little income for 60 ha of scrub. And that's not the only benefit.

For some time, Robert had observed his lambs finishing really well in the mānuka blocks during dry summers. This he attributes partly to the shade of the scrub and partly to the understorey pasture which is full of *Lotus major*. The scrub is not very dense, and so there is still pasture growth underneath. In years past, Robert had been gradually clearing the scrub from the slopes to improve pastures and plant poplar poles for erosion control, and at one point he asked himself "Why am I cutting down trees to plant more trees?"

The local soil conservation officer advised him that mānuka had good rooting properties, so he stopped clearing it. The neighbours were concerned about the precedent of leaving mānuka, and Robert is still motivated to clear it where the economics of pasture improvement stack up.

The farm discussion group did an exercise examining the cost-benefit of pasture renewal on the mānuka blocks (*see* box). Interestingly, the numbers show only a small benefit, which will be very dependent on the number of extra stock units the Carters can carry. On the other hand, it's not clear whether they can retain the mānuka in production either — the older mānuka is slowly being replaced with broadleaf native trees such as māhoe, hohere, and putaputawētā — and so it is conceivable that the active honey supply may dry up. Robert has been exercising his imagination as to whether it's possible to operate a mānuka crop rotation, to retain an ongoing area in young flowering plants and keep the honey flowing. This challenge has also served to stimulate his thinking as to what other services the regenerating scrub may provide in future, such as carbon credits, riparian management, and soil conservation.

Cost-benefit analysis of mānuka clearance for Carters (60 ha)

Income		$/ha/year
Gross margin for Stock Unit increase		
420 SU @ $25/SU	$10,500/year	175
Expenses		
Development costs	$/ha	
Clearing	400	
Capital fertiliser	150	
Seed	150	
Fencing/water	20	
New stock	700	
Capital cost	1,420 @ 7%	100
Opportunity cost of honey		
90 kg @ $40/kg	$3,600	60
Net benefit = 175 – 100 – 60 =		15

The input by Rob McGowan (University of Waikato, Tauranga), Liz McGruddy, and Marion Johnson (University of Otago, Dunedin) to this section is gratefully acknowleged.

Besides their potential for timber, there are many other productive uses of native plants. Some of these are traditional uses, developed through the indigenous knowledge systems of Māori, while others are more recent developments.

Traditional Uses of Native Plants: Rongoā Māori

The plants used for rongoā, traditional Māori medicine, are generally found in the regenerating fringe of the forest, so it is fair to say that the plants that heal the land also heal those who live off the land. In the bush, their role is to cover the ground quickly and provide a protective canopy under which the more substantial and permanent trees of the forest can become established. The presence of these species is a good indicator of forest health and restoration. While few of them will give a return to the farmer, they may bring benefits either for personal health or for stock. Māori have traditionally used many of these forest fringe plants for medicine, and this still happens on a local basis. For example, today people are again being encouraged to use the tops of ti kōuka, the cabbage tree, to help manage diabetes.

Stock Fodder Use

Many plants are beneficial to stock, including harakeke, karamū, koromiko, raurēkau/kanono, houhere, and makomako. Koromiko can be helpful for stock, particularly calves that are scouring. Farmers concerned about drench resistance are planting harakeke (flax) into hospital paddocks for grazing by stock with worms. With growing concerns about the use of animal pharmaceuticals on the farm, there is great potential for more research into viable alternatives from the bush. Reports on anthelmintic properties of plants say little about New Zealand natives, but identify a good number of South American plants which have relatives in New Zealand. Extracts made from 100 native plants were tested in the lab for their effect on lungworm, a parasite infecting deer, cattle, and sheep. Of these, 40 showed some activity with māpou, makomako, and the myrtle *Lophomyrtus obcordata* showing the most promise, followed by a number of coprosma species. While this is only a preliminary lab result, field trials are planned to determine their role on the farm in the battle against parasites.

Cattle are well-known for stripping flax leaves, and anecdotal information says they do well on them. In 1959 Hector McIntosh, SI Consulting Officer, wrote that of all the cattle seen in his travels in the South Island, the cleanest young stock were to be found in Western Southland where flax is grown as shelter. A Te Pahu farmer offered foliage of different plants to his animals, with the clear favourites being taupata and flax. These seemed equally palatable to horses, cows, and sheep. Other native plants which animals self-served with relish included māhoe and five-finger.

Native Plants for Cosmetics

Several native plants are used for cosmetics and natural skin products. Suitable mānuka oil is currently produced only on the East Coast of the North Island, but other plants used in natural cosmetics are more widespread. For example, one company in Northland uses the following plants:

- Kūmerahou — used in a shower gel and shampoo
- Tōtara — a cosmetic preservative is currently extracted from old tōtara fence posts, rather than using living trees
- Harakeke (flax) — the gel extracted from plants is a common ingredient in cosmetic products.

Flax — Wonder Plant

In addition to its traditional use as a source of fibre, there are applications for all parts of this highly valued plant (McGruddy 2005). Today, apart from landscaping uses, the leaf is used in weaving and floristry, the root is used in medicinal products, leaf extracts are used in soap, seeds are used to make flax seed bread, and the gel is turned into flax cough lollies.

Spicing Up Restaurant Food with Natives

There is a growing market for natives being used in gourmet and restaurant food. Pikopiko, the young shoot of the mouku fern, is becoming a New Zealand connoisseur food, while horopito and kawakawa are used in spice mixes.

Wai 262 Claim and the Therapeutic Goods Act

The use of native plants for commercial purposes is subject to a Treaty Claim lodged with the Waitangi Tribunal, known as Wai 262. The concern is over the commercial use of native flora and fauna and particularly the claiming of intellectual property rights without reference to Māori, or to the well-being of the species involved. The issues are complex, especially with the New Zealand Government currently considering the Therapeutic Goods Act, under which the manufacture of pharmaceuticals from New Zealand species could come under the control of a joint Australia-New Zealand committee.

Māori strongly support the use of New Zealand plants in the landscape and efforts to use land in a way that respects and protects its integrity. It is important to appreciate Māori concerns in this area, and to support their drive to retain New Zealand control of indigenous species. If issues arise, the best course is to discuss them with local Māori.

2.8 CARBON SINKS

KEY POINTS:

- Only actively regenerating forests, not mature forests, accumulate carbon
- There will be an international market in carbon credits based on the Kyoto Protocol
- There are systems available and under development for individual landowners to be paid for carbon storage in growing forests
- The ideal forest type is a regenerating forest at low altitude, at least 50 ha in area
- Only forest that has been planted since 1990 will qualify for carbon credits.

KEY ISSUE:

Can I get anything out of these carbon credits or has the Government taken them?

Farmers said:

- Native trees are a carbon sink
- Carbon credits need to be available to landowners to create Kyoto forests
- Carbon credits could be gained from planting native trees
- A credit system for farmers must be simple to manage.

HYPOTHETICAL CASE STUDY

Managing a Forest for Carbon Sequestration

If your primary aim is to manage native forests to create a permanent carbon sink, what should you be looking for?

The following points may help (sourced from EBEX21, the Manaaki Whenua - Landcare Research carbon trading framework):

What type of patch is ideal as a carbon forest?

- Scrub or young regenerating forest at low altitude
- At least 50 ha in area
- In pasture or less than 30% tree cover at 31 December 1989
- Contains plant species that can reach 5 m height at maturity
- Close to seed sources of native forest trees
- Protected by a covenant (e.g., QEII or Nga Whenua Rahui covenant)

How to manage a forest for carbon sequestration

- Prevent fires
- Exclude stock by fencing
- Encourage natural regeneration (this may mean leaving gorse or other woody weed species that act as a nurse species for indigenous tree seedlings)
- Control animal and plant pests to maximise regeneration
- Plant native seedlings to accelerate regeneration or when canopy forest species are not establishing (perhaps due to a lack of a nearby seed source). Typically there is a rapid increase in biomass (hence carbon) over the first 300 years after planting (Fig. 4).

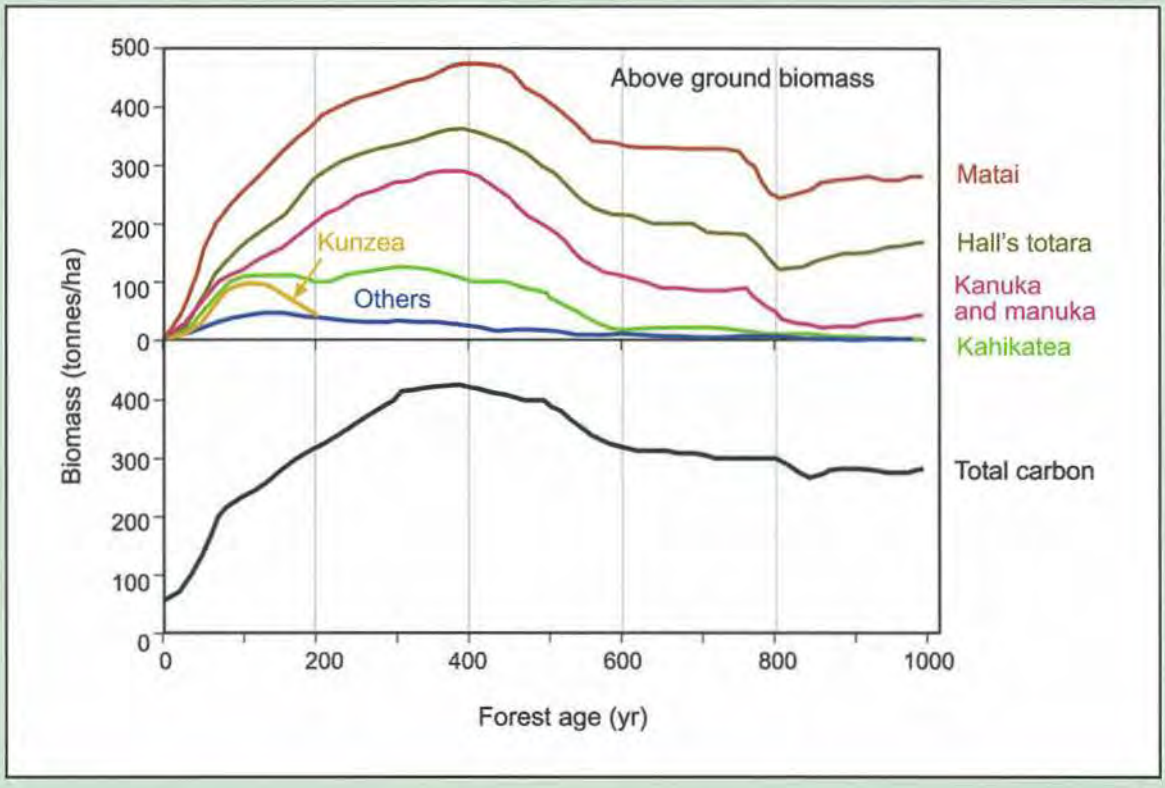


Figure 4. *Typical above-ground biomass and carbon levels in a planted forest over 1000 years, showing accumulation in the first 300 years (adapted from Hall 2001)*

Indigenous Forestry Unit, MAF, Christchurch.

The Kyoto Protocol came into force on 16 February 2005, binding those countries that have ratified the Protocol, including New Zealand. The aim of the Protocol is to reduce greenhouse gas emissions linked to global climate change. For more information on the Kyoto Protocol, visit the New Zealand Climate Change Office website www.climatechange.govt.nz

MAF is currently developing a Permanent Forest Sink Initiative (PFSI), to promote new permanent forests under Article 3.3 of the Kyoto Protocol. The PFSI offers landowners the opportunity to claim carbon credits from newly established permanent forests between 2008 and 2012.

To qualify for carbon credits under the PFSI, forests must be established and managed according to certain requirements. These include establishment using a *"direct human induced activity"* on *"Kyoto-compliant land"*. Any harvest must be consistent with *"continuous canopy forestry"*, meaning these forests cannot be clearfelled. The forest owner will meet all costs of administration, monitoring, auditing, compliance, and any liabilities for maintaining carbon stocks.

What is Kyoto-compliant Land?

The official definition of Kyoto-compliant land has not yet been internationally approved. Generally, it is land that was non-forested as at 31 December 1989. The definition of non-forest clearly includes pasture, but is less clear regarding different levels of scrub cover. The minimum area is 1 ha.

What is a Carbon Credit?

A carbon credit is equivalent to 1 tonne of carbon dioxide (CO_2). To work out the approximate amount of carbon (in CO_2 equivalents), multiply the volume (in m^3) of stemwood by 1.5. This figure has been calculated from generalised exotic conifer data, and estimates the carbon stored in the whole tree, including branches, leaves, and roots.

What is a Carbon Credit Worth?

The international price for emission units during the first commitment period is difficult to forecast. Uncertainties over future price levels apply to any commodity, but are greater for carbon given the lack of market history. The Treasury contracted The Allen Consulting Group in June 2005 to prepare a report on the price of CO_2 equivalent carbon credits. The "Allen Report" concluded that US$6.00 was a good indicative price, based on current market trading, although prices have fluctuated markedly since then.

How Many Credits are in a Hectare of Forest?

This depends on the age of a forest, the rainfall, altitude and latitude, and the species. Generally, using the average carbon uptake of a forest over its growing life, 3–5 tonnes of CO_2 could be absorbed per hectare per year for slower-growing species and 10–15 tonnes for faster-growing species. Only those forests that are growing absorb carbon; mature forests are at equilibrium, putting out as much carbon as they absorb.

Who Might Buy Carbon Credits?

It is anticipated that companies or countries with obligations under the Kyoto Protocol may purchase carbon credits. Third party traders and speculators may also wish to trade.

What is the Grey Market?

People are currently trading in grey market carbon credits, through schemes such as EBEX21. These have been created outside the Kyoto framework as a means to encourage carbon sinks. It is important to realise that only Kyoto-compliant credits earned through the PFSI can be used to meet obligations under the Kyoto Protocol. For more information on the EBEX21 carbon trading system, visit their website:
www.ebex21.co.nz

How will the Permanent Forest Sink Initiative Work?

Basically the PFSI will work following these steps:

- The landowner will apply to MAF with a forest sink management plan
- A forest sink covenant will be drawn up and registered on the title of the land.
- Audits will be undertaken at the beginning and end of each commitment period.
- Credits will be allocated on the basis of verified carbon absorbed.

For further information on the PFSI, visit:
www.maf.govt.nz/forestry/pfsi

CHAPTER 3 – MANAGING NATIVE TREES ON FARMS

This section provides a framework for managing native plants on farms, whether this is enhancing existing vegetation or new plantings. It is not a detailed how-to guide, for two reasons. Firstly, there is a great degree of variation in what are the most appropriate methods, depending on location. Secondly, there are many excellent publications and internet resources already available that cover this level of detail. Most of these are listed in the appendices. What this section does do is highlight the experience and learning of the farmers and researchers in order to present the wide range of issues that need to be considered when choosing to use native plants on your farm.

Where to start?

These two statements seem to be contradictory, but the essence is, get enough information to enable you to get started but don't get bogged down in too much detail. Much of the real learning and the successes come with experience and working with others. However, a number of key considerations came up time and time again in the workshops held with Northland and Waikato farmers who had experience with managing native trees. They are summarised in the Top Ten box, and the following sections cover them in more detail, with some additional sections on covenants and tax implications.

TOP 10 Important Considerations for Managing Native Trees on Farms

1. **Good advice:** get help and advice from others with local experience. Start with your neighbours' successes, and learn from their mistakes
2. **Do more research:** start reading around, apply for funding, especially now that there are many opportunities for grants to fence, plant trees, and control weeds and pests
3. **Encourage natural regeneration:** try to find out what's stopping natural regeneration and manage things where practical to improve natural revegetation processes, rather than starting with costly plantings
4. **Focus on key areas:** don't start with the most difficult site, start with small areas, do a good job, learn a lot, and move on to more challenging sites. Tackle what you can manage in the long term — planting is just the start
5. **Do pest control**, especially of possums and hares
6. **Be smarter with fencing:** match the fence type and construction to considerations of landscape and damage from falling trees. Make sure fences are permanently stock-proof for your type of stock
7. **Match species to site:** use what's growing on similar sites nearby as a guide, but consider whether you need to plant hardy pioneer species initially
8. **Use high-quality plants:** bite the bullet and pay for healthy well-grown nursery stock, but look for cheap ways to get good plants
9. **Consider the labour and money trade-offs:** dense plantings mean less maintenance but greater up-front cost
10. **Keep on top of maintenance:** you can't plant and forget. Inspect local sites to determine the type and intensity of weed growth you can expect. Establish tracks to ensure access for later maintenance.

3.1 PLANNING AND PRIORITIES

There are many reasons for planting and protecting native trees (*see* Chapter 1), so it is a good idea to decide where your priorities might be. If you are unsure of what you would like to do first, you could consider some of the different functions native trees can perform on a farm (*see* Chapter 2 for more ideas). This will give you a rough idea of the costs and benefits to you of some of your ideas.

Farmer quote:

"My first priority was fencing steep gullies out to prevent stock deaths"

Taking time to plan can help identify areas where native trees are the best land use.

Things to consider:

- Getting good advice. Many farmers in the workshops pointed out that that the best sources of advice were local enthusiasts, consultants, and farmers who had a combination of technical expertise and local experience. There is now a wide range of organisations and individuals interested in encouraging and supporting management of native trees on farms, and these are listed in Appendix II.
- How do you want the landscape to look in future (what was the original vegetation?)
- Views you want to enhance or screen
- Future access for maintenance and harvesting
- Who else might use the areas and how will the changes affect them (e.g., anglers)?
- Potential damage to fences and plants from flooding and the need to keep flood channels clear
- Which pests need to be controlled — possums, hares, goats, rats, stoats, ferrets, weasels, and even humans?
- Use a good-quality map of the farm to aid planning
- Site conditions — windy, waterlogged, frosty, dry, poor pasture growth, weedy
- Set a budget allocation within the overall farm budget
- Are there plants poisonous to stock (e.g., tutu, ngaio, tree nettle, poroporo, rangiora)?

Key resources

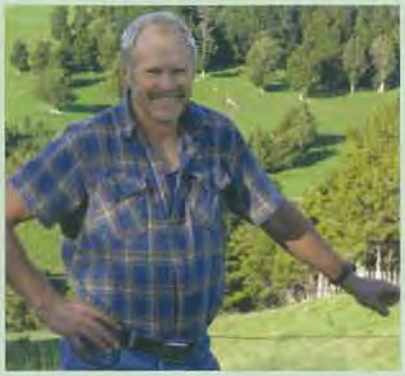
"Managing Natural Features on Farms" available from the NZ Farm Environment Award Trust or www.maf.govt.nz

"Forest Fragment Management Series" factsheets (1–5) available from Environment Waikato

"Wetland Management Series" factsheets (1–5) available from Environment Waikato

"Restoring the Balance" biodiversity self-help kit, available from the NZ Landcare Trust

"The poisonous plants in New Zealand" by Henry Connor, available from Landcare Research



Whole farm planning

Doug and Sally Lane have their 250-ha sheep and beef farm in the headwaters of the Kaeo River. They've been doing their bit to improve water quality and biodiversity through a range of land management measures which are helping to make farming easier.

Doug has long been involved in farm forestry, and has planted thousands of trees on the property. They have taken the steeper areas of the farm out of grazing, with 60 ha in radiata pine and cypress production forestry and various native species for timber including kauri, kahikatea, and tōtara. Steep, marginal sidlings are being allowed to regenerate in tōtara which will be managed for timber in the long term. Over 60 ha of the very steep regenerating country has Queen Elizabeth II National Trust covenants to protect existing bush remnants on the steepest parts of the farm. Doug says "The QEII Trust helps by paying for half of the cost of the project."

"This land was cleared with the encouragement of Government land development loans in the late 1970s and early 1980s. But it's always been marginal country. I'm turning that around and planting the whole lot in trees again. I've taken all the steep land out so that the remainder of the farm can be fertilised by a ground spreader," Doug says.

With a Department of Conservation block next door, there are now about 400 ha that are protecting the main stream that feeds into the Kaeo River. His current scheme is to fence off as many of the waterway edges as possible as cattle crossings are known to be significant pollution sources. These are an ideal place to plant native trees such as kauri for timber. Beef cattle are not moved as much as dairy herds, but Doug would still like to keep them out of waterways and install water troughs for them. "I don't want stock getting stuck in gullies." He says the better part of 1 km of stream bank will be protected from stock on his farm.

Doug says he originally planted trees that he could harvest quickly such as pines and cypress, but now he tends to plant more native trees. He aims to have shade available for stock in every paddock. "It makes a much more pleasant work environment," he says.

He has applied successfully to the Northland Regional Council Environmental Fund for help with this project. "The grant pays for fencing and some planting and I provide the labour. I've always put $2000 aside each year for planting trees. Native trees are much slower to establish but I tend to have little problem with them," he says.

Above: *Pruned tōtara in the foreground with QEII covenanted area behind.*

Right: *Regeneration under tōtara forest that has been fenced off.*

3.2 FENCING

Fencing existing native forest or new native plantings from stock is essential. While there are a few hardy species such as mānuka and tōtara that will tolerate some grazing, most species will be quickly ringbarked or browsed. Bush exposed to grazing will usually not regenerate and will die out over time.

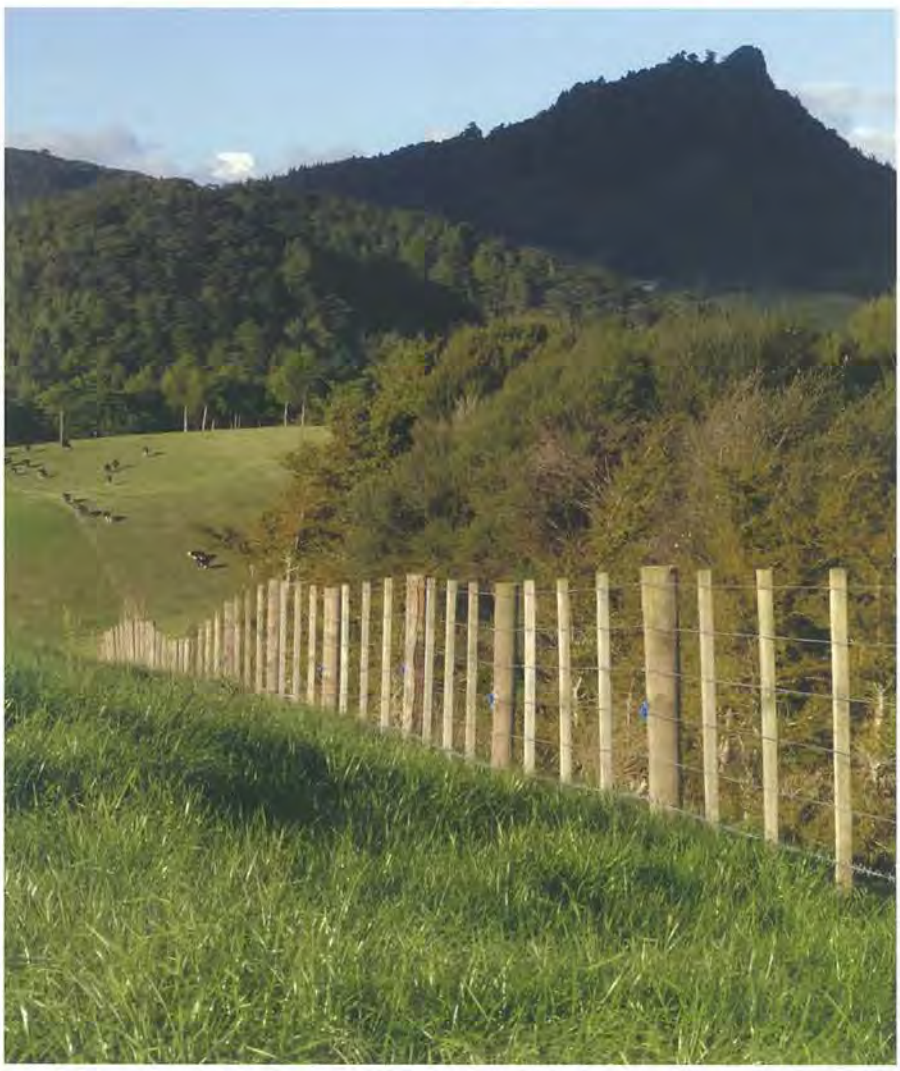
Farmer quote:

"Remember to include gates in fences — you need to be able to get the stray stock out!"

Unfenced native trees are prone to stock damage — while stock access to bush areas prevents regeneration and transfers valuable farm nutrients to unproductive areas.

Things to consider

- The type of fencing needs to be appropriate for the type of stock.
- Stock pressure on fences may require a robust design or an additional electric outrigger.
- Bench with a bulldozer to make construction and maintenance easier, but do apply fertiliser and resow any exposed areas.
- There are various funding sources to assist with fencing.
- Pest-excluding fence designs have been developed, though these are very expensive.



Getting the fencing right

Bill and Sue Garland have made managing native trees a significant focus of their sheep and bull beef farming operation on the western slopes of Maungatautari. Their first QEII covenant was put in place by Bill's father, mainly because it wasn't good grazing land, but partly, Bill says, because he "didn't trust us boys not to cut it down".

Bill has spent plenty of time thinking about, and experimenting with, the bush remnants. For him there is little question as to whether they should be fenced. In the early years he had major hassles mustering stock in the larger paddocks with open bush blocks in the middle. "The mobs would push through the trees from one side to the other so that it was a two-man job getting them out of the paddock." Bill has two clear aims for mustering: it has to be a one-man job and the mob has to get to the yards within half an hour. Fencing the bush blocks has enabled both aims to be met, so that mustering can now be done at any time of day, including the hotter periods when the stock would otherwise seek shade under the trees. One of the added benefits of fenced strips of trees is that they screen the bull mobs from each other and improve their behaviour.

The Garlands choose to bench steeper fencelines with a bulldozer

Then there's the question of where to put the fence. Bill says there isn't a recipe because every paddock is different, but he's developed a few guidelines over 20 years. Putting the fence as close as possible to the treeline is not a good idea — trees will fall over and wreck the fence. He reckons they get two or three windfalls in a typical year, but sometimes eight to 10 in a single storm. On the other hand, there's little value in leaving large areas in pasture inside the fence, just for the sake of a straighter fence. Bill isn't afraid to put plenty of angles in, although he's careful to avoid sharp corners that will trap stock when mustering, and every part of the fenceline needs to be visible from the bike.

Another issue is soil build-up along fencelines on hill slopes

And finally, what is the best type of fence? Their first makeshift attempts involved nailing mesh to the edge trees. Early post and batten fences were rendered useless by falling trees, and in one case by soil erosion piling up against the outside of the fence. Now they usually use an 8-wire fence with quarter rounds at 3-m intervals, a hot wire on the second-to-top, and permanent strainers on all wires. They use no battens, unless the fence is subject to stock pressure, such as along a raceway. A new long-life 2.3-mm wire (in friendly green) is also now available. They have managed to keep the cost of fencing below $10 per metre, but refuse to cut corners to save a few dollars when they can see much greater costs will result down the track.

The Garlands do not put battens on cattleproof fences beside bush

While nearby bush will give sone indication of well-adapted local species, factors such as exposure to wind, frost, waterlogging, high soil fertility, and competition from grasses and weeds will limit the success of planting into open pasture. Most new planting projects begin by planting a small area with a range of hardy coloniser species in the first year to observe what establishes best.

Farmer quote:

"I should have sourced more information on different species"

Things to consider

Plant type, growth rate, and site tolerance are important considerations in deciding on species for a particular purpose. Once you have some idea on what you would like to achieve, the following three-step process can be helpful:

- Select species that will perform the desired purpose (e.g., hardy species for shelter)
- Then from that list select species that are broadly matched to habitat type (e.g., wet swamp land, fertile but potentially weedy riparian margins, drought-prone ridges)
- Then from the list of species remaining select those that will tolerate the localised extremes at the planting site (e.g., frost, wind, drought) and/or select some fast-growing hardy native coloniser species that will tolerate the site to accompany the less tolerant species and quickly provide the micro-climate that will assist their growth.

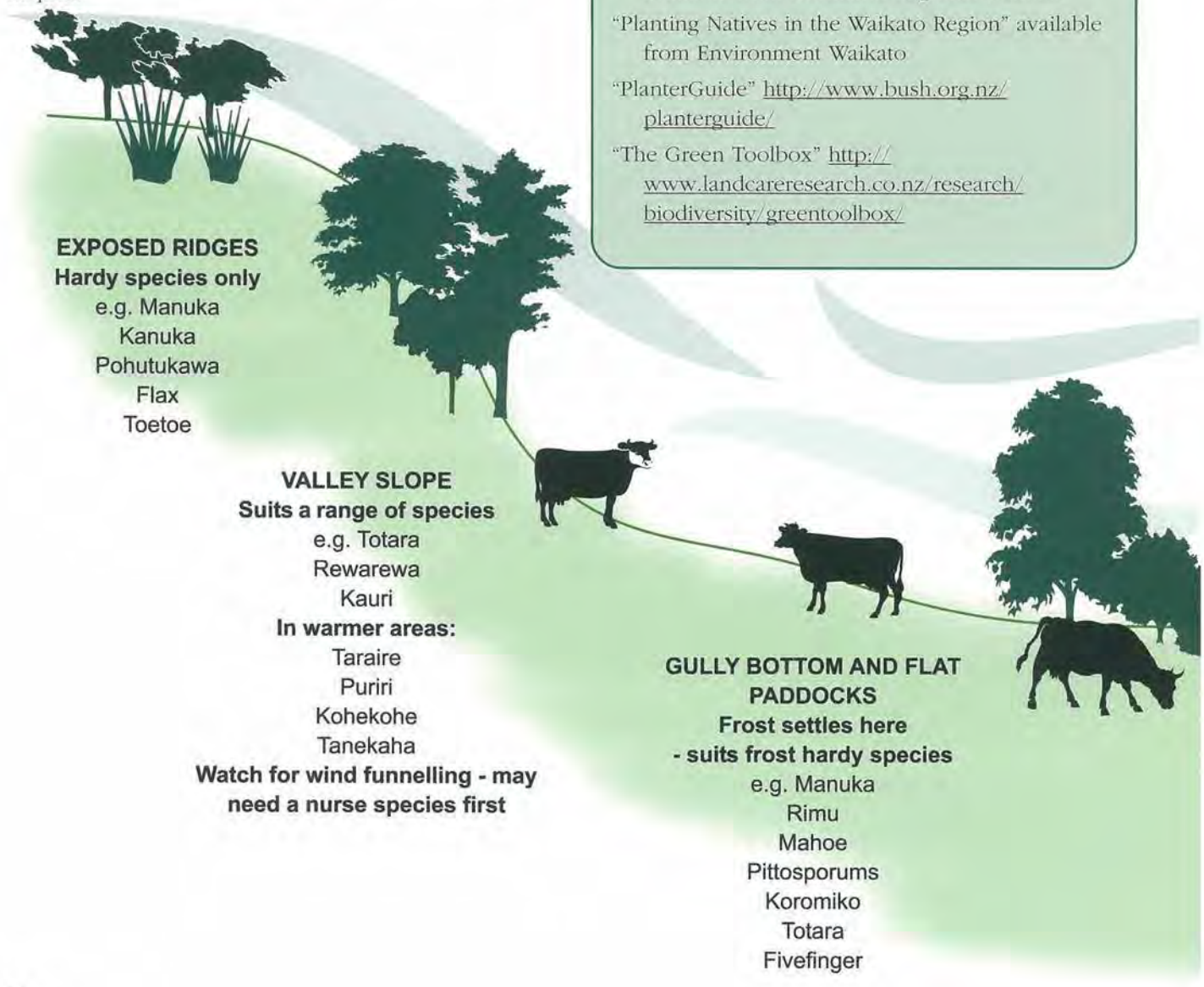
Key resources

"A Planter's Handbook for Northland Natives" available from Northland Regional Council

"Planting Natives in the Waikato Region" available from Environment Waikato

"PlanterGuide" http://www.bush.org.nz/planterguide/

"The Green Toolbox" http://www.landcareresearch.co.nz/research/biodiversity/greentoolbox/



3.4 PLANTING DESIGN

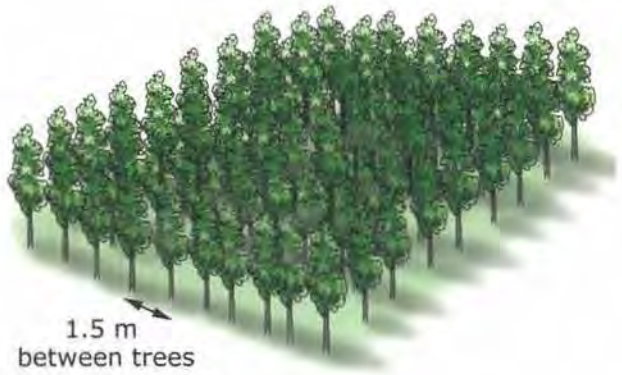
Planting design is very dependent on the function you want native trees to perform on your farm. Designs and layouts will vary greatly for shade, shelter, erosion control, timber, specialist crops, riparian zones, creating habitat, and forest restoration.

Farmer quote:

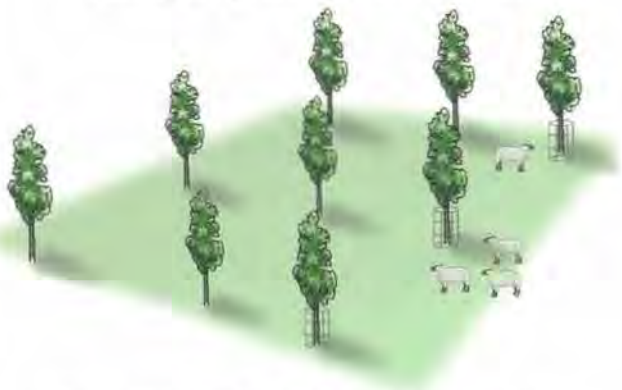
"The one thing I should have done?
Planted more trees sooner and gotten the benefits quicker"

Things to consider

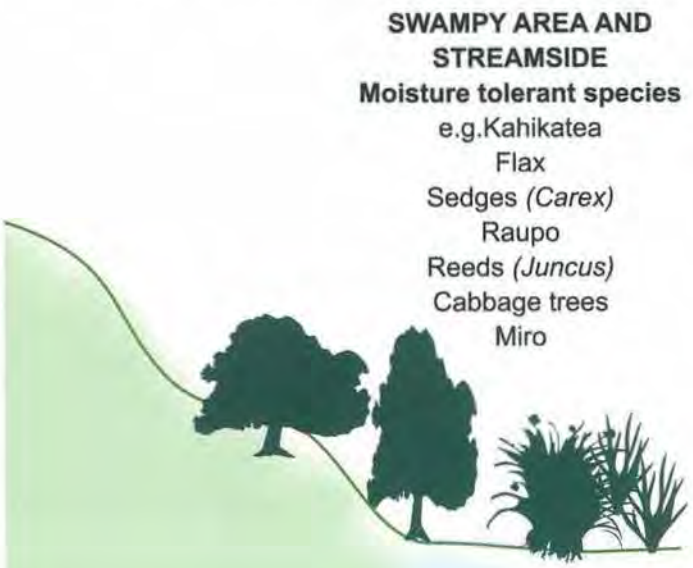
- **Shelterbelts**: Less dense belts give effective shelter over a deeper area. It is also important that belts are long enough, without gaps that will funnel the wind. Shelterbelts are often oriented at right angles to the prevailing wind, but a north-south orientation should be considered for taller belts to reduce pasture shading in winter. In frosty climates, plant down rather than across hill slopes to avoid creating cold air pockets.
- **Stock shade**: Single trees have a minimal shading impact on pasture production, but where there are few in a paddock, stock will gather around them, which can lead to soil erosion, pathogen build-up, and weed infestation. Spaced trees will have shelter benefits, but will also have a shading impact on pasture production that may be reduced by pruning.
- **Timber**: Lines and grids give even plant spacing and ensure a specific stocking rate is achieved for a timber plantation, but may detract from a natural look. Planting dense groves in the corners of paddocks will encourage good stem form compared to widely spaced plantings within paddocks which will require stock-proof fencing for each tree and may result in multi-stemmed and coarse-branching trees. For woodlots, lower-density planting will need less thinning to reach final stocking but will require more tending to ensure good tree form.
- **High or low planting density**? Planting at high density (1–2 m apart) will achieve canopy closure quickly with less weed control, less tree loss due to weed competition, and more effective erosion protection sooner. Lower density plantings (3–5 m apart) will allow more rank grass and weed growth around trees, which can be beneficial for riparian margins as grass is a good filter for runoff. It may also be the most appropriate option where access and space are required for fishing or drain maintenance.



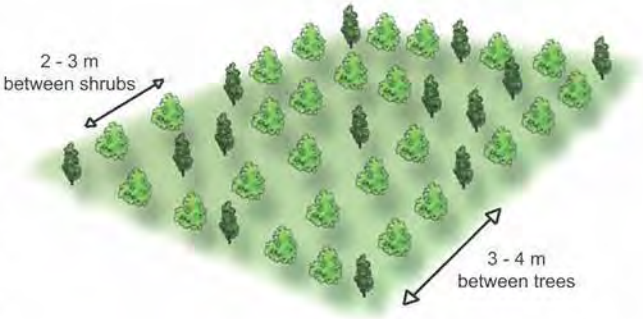
Planting at high density (>6000 stems/ha)



Planting at low density (about 500 stems/ha)



- **Habitat**: For native fauna, diverse species mixes with different plant forms (trees, shrubs, forbs grasses, sedges) provide the best habitat.
- **Mixed or uniform plantings?** Mixed species plantings can be helpful for establishing timber, as shrubby species provide side shading, which encourages the dominance of a single main leader and smaller branch size. Fast-growing shrubby species can also achieve rapid canopy closure and reduce weed growth. On more exposed sites, hardy pioneer species can be planted first as a nurse crop with larger, more wind-sensitive trees added in later. Wherever larger trees are mixed with others, either by planting together or by inter-planting at a later date, regular inspection is required to ensure light levels remain adequate for the slower-growing species.



Planting mixed species

Key resources

"Trees on Farms" available from Environment Waikato

"Trees for Our Land" available from Northland Regional Council

"Native Trees — Planting and Early Management for Wood Production" available from Scion

3.5 ESTABLISHING PLANTS

The conventional approach to establishing native plants on pasture sites is as hand-planted seedlings. The process involves giving the area a hard grazing, then either spot spraying a 1-m square of grass for each tree (for low-density plantings) or blanket spraying (for high-density plantings). It is recommended that glyphosate is sprayed at least 1 week before planting, with a surfactant and a marker dye added. Compared to most exotic forest species, natives are considerably more expensive to purchase as seedlings.

Farmer quote:

"Sometimes you can get natives for free, but no-one's giving away exotics"

Native plants will not compete with established blackberry.

A site completely cleared of weeds prior to planting.

Things to consider

- The best time to plant usually depends on local climate. Autumn is better for summer-dry sites, spring for winter-cold sites, and summer may be best for wetlands.
- Existing exotic weed cover may need to be mechanically removed or cut in planting lines. Blackberry and other vigorous scramblers will need to be sprayed with herbicide. Don't plant natives too soon after using herbicides with residual activity.
- Native plants are very vulnerable to competition from other plants. Regrowth of vigorous weeds will need constant surveillance and control. Herbicides are most practical for large-scale plantings, but many natives are very susceptible to herbicides.
- Rabbits and hares can decimate new plantings by chewing the tips off trees.
- When buying plants, quality is essential. Get healthy fast-growing tall seedlings.
- Collect seed to grow your own plants in pots. Eco-sourcing (using seedlings raised from seed collected locally) maintains local genetic resources and natural character, and improves the likelihood of good establishment.
- Most pasture sites have adequate fertility; however, in eroded or depleted soils fertiliser may aid establishment
- Staking trees supports them in windy sites and makes them much easier to find when doing weed control.
- Direct seeding has been successful for a limited number of rapidly establishing species (e.g., mānuka, koromiko), but availability of large quantities of seed and control of weeds during early establishment are major problems.
- Natural reversion is a low-cost option that should be encouraged wherever possible, but local seed sources must be present and vigorous weed growth is usually a problem during the establishment phase on fertile farm sites.

Root-trainer plants are cheaper, but may suffer if soil conditions dry out quickly. Healthy container-grown plants are the most reliable option.

CASE STUDY – WAIKATO

Is spraying always necessary?

The Whaingaroa Harbour Care group have used an alternative approach to site preparation that has been found effective, particularly where hares and rabbits are common. This method involves planting straight into long grass (e.g., ungrazed for 3 months prior to planting — around 50 cm tall). The long grass disguises the trees from hares, rabbits, and pukeko. The group has found that spot spraying gives the opportunity for weeds to come up around the trees, having wiped out the more tree-friendly cover of ryegrass and clover. They have found that long grass provides shade, shelter, and wind protection for young trees and retains moisture better than bare ground.

Typical site preparation —spot spraying several weeks before planting.

The group has planted 750 000 trees over 10 years, with a good survival rate. They do not normally release trees, having found that herbicide is too hard on native species. They prefer instead to plant a tall PB 2 grade of tree (50 cm to 1 m high) at 1- to 1.5-m spacings to out-compete weeds.

The success of alternative strategies for plant establishment will depend on local conditions. It is important to find out what works well in your own locality, and conduct small-scale trials to test different approaches.

Alternative planting technique — straight into a weed-free dense ryegrass sward.

3.6 MAINTENANCE

Competition from weeds and grass is the main cause of poor survival and slow growth in native plantings. Many worthy restoration planting projects have begun with a lot of activity and enthusiasm only to fail through neglect of weed and pest control.

Farmer quote:

"Planting is the easy part.
It takes more time to keep the weeds out so the plants can establish"

Things to consider

- Weed control — most plantings will need releasing at least once in the first spring, and possibly two or three times for the first 1–5 years, or until trees are 1 m high. It is especially critical to keep control of any shade-tolerant weeds (e.g., tradescantia or wild ginger) and climbers (e.g., convolvulus). Mulching is a good weed control option for smaller areas and a wide variety of organic material is suitable (e.g., newspaper, bark, seaweed).
- Pest control — goats and possums impede forest regeneration. Possums and rats reduce flowering and fruiting, compete with birds for food (fruit and insects), and eat eggs and chicks out of nests. Stoats, ferrets, and cats kill birds, and dogs are also a hazard to kiwi. Care is required when undertaking pest control, since removing one pest or predator may promote explosions in other pest populations.
- Pruning — timber trees require regular form pruning from an early age. Shade trees should have their lower branches pruned, so that the shady area moves around during the day. The porosity of shelterbelts can be modified over the life of a belt by thinning, pruning, and replanting.

Key resources

"Restoring the Balance" available from the NZ Landcare Trust (www.landcare.org.nz)

"Managing Natural Features on Farms" available from the NZ Farm Environment Award Trust or www.maf.govt.nz

CASE STUDY – NORTHLAND

Overcoming weeds

Early morning birdsong was one of the factors that convinced Whangarei Heads farmer and stock agent, Murdoch Ross, that he needed to take action to protect habitat on his land. He recalls helping a farm worker take some cattle away in the early morning and he noticed all the birds getting up. "It was lovely and I thought, I'm not going to let anyone ruin this", Murdoch says.

Murdoch owns about 200 ha in various blocks around the Parua Bay area, including the family farm which supports a milking herd of 150 cows.

Two areas of bush have been protected under a Queen Elizabeth II covenant, and two wetland areas fenced off with the help of the Northland Regional Council Environmental Fund, QEII Trust, and Government biodiversity funding. A large wetland area of about 6 ha needed about 1.8 km of fencing to protect the water's edge of a stream that flows into the Pataua estuary. The wetland and two of the covenanted bush blocks had significant weed problems — elaeagnus, tobacco weed, and tradescantia in the bush, and glyceria, mothplant, and pampas throughout the wetland and edges. Funding applications included money for weed control, and Murdoch also worked in with the Whangarei Heads Landcare Group who had Task Force Green workers and a members' working bee to control the mothplant.

Since the weed control has been done in the wetland area, Murdoch has noticed a tremendous resurgence in birdlife. The wetlands link in with about eight other wetlands to form a whole chain down to the Pataua estuary, and this is improving water quality for the estuary.

Murdoch, who is disabled with cerebral palsy, uses his trusty old tractor as his all-terrain wheelchair. He's a well known local entity, with people stopping to chat wherever he goes. The difficulty for Murdoch was that farmers usually supply free labour as their half of the project with the material costs reimbursed by the funding. "Being disabled, I wasn't able to do that, so they managed to arrange some extra funding so that I could pay my neighbour to do the fencing for me," he says. "I just have to do it my funny old way. I wouldn't be able to do it without other people helping."

Murdoch says his father had always told him to concentrate on "what's in grass" so he has put 34 ha of the steep parts of the land into pines in partnership with an experienced farm forester . He is also planning to add more sanctuaries on his property now that he has seen the success of the existing areas. "As my father said, we must look after the bush and water."

3.7 COVENANTS

Long-term protection for your native bush and wetlands can be achieved through a covenant. This is a legal agreement that protects natural values on private land in perpetuity, or for a time specified in the covenant. It is registered on the title and binds current and future owners to protect the area for the duration of the covenant, while still retaining ownership and management.

Farmer quote:

"Most farmers aren't aware how flexible covenants can be"

Things to consider

Covenanting requires surveying of the block and ensuring a stock-proof fence surrounds it. Covenanting agencies can help with the cost of surveying and fencing and are often able to provide advice about the management of the block. If you want to carry out pest control, they can help you with seeking funding.

There is considerable scope for flexibility in the conditions of a covenant. These can include provision for recreational infrastructure, tracks, and harvest of existing plantings. By designing your own covenant conditions, there is minimal risk that protected areas will attract imposed conditions from external agencies at a later date.

You can achieve legal protection for an area by:

- Registering it with the Queen Elizabeth II National Trust under an Open Space Covenant.
- In the case of Māori land, placing it under a kawenata (covenant) or creating a Māori reservation through Nga Whenua Rahui.
- Creating a conservation covenant with the Department of Conservation or a District Council.

Key Resources

"Open Space" available from the QEII National Trust (www.qe2.org.nz)

Protecting bush brings benefits to farm

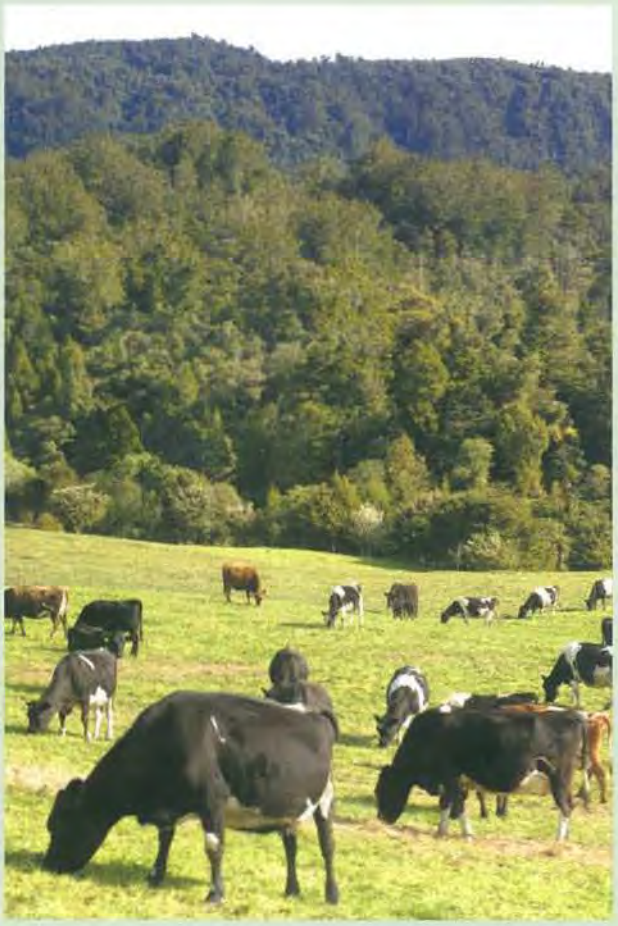
When Ian and June Wilson moved to their Puketi property in 1980, native bush was used as a wintering pad for stock. At first the couple followed the practice of the previous owner until they thought about the cost to the farm. "While it got the stock off the pasture, the problem was they wouldn't all come out of the bush", says Ian. "Each year there would be three to five cows that would not reappear, and as young farmers that was too big a loss for us."

He says he also considered the loss of fertility with cattle not returning their dung to pasture. "All the fertiliser we had put on was, in effect, being put into the bush by the cattle. In the long term this wasn't good in terms of sustainability."

Fencing off the existing bush has made the farming operation easier. "We fenced off gullies for easy maintenance, so now we don't lose cows." River flats that had been cleared and grazed have also been fenced. "I used to use the stream as a barrier, but there would always be some that could get across so it made sense to put up a fence. Although it floods, we've never lost any fences. There is now a lot of mature matai. The biggest ones were logged in the early days but I've never seen as many anywhere else in Northland."

The Wilsons have covenanted 20 ha of their 143-ha property under the Queen Elizabeth II National Trust, which paid for the cost of the fencing materials. "Since then rates relief has also been brought in", Ian explains.

It's now been 25 years since the bush was fenced from stock. Weeds spread by birds are often a problem for land owners but the Wilsons are fortunate to have the huge resource of the neighbouring Puketi Forest, so the seeds dropped tend to be of native trees. Ian has been delighted to see taraire, nīkau, and pūriri trees sprouting where there were none before. "It is amazing how quickly bush regenerates from seeds carried in by birds. We're lucky to have such a clean bush backdrop — the only weed has been one monkey apple", he says.



Fencing the bush prevents fertility transfer and stock losses

3.8 TAX PROVISIONS

Input to this section from Ron Gleeson (Inland Revenue, Hamilton) is gratefully acknowledged.

Currently, tax implications for native tree plantings differ according to the purpose of the planting, and whether the landowner can show they are in the business of forestry (in addition to farming).

- Whenever a person is in the business of farming (not necessarily their principal business), they can claim the full expenditure incurred for trees (including natives) planted to prevent or combat erosion or to provide shelter to the land.
- When a person is principally in the business of farming they can claim up to $7500 per year for expenditure incurred in planting trees for purposes other than erosion and shelter and up to $7500 per year for expenditure incurred in maintaining those trees (including natives but excluding fruit trees).

Plantings to prevent or combat erosion or provide shelter on farms are fully deductible in the year they are planted, while farmers can also claim $7500 per year for planting trees for other purposes.

- When a person carries on a commercial operation of forestry (a business) the cost of planting and maintaining trees is fully deductible in the year incurred. They must be able to show that they are going about their forestry activity in a business-like manner, and have a reasonable expectation of generating income from it in the future.
- Under a general 2005 amendment (not necessarily aimed at forestry or farming businesses), business environmental expenditure (which can include riparian and screen plantings) is now tax deductible. Business environmental expenditure is incurred to avoid, remedy, or mitigate the effects on the environment from the discharge of contaminants. (This could include filtering farm runoff, but it is unclear whether carbon dioxide is considered a contaminant and therefore whether carbon sink planting is tax deductible). Where this expenditure constitutes environmental planning, feasibility, monitoring, or restoration of past contamination, it is immediately tax deductible. Other business environmental expenditure (including riparian plantings aimed at dealing with future farm discharges) is claimable over the life of the expenditure. This is taken as the life of a resource consent (where one exists for that activity), or 35 years (where there is no resource consent required). This means you can claim only 1/35th of the full cost each year, for 35 years (if you surpass the $7500 limit specified above).

An additional tax matter to be aware of is that under current legislation, the value of all standing trees containing timber is taxable when land is sold, irrespective of whether those trees were planted or managed for timber. As a buyer, you can later claim this as an expense if you mill trees (or sell the land with the standing timber) and receive income from them. But to do so you need to have the trees valued and have this value certified by IRD at the time of purchase. As a land seller, you are deemed by IRD to have gained income as part of the sale price from that standing timber, and may be liable to pay tax on that.

Anyone proposing a significant planting of natives, or buying or selling land with standing timber on it should seek taxation advice from their accountant before advancing too far. Careful planning, good advice, and thorough documentation can help you gain all the deductions you are entitled to.

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APPENDIX I: Annotated Bibliography

The following is a list of printed publications for those interested in learning more about the uses and management of native trees on farms.

Auckland Regional Council 2002: "Plant Me Instead" ARC. 72 p.

A guide for individuals who want to replace common pest plants with other, non-weed species. Some native alternatives given.

Barton, I.; MacGibbin. R.; Burns, B.; Berg, P. (Ed.) 2005: "Profiting from Diversity: Reducing the Impediments to Planting Native Trees". Tane's Tree Trust. 40 p.

Summary of two workshops covering a range of topics such as restoration, sustainable indigenous forestry, taxation rules, and Regional and District Council plan provisions.

Bergin, D.O. 2003: Totara — Establishment, growth, and management. *New Zealand Forest Research Institute, New Zealand Indigenous Tree Bulletin No. 1*. 40 p.

A Bulletin describing past use, current distribution, and useful characteristics of totara and provides guidelines for establishing plantations and managing naturally regenerating stands on farmland.

Bergin, D.O.; Steward, G.A. 2004: Kauri — Ecology, establishment, growth, and management. *New Zealand Forest Research Institute, New Zealand Indigenous Tree Bulletin No. 2.* 48 p.

A Bulletin providing up-to-date information for anyone wishing to plant individual trees or stands, and to manage kauri forest for timber production, conservation, and amenity value.

Bergin, D.O.; Gea, L. 2005: Native trees — Planting and early management for wood production. *New Zealand Forest Research Institute, New Zealand Indigenous Tree Bulletin No. 3.* 44 p.

A Bulletin examining the range of objectives and site types where the planting of native tree species can be appropriate in our productive landscapes.

Connor, H.E. 1977: The poisonous plants in New Zealand. 2nd rev. ed. *New Zealand Department of Scientific and Industrial Research Bulletin 99*. 247 p.

Davis, M.; Meurk, C. 2001: "Protecting and Restoring our Natural Heritage – A Practical Guide". Department of Conservation, Christchurch. 94 p.

A guide that brings together detailed information and project experiences to help community groups, local bodies, and individuals to initiate restoration projects, and make best use of resources to protect and restore native plants and ecosystems.

Environment Waikato 1999: "Wetland Management Factsheets 1–5". Environment Waikato. 4–8 p.

Five factsheets covering "Wetland restoration", "Wetland wildlife", "Wetland planting guide", "Wetland management information and contacts", and "Wetland restoration case studies".

Environment Waikato 2001: "Forest Fragment Management Factsheets 1–5". Environment Waikato, 4–8 p.

Five factsheets covering "The facts on forest fragments", "Life in a forest fragment", "Managing forest fragments", "Forest fragment information and contacts", "Forest fragment case studies".

Environment Waikato 2002: "Trees on Farms" — Environment Waikato with NZ Farm Forestry Association, Federated Farmers. 52 p.

A guide with local experience of growing trees in the Waikato Region, with practical information on planning, planting, and species selection with mainly exotics but also some natives.

Environment Waikato 2004: "Clean Streams. A Guide to Managing Waterways on Waikato Farms". Environment Waikato. 42 p.

A booklet which provides information about how to manage waterways to improve water quality, freshwater life, and bank stability as well as enhancing your farm.

Environment Waikato 2005: What to plant in Maungatautari Ecological District. *Environment Waikato Local Area Planting Guide Series 1.* 27 p.

A specific planting guide for the Maungatautari Ecological District, which is located in the rolling and hilly South Waikato country.

Environment Waikato 2005: "Planting Natives in the Waikato Region". Environment Waikato. 15 p.

A comprehensive guide that covers choosing what to plant, finding quality plants for planning, site preparation, and planting in the Waikato Region.

Farm Environment Award Trust 2003: "Managing Natural Features on Farms". FEA Trust. 12 p.

A practical guide to natural features on farms, focusing on case studies from top farmers in the Waikato Region.

Farm Environment Award Trust 2004: "Winning Margins: Waterways on Farms". FEA Trust. 10 p.

A booklet that includes a sheet on budgeting and planning for managing waterways on farms. The focus is on costs and benefits identified by top farmers in the Waikato Region.

Forest Research Institute 1980: Raising native trees. ***New Zealand Forest Research Institute, What's New in Forest Research No. 85.*** **4 p.**

A factsheet describing large-scale bare-rooted nursery techniques for the major podocarp species (rimu, totara, kahikatea, tanekaha, matai, miro) and the beeches (red and silver).

Forest Research Institute 1980: Establishing nursery-raised native trees. ***New Zealand Forest Research Institute, What's New in Forest Research No. 86.*** **4 p.**

A factsheet describing the successful performance of planting trials in forest, scrub, and open sites of planted native podocarp seedlings raised in the nursery as bare-root transplants.

Forest Research Institute 1987: Replacing pampas grass — Alternative species for low shelter and amenity plantings. ***New Zealand Forest Research Institute, What's New in Forest Research No. 150.*** **4 p.**

A factsheet offering suitable alternatives for planting a range of native and exotic trees and shrubs as low shelter.

Forest Research Institute 1988: Raising native trees and shrubs from seed. ***New Zealand Forest Research Institute, What's New in Forest Research No. 158.*** **4 p.**

A factsheet describing methods of seed collection and raising seedlings for 15 common native hardwood tree and shrub species as bare-root seedlings.

Hanna, M. (undated): "Forestry Rights in New Zealand". 3rd edition. Lewis' Solicitors, Cambridge.

A lay-person's guide to using forestry rights under the Forestry Rights Registration Act 1993, covers issues to consider when investing in forestry, including legal and taxation requirements.

Handford, P. 2002: "Native Forest Monitoring. A guide for forest owners and managers". FRONZ, Wellington. 184 p.

A booklet that provides information to forest owners, managers, groups, and individuals to effectively monitor native forest and its management to ensure timely remedial action.

Head, J.; deRidder, L.; Findlay, C. 2004: "Protecting Natural Areas Design Guide". Nature Heritage Fund. 26 p.

A guide to assist effective protection on existing natural areas; it considers management issues to ensure their long-term viability, with an emphasis on landscape architecture.

Janssen, H. 2004: "Bush Vitality: A Visual Assessment Kit. Managing the Seasons for the Years". Horizons Regional Council, Manawatu.

A booklet to assist private landowners with native forest remnants to determine the ecological health of bush patches and to improve forest health.

Meurk, C. 2003: "Establishing Shelter in Canterbury with Nature Conservation in Mind". Environment Canterbury and Lincoln University.

A Canterbury-focused practical guide on the use of indigenous species for shelter and hedgerows in rural settings, much of which is applicable to other areas.

Ministerial Advisory Committee 2000: "Biodiversity and Private Land". Final report of the ministerial advisory committee. ("Biowhat?)" Ministry for the Environment, Wellington. 112 p.

A series of recommendations to the Minister for the Environment on how to improve the sustainable management of biodiversity outside the conservation estate.

Ministry of Agriculture and Forestry 2002: "Standards and Guidelines for Sustainable Management of Indigenous Forests". Ministry of Agriculture and Forestry. 133 p.

Detailed procedure and practice standards for sustainable forest management consistent with the Indigenous Forestry Provisions (Part IIIA) of the Forests Act (1949).

Ministry of Forestry 1998: "Indigenous Forestry: Sustainable Management". Ministry of Forestry and New Zealand Farm Forestry Association. 212 p.

An introductory guide to sustainable indigenous forest management that includes information on the growth and potential of the major timber species for planting and management.

Mortimer, J.; Mortimer, B. 1999: "Trees for the New Zealand Countryside. A Planter's Guide". Taitua Books, Hamilton. 270 p.

A book covering many aspects of both exotic and indigenous trees on farms including planting design, site conditions, shade, shelter, and wood properties.

Northland Biodiversity Enhancement Group (N-BEG) 2004: "Restoring the Balance. Biodiversity Self-help Kit". NZ Landcare Trust. 90 p.

A kit that provides guidance to assist the landowner in identifying the property's natural values and then identifying the threats they may face.

Northland Regional Council 2005: "A Beginner's Guide to Wetland Restoration". NRC. 20 p.

A guide for restoring wetlands, whether as a habitat for native plants and animals, as an attractive part of your property, or as a way to clean up your water supply.

Northland Regional Council 2005: "Clean Streams". NRC. 48 p.

A guide to riparian management in Northland.

Northland Regional Council 2005: "Trees for the Land". NRC. 36 p.

A guide to growing exotic and native trees in Northland for protection, production, and pleasure.

Northland Regional Council and Department of Conservation 1999: "A Planter's Handbook for Northland Natives". NRC. 22 p.

A guide for native species selection in Northland, including special plants for wetlands, coast, and bird food sources.

Pardy, G.F.; Bergin, D.O.; Kimberley, M.O. 1992: Survey of native tree plantations. *New Zealand Forest Research Institute, FRI Bulletin No. 175.* 24 p.

A Bulletin that assesses the performance of 55 stands of native trees that had been planted for a wide range of reasons from 10 to 90 years ago, mostly on private land or local authority land, for a wide range of reasons.

Parliamentary Commissioner for the Environment 2002: "Weaving Resilience into Our Working Lands — Future Roles for Native Plants on Private Lands". Parliamentary Commissioner for the Environment, Wellington. 39 p.

A discussion document arising out of stakeholder consultation that explores the values and attitudes of New Zealanders, and barriers to establishing native plants on private land.

Pollock, K.M. 1986: Plant materials handbook for soil conservation. Volume 3: Native plants. *Ministry of Works and Development, Water and Soil Miscellaneous Publication No. 95.* 66 p.

A guide to the selection of suitable species for soil conservation, covering the propagation, establishment, and maintenance requirements of some 70 native plant species.

Porteous, T. 1993: "Native Forest Restoration. A Practical Guide for Landowners". Queen Elizabeth II National Trust, Wellington.

A guide to the restoration of native forest that covers both the principles of managing forest remnants and revegetation of a range of sites with native plants.

Silvester, W.; McGowan, R. (Ed.) 2000: "Native Trees for the Future. Potential, Possibilities, Problems of Planting and Managing New Zealand Native Trees". Proceedings of a Forum at the University of Waikato, 8–10 October 1999. 96 p.

Comprises 18 papers based on presentations on issues of planting and managing native tree species for a wide range of objectives, with some emphasis on timber production.

Simpson, P. 2001: "Dancing Leaves. The Story of New Zealand's Cabbage Tree, Ti Kouka". Canterbury University Press.

A reference book on the cabbage tree, including the disease known as Sudden Decline.

Simpson, P. 2005: "Pohutukawa and Rata, New Zealand's Iron-hearted Trees". Te Papa Press.

A book covering science, history, art history, and ethnobotany, with a plea for conservation.

Spellerberg, I.; Given, D. (Ed.) 2004: "Going Native. Making Use of New Zealand Plants". Canterbury University Press.

A compendium of ideas on how to use New Zealand native plants in home gardens, institutions (such as schools), and on farms, with practical advice on how to contribute to conservation.

Wall, K.; Clarkson, B. 2001: "Gully Restoration Guide". Hamilton City Council.

A guide on restoration of gullies in Hamilton City with information on the different stages of restoration, soils, native plant propagation, and matching species to site.

APPENDIX II: Resources and Contacts

Government agencies

Department of Conservation www.doc.govt.nz

Ph (09) 430 2470 – Whangarei
(07) 838 3363 – Hamilton

Environment Waikato www.ew.govt.nz

Ph (0800) 800 401 – Hamilton

Inland Revenue Department www.ird.govt.nz

More detail on tax developments about the issues of native tree management can be found at: www.taxpolicy.ird.govt.nz/publications/files/html/busenvironm.html

Local authorities www.localcouncils.govt.nz

Various councils have different support measures for native tree management including voluntary protection, rates relief, environmental grants, infrastructure grants, etc.

Northland Regional Council www.nrc.govt.nz

Ph (0800) 002 004 – Whangarei

Crown Research Institutes

AgResearch www.agresearch.co.nz

Ph (07) 856 2836 – Hamilton

Sustainable management of pastoral agriculture, including teams focused on land and environmental management, agricultural systems, and biocontrol and biosecuriry.

Manaaki Whenua - Landcare Research www.landcareresearch.co.nz

Ph (07) 858 3700 – Hamilton

Sustainable management of all land resources, enhancing biodiversity, increasing resource efficiency of businesses, and conserving and restoring the natural assets of our communities.

National Institute of Water and Atmospheric Research www.niwa.co.nz

Ph (07) 856 7026 – Hamilton

Use and management of the atmosphere, freshwater and marine environments, focusing on aquatic biosecurity and biodiversity, fisheries, aquaculture, and biotechnology.

Scion (formerly Forest Research) www.scionresearch.com

Ph (07) 343 5899 – Rotorua

Research and development in forestry science (exotic and indigenous), renewable materials, and products from plant resources.

Other organisations

Biodiversity Advice Waikato www.waikatobiodiversity.org.nz

Ph (0800) 246 348

Provides free advice on planting, pest and weed contyrol, native fauna, and conservation activities through a free phone number and site visits. Managed by the Waikato Biodiversity Forum.

Centre for Biodiversity and Ecology Research www.cber.bio.waikato.ac.nz

Ph (07) 838 4237 – Hamilton

A research unit of the University of Waikato with an integrated approach to research into biodiversity and ecology; provides consultancy and advocacy services.

Ecosourced Waikato email: wbennett@xtra.co.nz

Ph (07) 824 7167 – Ngaruawahia

Supporting the use of locally sourced native plants for ecological restoration in the northern Waikato.

Envirofunz www.envirofunz.org.nz

A database of funding information for environmental projects in New Zealand.

Farm Environment Award Trust www.ballance.co.nz/fea.html

Ph (0800) 800 401 – Waikato
(09) 433 1576 – Northland

Sponsored by Ballance Agri-nutrients, the Trust administers the regional Farm Environment Awards as well as learning events for farmers to encourage sustainable agricultural practices.

New Zealand Association for Environmental Education www.nzaee.org.nz

Ph (04) 801 9935 – Wellington

Aims to foster the development of environmental education in New Zealand at national and regional levels.

New Zealand Ecological Restoration Network www.bush.org.nz

Lists existing native restoration projects in New Zealand by region and district, with comprehensive information on establishment and management practices.

New Zealand Farm Forestry Association www.nzffa.org.nz

Ph (04) 472 0432 – Wellington (three branches in both Northland and the Waikato)

Dissemination of information on forestry practices

including alternatives to radiata pine, industry and research lobbying, forestry legal issues, and forest health.

New Zealand Landcare Trust www.landcare.org.nz

Ph (09) 436 3170 – Whangarei
(07) 858 3725 – Hamilton

Facilitating and encouraging community involvement in sustainable land management and projects enhancing biodiversity.

New Zealand Native Forests Restoration Trust
www.nznfrt.org.nz

The Trust acquires forest land to protect important species, restore their habitats, and improve the quality of waterways.

New Zealand Tree Crops Association
www.treecrops.org.nz

Aims to promote information on tree crops, exotic and native, and the value of sustainable management of tree cropping for New Zealanders.

Northland Biodiversity Enhancement Group
www.landcare.org.nz

Ph (09) 436 3170 – Whangarei

An informal forum of the agencies in Northland with an interest in the protection of biodiversity on private land.

Queen Elizabeth the Second National Trust
www.qe2.org.nz

Ph (0508) 732 878 – Wellington
(local representatives in Northland and the Waikato)

A farmer-founded organisation set up to help landowners protect important landscape features on their land while retaining ownership.

Royal Forest and Bird Protection Society
www.forestandbird.org.nz

Ph (04) 385 7374 – Wellington

A conservation organisation which aims to preserve and protect the native plants and animals and natural features of New Zealand.

Tane's Tree Trust www.tanestrees.org.nz

Ph (09) 239 2049 – Auckland

Publications and workshops on indigenous forest establishment and management,

Trees for Survival Trust www.treesforsurvival.org.nz

Promotes the growing and planting of native trees to prevent soil erosion, improve water quality, and increase biodiversity.

Journals/ Magazines

Austral Ecology www.blackwellpublishing.com

A journal of ecology in the Southern Hemisphere, with papers on experimental, observational, or theoretical studies on terrestrial, marine, or freshwater systems.

Growing Today www.isubscribe.co.nz

Targeted at farmers and lifestyle farmers with advice on horticulture, agriculture, and aspects of rural living.

Indigena email: woodlot@orcon.net.nz

Published quarterly by the Indigenous Forestry Section of the New Zealand Farm Forestry Association, promoting sustainable forest management.

New Zealand Journal of Ecology www.nzes.org.nz

Research and reviews on all subjects of relevance to the natural ecology of New Zealand.

New Zealand Journal of Forestry www.forestry.org.nz

The official journal of the New Zealand Institute of Forestry, published quarterly.

New Zealand Lifestyle Farmer
www.lifestylefarmer.farmonline.co.nz

Big ideas for small farms — wide-ranging articles with relevance to small block farmers in New Zealand.

New Zealand Tree Grower www.nzffa.org.nz

The official journal of the New Zealand Farm Forestry Association, published quarterly.

Open Space www.qe2.org.nz

The quarterly magazine of the QEII National Trust, including information and case studies on covenants.

Mike Dodd, AgResearch, at the native tree plantation at the Whatawhata Research Centre.

APPENDIX III: Native Plant Names

The following is a list of common names for the plants mentioned throughout this Bulletin, matched with their scientific names:

Native Plants

akeake	*Dodonaea viscosa*
beech	*Nothofagus* spp.
cabbage tree	*Cordyline australis*
five-finger	*Pseudopanax arboreus*
flax	*Phormium tenax*
harakeke	*Phormium tenax*
horopito	*Pseudowintera colorata*
houhere	*Hoberia populnea*
kahikatea	*Dacrycarpus dacrydioides*
kanono	*Coprosma grandifolia*
kānuka	*Kunzea ericoides*
karamū	*Coprosma robusta*
kauri	*Agathis australis*
kawakawa	*Macropiper excelsum*
kohekohe	*Dysoxylum spectabile*
kōhūhū	*Pittosporum tenuifolium*
koromiko	*Hebe stricta*
kūmarahou	*Pomaderris kumeraho*
lemonwood	*Pittosporum eugenioides*
mānuka	*Leptospermum scoparium*
māhoe	*Melicytus ramiflorus*
makomako	*Aristotelia serrata*
mangeao	*Litsea calicaris*
māpou	*Myrsine australis*
matai	*Prumnopitys taxifolia*
miro	*Prumnopitys ferruginea*
mouku	*Asplenium bulbiferum*
ngaio	*Myoporum laetum*
nīkau	*Rhopalostylis sapida*
pohutukawa	*Metrosideros excelsa*
poroporo	*Solanum aviculare* and *Solanum laciniatum*
pūriri	*Vitex lucens*
putaputawētā	*Carpodetus serratus*
raupō	*Typha orientalis*
raurēkau	*Coprosma grandifolia*
rewarewa	*Knightia excelsa*
ribbonwood	*Plagianthus regius*
rimu	*Dacrydium cupressinum*
tōtara	*Podocarpus totara*
tanekaha	*Phyllocladus trichomanoides*
taraire	*Beilschmiedia tarairi*
taupata	*Coprosma repens*
tawa	*Beilschmiedia tawa*
ti kōuka	*Cordyline australis*
tītoki	*Alectryon excelsus*
toetoe	*Cortaderia* spp.
tree nettle	*Urtica ferox*
tutu	*Coriaria* spp.
wineberry	*Aristotelia serrata*

Non-native weeds

bindweed	*Convolvulus* spp.
elaeagnus	*Elaeagnus* x *reflexa*
glyceria	*Glyceria maxima*
mothplant	*Araujia sericifera*
pampas	*Cortaderia* spp.
tobacco weed	*Solanum mauritianum*
tradescantia	*Tradescantia fluminensis*
wild ginger	*Hedychium gardnerianum*

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For information on management of native species, contact Dr David Bergin, Ensis, Private Bag 3020, Rotorua. Phone (07) 343 5899; Fax (07) 343 5332; email: david.bergin@ensisjv.com

Tane's Tree Trust was formed in 2001 to encourage New Zealand landowners to plant and sustainably manage native trees for multiple use. The objectives of the Trust are: promotion of native forestry as an attractive land use option by consolidating and advancing the state of knowledge of native tree species; maximising economic incentives for establishing natives; resolving legal and political obstacles to the planting of natives; and encouragement of knowledge-sharing amongst stakeholders.

If you are interested in joining the network (subscriptions range from $30 for individual members to $110 for corporate members), or require further information, contact the Chairman: Ian Barton, 105 Cowan Rd, Hunua, RD3, Papakura. Phone (09) 292 4825; Email ibtrees@ihug.co.nz .

The purpose of the Sustainable Farming Fund (SFF) is to fund projects that will contribute to improving the financial and environmental performance of the land-based productive sectors. The SFF provides grants for projects lasting from 1 to 3 years. Members of the SFF team are available to provide assistance to applicant groups.

INDIGENOUS TREE BULLETIN SERIES

Farming with Native Trees — A Guide for Farmers from Northland to Waikato is the fifth in this series of New Zealand Indigenous Tree Bulletins which summarise the latest information about planted and naturally regenerating native tree stands. The focus is on production as well as environmental and social objectives.

Bulletin No. 1 is *Totara Establishment, Growth, and Management.*
Bulletin No.2 is *Kauri Ecology, Establishment, Growth, and Management.*
Bulletin No. 3 is *Native Trees — Planting and Early Management for Wood Production*
Bulletin No. 4 is *Pohutukawa Ecology, Establishment, Growth, and Management*

Subjects for future Bulletins include: management of the beech species; establishment of native hardwood species; and assessment and monitoring of native plantations.

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