

The Potential Contribution of Research to a Proposed Long-rotation, Continuous-cover, Plantation Forestry Project with Indigenous Species

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Landcare Research Contract Report: LC0607/111

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DATE: April 2007



ISO 14001

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1. Introduction

In February 2006 Far North District Council coordinated a proposal and work programme for a project investigating the potential for commercial plantations of mixed indigenous species (Appendix 1). The project, Ruia mai nga kakano, Kia tupu ai nga mokopuna o Tane, Hei orange mo apopo (Growing Common Futures) is intended to harness interest from the farming community and Maori landowners in sustainable alternatives to livestock and radiata pine forestry. The vision is to establish a permanent, indigenous production forestry resource in the Far North.

The proposal recognises the need to establish the economic, silvicultural, and institutional viability of commercial plantations of indigenous species in the Northland context before promoting a large-scale initiative. An initial model suggests this might involve mixed indigenous and exotic plantings to provide intermediate revenue and support for the developing indigenous forest.

A first step in the work programme is to build relationships with key researchers in the field to access existing information and identify research needs for the project. This is to be followed by applications to various funding agencies to support research projects specific to the proposal.

2. Background

Indigenous plantation forestry in New Zealand is still in its infancy. There are no clear data on the extent to which planting of indigenous species for timber production has been undertaken. A 1986–88 survey contacted some 160 organisations likely to have information on the location and background of plantings of native trees (Pardy et al 1992). Over 130 plantings were identified of which 55 apparently successful plantings were selected and visited. The total area of these plantings was less than 100 ha. Tane's Tree Trust have plans to develop a database of indigenous plantings but this has not been implemented to date (B. Burns pers. comm.). At least 100 ha are anticipated (Richards 2005).

The following quote from the 2005 edition of the NZIF Forestry Handbook summarises the situation:

...despite the enthusiastic support of individuals from organisations such as Tane's Tree Trust with specific objectives of promoting indigenous forestry, general activity outside existing natural stands is small. General lack of knowledge, current taxation laws, and uncertainty as to status of plantations at the time of harvest under the Resource Management Act are considered to contribute to the low level of activity, along with ill-defined economic benefits (Richards 2005).

In this context, the proposed Growing Common Futures project would be breaking new ground. The role and contribution of research therefore becomes critical and is recognised in

the proposed work programme. This report outlines both the current level of investment in and focus of indigenous forestry research in New Zealand and an opinion on the research needs and potential providers of that research for a project like Growing Common Futures.

3. Objectives

The objective of the advice provided under the Envirolink Small Advice Grant was to provide information that increased Council and community awareness of (a) the risks, (b) the land and water impacts, and (c) social implications of decisions about land use conversion and development. Factors to be considered included silvicultural and economic risks, social benefits, cultural values, and implications for biodiversity, soil and water management associated with changing land use.

The approach taken was to:

- visit representative sites for the proposed plantations of mixed indigenous species.
- discuss the target outcomes of the project with key stakeholders including Maori landowners and the Far North District Council.
- visit research organisations involved in research on indigenous forestry to:
 - elicit their interest in contributing to the proposed project, and
 - collect and summarise current research in the field.
- summarise research to date and current research in a brief report.

4. Methods

A site visit to the Far North District was made on 4 July 2006 and discussions held with Ngati Rehia (Wally, Norma, and Tai Rameka) at Takou Bay; Far North District Councillors (Laurie Byers, Garry Weeds, Ian Bamber), landowners (Geoff Wightman, John Crawford), and Te Runanga o Te Rarawa (Kevin Robinson) at Kaikohe; and with Te Puni Kokiri (Whitianga Peehikuru).

Visits were subsequently made to:

- | | |
|---------|---|
| 18 July | Ministry of Agriculture and Forestry (Rotorua) – Gerard Horgan |
| 18 July | ENSIS (Rotorua) – David Bergin |
| 20 July | School of Forestry, University of Canterbury – Euan Mason
Ministry of Agriculture and Forestry (Indigenous Forestry Unit) – Alan Griffiths |
| 20 July | Landcare Research (Lincoln) – Rob Allen |
| 25 July | Ministry of Agriculture and Forestry / Sustainable Farming Fund (SFF) – Richard Lynch |

3 August Landcare Research (Hamilton) – Bruce Burns

11 August Tane’s Tree Trust – Ian Barton

At the same time, recent research reports and publications on indigenous plantation forestry were collected, reviewed and summarised.

This report briefly summarises the data collected from visits and publications including research to date on indigenous plantation forestry in New Zealand, on research groups that are currently active in the area, and on research currently being undertaken.

5. Results

5.1 Currently funded indigenous forestry research in New Zealand

Current funding for research into indigenous timber forestry reflects the relative scale and focus of activity in indigenous forest management in New Zealand. Approximately 83% of the over \$1 million per annum invested in indigenous forestry research is directed at the sustainable management of indigenous forests used for production and in developing the market for indigenous timber products (Table 1).

The three largest programmes are the Public Good Science Fund supported “Indigenous Forestry” programme led by Dr Rob Allen of Landcare Research; the “New Plantation Species” programme led by Dr Luis Gea of ENSIS; and the Sustainable Farming Fund (SFF) supported “Expanding economic viability and sustainably managed indigenous beech forests and industry” programme led by the NZ Farm Forestry Association, the Office of the Maori Trustee, and SILNA landowners, with research provided by the University of Canterbury School of Forestry.

The Indigenous Forestry programme aligns its work with the Forest Amendment Act and focuses on developing silvicultural systems that minimize harvesting impacts and retain the important characteristics of forests. It seeks in particular to understand how forests managed for timber production can at the same time provide improved cultural and environmental benefits to Maori owners (Appendix 1).

The multi-partite beech forestry programme has three components:

- Surveying and evaluating the main domestic and export product/market value propositions for the primary beech species
- Evaluating the beech resource and confirming the commercial supply potential by estimating volumes and product classes across the three Indigenous Forestry Unit working circles
- Re-establishing beech forest management guidelines based on an improved understanding of the biological systems, economics and sustainability of managing beech forests.

The other major funder of indigenous forestry research is the Ministry of Agriculture and Forestry through its operational research funding. All of this research is directed toward the

knowledge requirements of the Indigenous Forestry Unit that administers the provisions of the 1949 Forests Act and 1993 Forest Amendment Act relating to the management of indigenous forests. As a result it primarily addresses issues to do with the harvesting, regeneration and health of existing indigenous forests from which timber is produced. While not immediately applicable to Growing Common Futures, this research will be relevant when the planned forests reach maturity.

Indigenous forestry research at SCION has been incorporated in a New Species PGSF programme following the demise of the previously funded Sustainable Development programme. In so doing investment in indigenous plantation forestry has fallen from approximately \$230,000 per annum to an estimated less than \$150,000 per annum. The new programme's focus is on species new to plantation management, maintaining and developing genetic resources of both exotic and indigenous species important in New Zealand, and recommending ways of increasing end-use value of those species. While most attention is being given to alternative pine, redwood, cypress and eucalypt species for commercial timber production, work on a small number of indigenous species (including kauri and totara) continues.

Funding to explore the potential of indigenous plantation forestry, particularly from the Sustainable Farming Fund, has been increasing in recent years, with four new projects beginning in 2006 (Table 1). These projects build on research carried out in the 1990s that focussed on evaluating the potential and performance of a small number of high-value indigenous timber tree species (kauri, totara) and on collating information on the propagation, planting and early management of native trees and on the wood properties of planted indigenous trees.

The new projects explore in more detail techniques for the production of large numbers of less-expensive indigenous tree seedlings for planting programmes, the selection and collection of seed from elite trees, the development of indigenous forests as carbon farms, and the management and use of naturally regenerated and planted totara.

5.2 Currently initiatives in indigenous forestry research

The growing interest in indigenous forestry was also reflected in a recent workshop hosted by the MAF Indigenous Forestry Unit, Tane's Tree Trust, New Zealand Institute of Forestry (NZIF), and Landcare Research to discuss priorities for research. The meeting reviewed current research, listed a wide range of issues that require further work and delegated a sub-committee made up of one representative from each of Tane's Tree Trust, NZ Farm Forestry Association, indigenous timber processors and Maori landowners to review the 1999 NZIF Indigenous Forestry Policy and develop a draft research strategy for discussion.

Table 1 Currently Funded Indigenous Forestry Research Programmes

Title	Organisation	Technical Provider	Funder	Amount (approx. \$/annum)
Omaha pilot open-ground indigenous plant nursery	Open-ground Indigenous Plants	P. Cole/J. Van Dorser	SFF	
Sustainable management options for wood production from regenerating totara	Northland Totara Working Group	ENSIS	SFF	50,000
Decision support for indigenous forest opportunities	East Coast Indigenous Forest Group	Motu Economics and Public Policy Research, Landcare Research	SFF	<20,000
Indigenous forestry – information dissemination	NZ Farm Forestry Association	NZFFA	SFF	<20,000
A pilot inventory of elite native timber trees as seed sources for native afforestation silviculture from lowland environmental domains	Native Afforestation Silviculture Group	H. Jansen	SFF	<20,000
Improving estimates of growth, recruitment and mortality for selected indigenous forest species	Landcare Research NZ Ltd	Landcare Research	MAF	
Long-term consequences of single tree and small group harvesting of podocarps.	Landcare Research NZ Ltd	Landcare Research	MAF	
Target stand structure – Longwood Forest	Landcare Research NZ Ltd	Landcare Research	MAF	
Expanding economic viability and sustainably managed indigenous beech forests and industry	NZFFA, Office of the Maori Trustee, SILNA landowners	School of Forestry	SFF	165,000
New Species	ENSIS	ENSIS	PGSF	<150,000 ¹
Indigenous Forestry	Landcare Research NZ Ltd	Landcare Research	PGSF	540,000
Indigenous forestry – a comprehensive approach to providing information to the widest possible audience	Tane’s Tree Trust	Various	SFF	93,000

¹ This amount refers only to that invested in indigenous plantation forestry research. The total programme value is \$925,000 per annum.

5.3 Review of information available to support indigenous plantation forestry

This section provides a brief overview of existing knowledge and information on the potential of planted indigenous forests.

Species selection and silvicultural systems

Current state of knowledge: While planting is the most common approach to re-establishing indigenous trees, seedlings are currently expensive. Other options include direct seeding and enhanced natural regeneration. All are labour intensive in the 2–3 years following planting. The presence of appropriate mycorrhiza is also likely to be important under all options (Ledgard & Baker 1988).

Encouraging natural regeneration depends on the distance to local seed sources of the desired species, the presence of seed dispersers, and the presence, vigour and persistence of weed species and browsing animals. Trials have demonstrated the importance of thinning, weed control and releasing from overtopping canopy in improving survival and growth (Bergin & Gea 2005). A review of stand development in red and silver beech forests on the West Coast highlighted the importance of the disturbance regime, size of gaps in the canopy and micro-topography on tree establishment, growth, and survival (Stewart 1995).

Reported trials of direct seeding are fairly limited and include the seeding or laying of manuka brush to establish shrub cover (Bergin & Stewart 2005), seeding of mountain beech and manuka after fire (Ledgard & Davis 2004) and native seedling establishment in pastures after herbicide use and varying seedbed treatments (Ledgard 2006, Douglas in press). Results suggest exposure of mineral soil and removal of competing vegetation is required. Collection of large amounts of seed can be difficult and newly germinated seedlings are at risk from desiccation, pathogens, and pests. Nevertheless it is reported that direct seeding of manuka can provide a rapid cover of woody native species on cleared sites that will enable later introduction of native trees (Bergin & Gea 2005).

The performance of planted indigenous forests depends strongly on site quality and existing vegetation cover. An important issue is the matching of species to site. Bergin and Gea (2005) suggest mimicking natural patterns of regeneration should give good survival and reasonable growth rates across a range of species. However, establishing selected species on fertile sheltered sites is likely to result in faster growth rates and increased timber yield. Site preparation, tree spacing, control of competing vegetation and animal control are critical factors regardless of site.

The limited research into planted indigenous trees suggests that on quality sites, and with appropriate nurse or shelter crops and silvicultural regimes, there is potential for species such as totara, kauri, puriri, and rewarewa to produce merchantable timber in time periods similar to or less than many northern hemisphere plantation species (Beveridge & Herbert 1995).

Factors that have resulted in a focus on this particular set of species are as follows:

Kauri: regular, good seed crops; relatively fast growth rates on suitable sites well beyond its natural range, tolerance of a wide range of soils, strong apical growth and the ability to self-shed lower branches in close-spaced plantings, reasonably successful establishment by natural regeneration or planting.

Totara: durability and machining qualities of the timber, tolerance of a variety of sites, ease of seed collection and seedling propagation, reasonable growth rates, amenability to tending, and cultural value.

Other hardwoods: A 1986 survey of planted indigenous trees identified puriri (*Vitex lucens*) and rewarewa (*Knightia excelsa*) as the two most commonly planted and best performing hardwood timber trees (Pardy et al. 1992). Both require dense stands or nurse crops to reduce the production of multiple leaders.

Research needs and potential providers for Growing Common Futures: Preliminary modelling for the Growing Common Futures project proposed establishing commercial plantations of mixed exotic and indigenous species. These would be managed using progressive selective harvesting to yield intermediate revenues before developing a sustainably harvested, closed canopy, permanent forest of indigenous species. Although such systems were developed early in Germany and France modern uneven-aged silviculture was largely developed in Europe in the 19th century in reaction to declines in growth, timber yield and timber quality; windthrow; and pathological disorders in even-aged forests (Benecke 1996). The approach not been widely tested in plantation forests in New Zealand.

There has, however been considerable work on uneven-aged silviculture in New Zealand over the past decade (Wiser et al 2005), largely in beech forests. In a series of projects (see appendix 2) forest ecologists at Landcare Research have been testing the sustainability of the group-selection system of silviculture; evaluating the immediate and long-term implications of small regeneration fellings; monitoring forest health, regrowth, composition, and plant biodiversity following harvest and developing an effective approach to minimizing damage by pinhole borer.

ENSIS is currently engaged in indigenous plantation silvicultural research with support from the PGSF, Tane's Tree Trust and the SFF, and has a small team of researchers experienced in this work. Several planting trials were established in the 1980s and 1990s, including planting indigenous trees with exotic and indigenous nurse crops, enrichment planting into regenerating scrub, and beech thinning trials in even aged stands. Work has continued with limited funding to monitor those and other silvicultural trials and to extend and maintain a network of growth sample plots.

The School of Forestry also has staff with some experience in this area and has added capacity in honours and post-graduate students who could contribute to a research programme in this field.

Members of Tane's Tree Trust have, individually, long track records in the establishment of planting trials with both exotic and indigenous species, singly and in mixtures. However, the organisation has limited research capacity in its own right.

Landcare Research also has a group of ecologists active in restoration ecology research, including reforestation with indigenous species on degraded lands. Their work is, however, primarily directed at re-establishing functioning ecosystems to support indigenous biodiversity rather than timber production.

Propagation and establishment

Current state of knowledge: There is limited access to information on how to establish plantations of indigenous timber trees successfully (MacGibbon 2003). Information on the

propagation of indigenous trees is largely based on operational experience rather than comparative experimental trials. Reported experience suggests larger, well-conditioned seedlings (1–2 year old) are more successful for large-scale afforestation. Although expensive, survival rates are significantly better than smaller seedlings, particularly where overtopping, smothering or browsing are risk factors. Root distortion leading to later strangulation or toppling of the planted tree has been reported as a risk with container-grown stock (Bergin & Gea 2005). The production of bare-rooted seedlings of indigenous trees is the subject of a new SFF project.

Kauri seedlings have been propagated and planted by the New Zealand Forest Service (NZFS) since the 1930s (Bergin & Steward 2005). In the 1970s the NZFS established a kauri management unit, developed techniques for large-scale production of potted kauri seedlings, and promoted planting by the public and in various trials (Beveridge & Herbert 1995). The NZFS also pioneered grafting of kauri and established a grafted seed orchard at Waipoua. Large-scale bare-rooted seedling production has also been trialled although there were difficulties in obtaining a dense fibrous root system (Bergin & Steward 2005). The former Auckland Regional Authority conducted a series of trials with regenerating and planted kauri in the Hunua ranges from the 1970s (Barton 1978; Barton & Madgwick 1987). From these and earlier plantings information is available on site preferences, response to fertiliser and thinning, and growth rates.

Totara can be raised as either container-grown or bare-rooted seedlings, and planting trials demonstrate over 90% survival on most sites with adequate post-planting management (Bergin & Steward 2005). Trials have also tested open-grown, inter-planting, and nurse crop systems, and response to pruning. Totara is light demanding; while tolerant of dry exposed sites it grows best on open fertile sites (Bergin 2003b). There is still some uncertainty as to how best to manage stocking density to maintain good form and vigour.

Current research on other hardwood species focuses on refining propagation and establishment methods with and without nurse crops and, as trials age, investigating silvicultural requirements (Bergin & Steward 2005).

Comprehensive guidelines for planting native trees have been produced by several authors including Pollock (1986), Porteous (1993), Davis and Meurk (2001) and Bergin and Gea (2005). Beveridge (2000) reviews forty years of podocarp reestablishment trials in a variety of environments. In some cases exotic species are reported as having been used as nurse crops although records of these ‘trials’ are often difficult to locate.

The effects of pests and pathogens on planted indigenous trees can be significant. These are discussed in some detail in Beveridge et al 1985 and summarised in Beveridge 2000. Defoliating caterpillars and insects, tunnelling beetles, browsing possums, deer, goats, rabbits and hares, and rooting pigs have all been recorded as damaging planted indigenous seedlings (Beveridge 2000).

Research needs and potential providers for Growing Common Futures: Successful large scale plantation forestry is dependent on the existence of methods for inexpensively propagating large numbers of seedlings that can be planted at relatively low cost and with high probability of survival and rapid early growth, thereby minimising the number of tending visits to young stands.

With PGSF support ENSIS is researching the selection and development of genetic resources for a small number of indigenous tree species. The SFF is currently funding a pilot research

project into the identification of elite seed trees and methods for producing open-grown seedlings of indigenous timber trees. The results of these projects will be important for any large-scale plantation proposal.

Information and skill in the planting and early silviculture of particular species are reasonably readily available; however, a large-scale programme will require active training and quality control programmes for staff and/or contractors.

In the preliminary survey for this report I have not been able to locate published New Zealand experimental data that might underpin silvicultural prescriptions for mixed indigenous and exotic species plantations, although monitoring data from some establishment trials that include mixed interplanting are reported held by ENSIS. In the absence of experimental data the development of models is being explored as an alternative way of predicting tree growth and stand productivity. In two current MAF funded projects (see appendix 2) models are being developed of the dynamics of podocarp-hardwood forest subject to single tree harvest and of silver beech management in regenerated forest. Some estimated scenarios are also included in Helmut Janssen's book "Bush Vitality" (Janssen 2006).

The interaction between species with regard to light, moisture and nutrient requirements and the response to periodic disturbance, browsing and weed invasion is complex and not well-understood in New Zealand's natural forests. These are issues under research by Landcare Research in both FRST and MAF funded projects (see appendix 2) though little of this research is undertaken in Northland forests which have significant compositional differences to other New Zealand forests.

Productivity

Current state of knowledge: The perception that indigenous species grow too slowly to be useful for timber production is still a barrier to more widespread planting of indigenous trees for timber (MacGibbon 2003). However, diameter growth for kauri plantations surveyed by Pardy et al. (1992) averaged 0.7 cm per year, while some individual trees averaged 1.1 cm/year over periods of 35–40 years. Productivity of between 5 and 12 m³/ha/annum in stand volume has been measured and estimates suggest rotations of 70–80 years may be feasible (Pardy et al. 1992) but are more likely to be 120–150 years (Steward & Kimberley 2002, Steward & Barton 2003).

A crude growth model for totara developed using data from eight planted stands surveyed over 12 years indicated that a mean stand volume of 800 m³/ha might be expected at age 80 (Bergin & Steward 2005). However, there were large variations in growth that reflected site, climate, stand density, and management history. Early growth appeared to be relatively slow, with mean annual volume increment increasing from less than 7 m³/ha/annum at age 30 to 14 m³/ha/annum at age 60 (Bergin & Kimberley 2003).

Pardy et al. (1992) reported mean annual height growth for planted puriri and rewarewa stands of 32–49 cm/annum over the first 20 years of growth, and more recent trials demonstrate rates exceeding 60 cm annual height increment within 5 years of planting under nurse crops (Steward 2000).

Productivity is a function of both timber yield and quality. In contrast with earlier supplies of indigenous timber that were typically from trees several hundreds of years old, planted and regenerated stands harvested at 80–120 years of age are likely to have high proportions of sapwood. Preliminary evaluation of sapwood from 68-year-old kauri suggests wood quality

characteristics are still acceptable for high-end uses. For example, while basic density of mostly sapwood timber from a 68-year-old kauri stand was less than that of kauri heartwood, shrinkage and stiffness were superior (Bergin & Gea 2005). Research also indicates that heartwood formation in second-growth kauri is most strongly correlated with stem diameter, with age a secondary factor, suggesting higher proportions of heartwood may be produced in fast-grown plantations than previously expected (Steward & Kimberley 2002).

While these results suggest merchantable timber of reasonable quality may be produced from single species plantations of a small number of indigenous species on favourable sites in rotations as short as 60–80 years, the conclusions are drawn from a very small sample of planted stands and may not be widely generalisable.

Research needs and potential providers for Growing Common Futures: The long-term productive potential of mixed species plantations managed under a permanent canopy regime with selective harvesting is probably best modelled from the productivity of natural forests on comparable sites that they are being planted to emulate. The primary source for the data to do this is the National Vegetation Survey Databank (NVS) maintained by Landcare Research. NVS is a physical archive and computer databank containing records from approximately 45,000 vegetation survey plots--including data from over 12,000 permanent sample plots. NVS provides a record spanning more than 50 years of indigenous and exotic plants in New Zealand's terrestrial ecosystems. A broad range of habitats are covered, with special emphasis on indigenous forests and grasslands.

Preliminary work for the project by Helmut Jansen suggested there may be increased production potential from selective inter-planting of complementary species. This is still to be demonstrated and confirmed by empirical measurement in New Zealand.

Historical records of indigenous planted forest research are being collated by Tane's Tree Trust under a SFF project to be completed by June 2007 (I Barton pers. comm.) and key trials are being measured in various MAF research projects (appendix 2).

ENSIS holds and maintains a database of historic and permanent sample plots from a very wide range of indigenous forest sites, both natural and planted.

Landcare Research is currently investigating the productivity of natural indigenous forests as part of the PGSF funded Indigenous Forestry programme. The work focuses on the podocarp forests of Te Urewera and the beech forests of the South Island. The potential for extending this or a new programme to Northland's indigenous forests should be explored.

Financial viability

Current state of knowledge: Conventional financial analyses, beginning as early as the 1913 Royal Commission on Forestry, do not support the establishment of slow-growing plantations of native tree species (Horgan 2000). These analyses, however, generally only include traded products and direct expenditure. They do not include, as would a full economic analysis, externalities associated with, for example, soil and water conservation benefits or additional non-timber forest products that may not be traded, e.g., cultural harvest of plant or bird species.

On a strictly financial basis one might expect the financial value of plantations producing decorative timber to increase through time with the growing scarcity of such timber from natural stands. The trend in the real (inflation adjusted) prices of decorative sawn timber over the past 50 years do not, however, provide much support for that view (Horgan 2000). It is

therefore likely that most stands of native trees will continue to be planted for more than one reason, as has been the case for most of the native tree stands planted over the last century (Pardy et al. 1992).

Conventional financial analyses for kauri plantations grown on 60–80 year rotations suggest returns on investment of less than 2% per annum, see for example, Barton and Horgan (1980) and Herbert et al. (1996). Both these studies describe their analyses as representing the potential of kauri on high quality sites. They conclude that other non-timber benefits would be required to reach rates of return on investment in forestry expected by private investors or central Government.

Initial work by Horgan in the mid-1990s suggested that for values of carbon up to \$40 per tonne and discount rates up to 4%, there were combinations of discount rate and carbon value for which planted kauri stands were more valuable than continuous crops of radiata pine (Horgan 2000). In contrast, Herbert et al. (1996) estimate that carbon sequestered in above-ground biomass would have to exceed a \$200/tonne in value to achieve a 10% return on investment in kauri plantation forestry.

Nevertheless, it seems likely that the rapidly growing interest in indigenous forest restoration and regeneration as a carbon offset mechanism currently offers the best opportunity to build a business case for the re-establishment of the long-rotation, closed-canopy, indigenous forests proposed in Growing Common Futures. Three issues are critical to the development of a business case including carbon credits under the United Nations Framework Convention on Climate Change rules:

- Eligibility of land – The principal consideration in identifying land eligible for use in generating certified emissions reduction (CER) units is the land use at 31 December 1989. Forest land is defined as a minimum area of land of 0.05–1.0 hectare, with tree crown cover (or equivalent stocking level) of more than 10–30 per cent with trees with the potential to reach a minimum height of 2–5 metres at maturity in situ. Land classed as forest land at 31 December 1989 is not eligible.
- Productivity of land – the extent of amelioration (weed removal, site preparation, seedling and planting costs, weed control) required to establish planted forest and potential Carbon accumulation rates (determined by growth rates) imply an effective “cost” of producing CER units. Where such costs are high, projects are less attractive to commercial investors or governments.
- Additionality – to qualify for CER units projects must arise from activities that are additional to those that would have occurred under a business-as-usual scenario. To be eligible for CER units the Growing Common Futures project would need to demonstrate that forest regeneration would not have occurred without the project’s intervention and that forestry is not the only land use alternative for the land.

A trial programme on the East Coast supported by the Tindall Foundation is attempting to demonstrate the potential for carbon sequestration in regenerating forest as a competitive management option for Maori land owners. The project aims to generate a competitive income from regenerating forests by taking advantage of:

- the Government’s Permanent Forest Sinks Initiative (PFSI) that provides an opportunity for landowners to establish permanent forest sinks and obtain tradable Kyoto Protocol compliant emission units in proportion to the carbon sequestered in their forests

- soil stabilisation grants
- funds for protecting valuable habitats, and
- potential income from tourism and non-timber forest products such as manuka oil and honey (Motu 2006).

Initial research shows that carbon could potentially yield higher financial returns than livestock farming or low-value pine plantations on some marginal lands where natural regeneration rates are favourable. This highlights the importance of low-cost establishment methods.

A second programme on the East Coast, led by Ngati Porou Whanui Forests Ltd, is proposing to develop mixed indigenous and exotic plantation forests under the Governments PFSI initiative with financial investment from an offshore partner. Details of this programme are not widely known but may be available from NPWF Chief Executive Officer, Chris Insley.

Research needs and potential providers for Growing Common Futures: Gerard Horgan, MAF Rotorua, developed financial assessment models for kauri while with the Forest Research Institute in the 1980s and 1990s (Barton and Horgan 1980, Horgan 2000). The business case for the East Coast programme discussed above has been developed as part of a PhD programme by Jason Funk with Sustainable Farming Fund support (see appendix 2) and may provide a useful model for the Growing Common Futures project.

The development of the business case should test the impact of the alternative mechanisms for encouraging afforestation included in the Government's discussion document on sustainable land management and climate change. Options under consideration are an afforestation grant scheme or giving forest growers the choice between an afforestation grant or receiving carbon sink credits and liabilities.

Institutional issues

Current status: Current government policy strongly supports the principle of planting native trees on private land. The New Zealand Biodiversity Strategy (2000) has the restoration of indigenous biodiversity as a key goal, and a draft National Policy Statement on biodiversity has been proposed to give effect to this. Policies in the draft Statement recognise the contribution enhancement and restoration can make and encourage the restoration and rehabilitation of areas important for halting the decline of indigenous biodiversity (Appendix 1). To argue for wider biodiversity benefit, however, it is likely that an indigenous plantation forest would need to restrict harvesting to a level similar to that required for sustainable forest management plans and permits under the Forests Act.

The recently released MAF discussion paper on sustainable land management and climate change proposes afforestation policies to encourage greater levels of greenhouse gas absorption by increasing the area of forest sinks. In addition to the existing Permanent Forest Sink Initiative, in which landowners who meet the requirements receive tradable Kyoto Protocol compliant emission units, the Government has identified two possible policies for encouraging greater levels of afforestation with exotic or indigenous tree species – an afforestation grant scheme or a devolved carbon credit and liability scheme (MAF 2006).

Despite this there is still a concern that provisions of the Resource Management Act 1991 (RMA), the local District Plan, or the Forests Amendment Act 1993 (FAA) could prevent

future harvest or extraction and that interpretations of existing tax law are less favourable to planting indigenous timber trees than exotic ones.

District Plans and the RMA: The ability to harvest planted indigenous forest is not always explicitly addressed in regional and district plans developed under the Resource Management Act and may inadvertently be covered by vegetation removal controls designed to protect natural forests for conservation purposes.

A survey of North Island District Plans in 2003 (MacGibbon 2003) showed considerable variation in the manner in which indigenous forestry was dealt with from making no distinction between exotic and indigenous forestry to those that distinguished between them and between planted and existing indigenous forest. Of 12 plans reviewed in detail, ten required consents to be issued before planted indigenous trees could be removed, six did not distinguish planted from natural vegetation and so included planted trees in rules intended to limit further loss in indigenous biodiversity, and only one had a mechanism to document a planted stand and the purpose of that planting – critical where the decision on harvesting is 60–80 years in the future (MacGibbon 2003).

What are needed are appropriate exemption clauses in district plans that explicitly state that vegetation removal rules will not apply to the harvesting of indigenous vegetation that was planted for commercial production. That intent should be registered against the Certificate of title of the land, held in a Council register that records the purpose of tree planting and attached as a separate record to the property file.

In the Far North District Plan (awaiting final consent order from the Environment Court), the felling or clearance of indigenous trees that have been planted and managed for timber production and for which a Sustainable Management Plan or Permit (under the Forest Act 1949) is in force is a permitted activity (Rule 11.2.6.1.1).

Income Tax Act: The principle issue is whether indigenous forestry is considered to be a forestry business activity and is therefore eligible for full deductibility of forestry expenses including, for example, the establishment of ‘nurse’ plants of several species before enrichment with timber species. If it is not, then those in the business of farming or agriculture can only claim against \$7,500 of expenditure per annum for planting activities. This despite the fact that if trees other than ornamental or incidental trees are assessed to have value as standing timber, irrespective of the purpose for which they were planted, then the increase in value of that standing timber is taxed when the property is sold.

Case law that sets a general test of whether a business is in operation. The test includes examination of the nature of the activity, the period over which it was engaged in, the scale of operations, the value of transactions, the commitment of time, money and effort, the pattern of activity, and the financial results. It is important, therefore, that an indigenous forest grower demonstrate through the development of a management plan, budgets, and accounting practice (GST registration, etc.) that there is clear intention and expectation that the venture is a business activity.

Forests Amendment Act: While it is clear that stands of indigenous trees planted on previously cleared land are not covered by the controls of the Forests Amendment Act (FAA), the status of forests in which natural regeneration also plays a part in the establishment process e.g. second-growth stands naturally regenerating on previously cleared

land with or without supplemental planting, is unclear. If such forests are deemed indigenous forest land under the FAA then the sustainable management provisions of the Act will apply.

The Forest Amendment Act has as its purpose the promotion of “the management of an area of indigenous forest land in a way that maintains the ability of the forest growing on that land to continue to provide a full range of products and amenities in perpetuity while retaining the forests natural values”. An imperfect understanding of the ecological processes in complex, mixed species ecosystems has led to the purposes of the Act being implemented through harvesting controls.

To maintain the character and structure of the forest podocarps, kauri and exposure-sensitive hardwoods may only be harvested as small groups and light-demanding species in coupes of up to 0.5 ha. The provisions of the Act prevent a forest owner from selling logs unless they are operating under a sustainable forest management permit or plan, and from exporting sawn timber (except rimu or beech) at all.

In the absence of legislative clarification, it would be wise for potential indigenous plantation owners to seek a declaration from the Ministry of Agriculture and Forestry as to whether the land to be established is classifiable as indigenous forest land and therefore covered by provisions of the Act. The Ministry is currently considering options for formally verifying that land is planted indigenous forest (A. Griffiths pers. comm.).

Research needs and potential providers for Growing Common Futures: Tane’s Tree Trust has been the most active group addressing these issues. The Trust has access to a number of prominent forestry, farming, and academic professionals and is active in commenting and submitting on proposals affecting the institutional support for the planting of indigenous forests. The Trusts’ support in this area would significantly strengthen the project.

Environmental and social issues

Current state of knowledge: Conversion of pasture or shrub land to continuous-cover indigenous forest is likely to have the following environmental impacts:

- Reduction in annual water yield from forested catchments in the order of 25–50% and an associated reduction in low flows (with the possible exception of low infiltration soils where forests may improve infiltration rates) (Fahey & Rowe 1992)
- Reduction in localised flooding and sedimentation in small catchments, particularly from smaller storms (Fahey & Rowe 1992) presuming adequately located and designed access roads.
- Improvement in surface water quality (reductions in in-stream nitrogen, phosphorous, sediment, and faecal contaminants) presuming adequate control of site preparation, harvesting and extraction operations (Smith et al. 1993).
- Reduction in surface and mass movement soil erosion rates (Clough & Hicks 1992) and sedimentation (Smith et al. 1993).
- Enhancement of the biomass carbon stock from 7 to 10 tCO₂/ha on pasture sites or in the order of 130 tCO₂/ha on sites under woody scrub, to up to over 1200 tCO₂/ha in mature forest (Tate et al. 1997).
- Significant increase in indigenous biota, including non-timber plant species, terrestrial and aquatic invertebrates, fungi and birds. Increases in structural, functional, and genetic diversity on reforested sites and potentially at a District level where largely cleared land types are reforested or where previously isolated remnants are reconnected.

The socio-economic impacts of a large-scale afforestation programme with indigenous species have not been explored. Work by Krausse and King (1997) on the impacts of land-use change from pastoral farming to exotic plantation forestry highlighted concerns about rural depopulation and unemployment, declining rural services, impacts on land prices, pressure on district infrastructure, and a breakdown of community structure resulting in increasing isolation.

The scale of these impacts depends largely on the nature of existing land use and the rate of afforestation. In the longer term, assuming local processing of harvested timber, Krausse and King forecast net increases in employment and household income, although the costs of losses in on-farm employment and of local services largely fell on small rural communities, while the benefits of future employment and services accrued to District centres.

In the Far North a number of potential costs are likely to be significantly mitigated: conversion of marginally productive land will displace proportionately fewer on-farm jobs; afforestation of multiply owned Maori land will not involve a change in tenure so is less likely to result in displacement of families or communities but involves a range of other potential costs associated with the management of multiply-owned land; indigenous forests are likely to provide a wider range of income generating opportunities than single-species plantations; and processing of indigenous plantation timber must be done in New Zealand. High-value timber and relatively expensive cartage rates for logs are likely to make local processing attractive.

The project work programme (Appendix 1) highlights the challenges associated with coordinated development programmes on Maori-owned land – large numbers of very small land holdings and communication and decision making challenges where there are many beneficial owners. These issues are significant and warrant explicit consideration in the project development phase.

Research needs and potential providers for Growing Common Futures: In the short term the project will need to develop the site preparation, establishment, and silvicultural techniques and expertise to establish the proposed forest efficiently and with minimum environmental impact. While much can be learnt from exotic forest plantation establishment techniques, there will be specific requirements relating to the species mixes being proposed. Research expertise in this field is held by the forest research institutions (Scion/ENSIS, School of Forestry) and small-scale forestry communities (NZ Farm Forestry Association, Tane's Tree Trust).

In the longer term the project will need to develop the knowledge to manage for forest ecosystem sustainability, i.e. to sustain the important compositional (e.g. species and abundances), structural (e.g., size range of trees) and functional (e.g., nutrient availability) characteristics of forests while maintaining a commercially sustainable harvest. Silvicultural systems will need to be developed that are appropriate to the species used, minimise harvesting impacts and provide cultural and environmental benefits. This is the current focus of research led by Landcare Research that includes a partnership with the Tuhoe Tuawhenua Trust and also involves Scion, AgResearch, international research collaborators, and private consultants. Examples of current projects include quantifying residual tree growth and mortality following harvesting in beech forest, demonstrating proof of concept for control of pinhole (Platypus) beetle build-ups, reviewing the consequences of harvesting on nutrient

cycling, establishing baseline levels of podocarps and kereru in Tuhoe Tuawhenua Trust forests, and determining the level of podocarp recruitment following harvesting and the consequences of tree removal on soil animal community structure and ecosystem processes. Researchers recently undertook a joint study visit, with Tuhoe Tuawhenua Trust members, to southern Germany to assess low-impact silvicultural systems developed there over the last three centuries.

6. Conclusions

The work programme outline for Growing Common Futures proposed a 3-year initial research phase investigating:

- economic and institutional barriers by developing a business case for the project
- silvicultural feasibility by establishing four representative pilot sites
- the capacity and training needed to sustain a large-scale afforestation project through time.

The results of this review confirm this as an appropriate strategy. Key challenges for a large-scale afforestation project of the type proposed are:

- The limited experience with indigenous plantation forestry in New Zealand – probably less than 150 ha in total, with very few sites larger than 5 ha in size.
- The even more limited experience and lack of published information on the application of uneven-aged silviculture in plantation forestry in New Zealand, although work in existing natural forests will be relevant to mature plantation forests.
- Investment in indigenous forestry research is currently in the order of \$1 - \$1.5 million per annum (approx 5 - 7 full-time equivalents) funded from three main sources – the Public Good Science Fund, MAF operational research contracts and the Sustainable Farming Fund.
- The research investment is dispersed across multiple organisations and in projects with very broad scope – the silviculture and ecology of existing indigenous forests (though not in Northland), the propagation and silviculture of a small number of indigenous species with potential for planting on favourable sites as fast growing plantations, and commercial utilisation of beech.
- The dispersed expertise and advocacy for indigenous forestry. No one organisation is in a position to provide all the necessary components to support a project like Growing Common Futures.
- The likelihood that such a project will require both private and government investment (recognising public benefits) to be financially viable. The context and timing of the project will therefore be critical. The discussion documents on sustainable land management and climate change offer an opportunity to engage central government in a discussion on how to integrate carbon sequestration, biodiversity protection and

enhancement, soil and water conservation, Maori economic transformation, and community development.

- The challenges associated with developing the capacity and agreement to enable a coordinated programme of development on Maori land.

7. Recommendations

- That a project leadership group for the Growing Common Futures project is established by the project partners and that the group
 - establish an appropriate legal structure for the project
 - appoint a project coordinator
 - prepare a description of the lands potentially available for the project and their status under the Forests Act 1949 and Kyoto Protocol rules.
- That the project coordinator identify and work with preferred providers to prepare funding applications for the proposed research projects.
- That the project coordinator establishes technical advisory groups of relevant partners and stakeholders, including central government agencies, to support the proposed research projects.
- That the project proceeds with a staged work plan as outlined in the Growing Common Futures document but that the three research projects occur in sequence rather than in parallel using an adaptive management approach. This would include a review and decision to conclude or proceed at the conclusion of each research phase:
 - Development of a business case for the project
 - Demonstration of technical feasibility in a small number of trial plantings, and
 - Capacity and land-use planning for large-scale implementation (including negotiating appropriate arrangements for afforestation on multiply-owned land).

8. Acknowledgements

This report was funded by the Foundation for Research Science and Technology under Envirolink grant NLRC23. The report is based on interviews with those referred to in section 4 and on material referred to or provided by them. Their assistance, and that of the staff of the Far North District Council, is gratefully acknowledged. Dr Rob Allen's comments on a draft significantly improved the report.

9. References

- Barton IL 1978. Temperature and its effect on the germination and initial growth of kauri (*Agathis australis*). *New Zealand Journal of Forestry Science* 8(3): 327–331.
- Barton IL 1994. Managing kauri on the farm, Part 1. *New Zealand Tree Grower* 15(4): 27–28.
- Barton IL 1995. Managing kauri on the farm, Part 2: establishing a kauri forest. *New Zealand Tree Grower* 16(3): 34–37.
- Barton, I.L 1996. Managing kauri on the farm, Part 3: silviculture. *New Zealand Tree Grower* 17(2): 31–35.
- Barton IL, Horgan GP 1980. Kauri forestry in New Zealand: a protagonist's view. *New Zealand Journal of Forestry* 25(2): 199–216.
- Barton IL, Madgwick HAI 1987. Response of a kauri stand to fertiliser addition and thinning. *New Zealand Forestry* 32(2): 19–21.
- Benecke U 1996. Ecological silviculture: the application of age old methods. *New Zealand Forestry* 41(2): 27–33
- Bergin DO 2003a. Early performance of planted totara in comparison with other indigenous conifers. *New Zealand Journal of Forestry Science* 33(2): 205–224.
- Bergin DO 2003b. Totara: establishment, growth and management. *New Zealand Indigenous Tree Bulletin No. 1. Forest Research. Rotorua.* 40 p.
- Bergin DO, Kimberley MO 2003. Growth and yield of totara in planted stands. *New Zealand Journal of Forestry Science* 33(2): 244–264.
- Bergin DO, Gea L 2005. Native trees: planting and early management for wood production. *New Zealand Indigenous Tree Bulletin No. 3. Forest Research. Rotorua.* 44 p.
- Bergin DO, Steward GA 2005. Establishment and management of indigenous plantation forest. In: NZIF forestry handbook. New Zealand Institute of Forestry. Wellington. Pp. 26–29.
- Bergin DO, Steward GA 2004. Kauri: ecology, establishment, growth and management. *New Zealand Indigenous Tree Bulletin No. 2. Forest Research. Rotorua.* 48 p.
- Beveridge AE Bergin DO 2000. The role of planting native trees in the management of disturbed forest. In: Silvester W, McGowan R eds *Native trees for the future. Proceedings of a forum held at University of Waikato, Hamilton, 8–10 October 1999.* University of Waikato. Pp. 51–60.

- Beveridge AE, Bergin DO, Pardy GF 1985. Planting podocarps in disturbed indigenous forests of the central North Island. *New Zealand Journal of Forestry* 30(1): 144–158.
- Beveridge AE, Herbert JW 1995. The Management of Rimu. In: Hammond D. ed NZIF Forestry Handbook 3rd Edition. New Zealand Institute of Forestry, Christchurch.
- Beveridge AE, Herbert JW 1995. The Management of Kauri. In: Hammond D. ed NZIF Forestry Handbook 3rd Edition. New Zealand Institute of Forestry, Christchurch.
- Beveridge AE, Smale MC, Christensen BR, Steward GA 2004. Ecology, management, and history of Whirinaki Conservation Park, New Zealand - An annotated bibliography Department of Conservation Science Internal Series 193. Department of Conservation, Wellington. 81 p.
- Beveridge AE, Smale MC, Holzappel AS 2000. Ecology and management of Pureora Forest Park. *Conservation Advisory Science Notes* 282. Department of Conservation, Wellington. 87 p.
- Clough P, Hicks DL 1992. Soil conservation and the Resource Management Act. Report to the Ministry of Agriculture and Fisheries. New Zealand Institute of Economic Research and Landcare Research NZ Ltd.
- Davis M, Meurk C 2001. Protecting and Restoring our Natural Heritage - a Practical Guide. Department of Conservation. <http://www.doc.govt.nz/templates/MultiPageDocumentTOC.aspx?id=42685>. 94 p.
- Ellis JC 1979. Tree volume equations for the major indigenous species in New Zealand. New Zealand Forest Service Technical Paper No. 67.
- Fahey BD, Rowe LK 1992. Land-use impacts. In: Moseley MP ed. *Waters of New Zealand*. Where published: New Zealand Hydrological Society. Pp. 265–284.
- Gould B 2003. Thinning a kauri plantation: a New Plymouth District Council initiative. *New Zealand Tree Grower* 24(2): 33–34.
- Halkett JC 1984. The practice of uneven-aged silviculture. *New Zealand Journal of Forestry* 29(1): 108–118.
- Hammond D 2003. *Development of Maori-owned indigenous forests*. MAF Technical Paper No. 2003/04. Ministry of Agriculture and Forestry. Wellington. 80 pp.
- Herbert J, Glass B, Kimberley M 1996. A preliminary stand productivity and economic case study of plantation growth kauri. In: An alternative approach to forestry: time to review. Proceedings of the New Zealand Institute of Forestry conference, Invercargill, 29 April–1 May 1996. New Zealand Institute of Forestry. Pp. 83–91.
- Horgan GP 2000. Economic issues in the planting of New Zealand native trees. In: Silvester W, McGowan R eds *Native trees for the future*. Proceedings of a forum held at University of Waikato, Hamilton, 8–10 October 1999. University of Waikato. Pp 76–79.

- Janssen H 2006. *Bush Vitality Assessment, Growing Common Futures*. Wellington. 176 p.
- Klitscher K 2002. Update on research with native species at Forest Research. *New Zealand Tree Grower* 23(2): 33–34.
- Krausse MK, King JM 1997. Impacts of land use change in Wairoa District: resource document. MAF Policy Technical Paper 97/3. Ministry of Agriculture and Forestry. 133 p.
- Ledgard NJ 2006. Revegetation by seeding – an alternative approach to restoring native plant communities. *Open Space* 67: 16–19
- Ledgard NJ, Baker GC 1988. Mountain land forestry - 30 year's research in the Craigieburn Range, New Zealand. *New Zealand Forest Research Institute Bulletin* No 146. 64 p.
- Ledgard NJ, Davis M 2004. Restoration of mountain beech (*Nothofagus solandri* var. *cliffortioides*) forest after fire. *New Zealand Journal of Ecology* 28: 125–135.
- MacGibbon R 2003. Reducing the impediments to planting native trees: what is the problem? In: Barton I, MacGibbon R, Burns B, Berg P eds *Profiting from diversity: reducing the impediments to planting native trees*. Proceedings of two seminars held at University of Waikato, Hamilton, 16 May 2003 and Ministry of Economic Development, Wellington, 20 May 2003. Tane's Tree Trust. Pp 8–14.
- MAF 2006. Sustainable land management and climate change, options for a plan of action: a public discussion document for those with an interest in New Zealand's forestry and agriculture sectors. <http://www.maf.govt.nz/climatechange/discussion-document/slm-and-cc-full.pdf>. Ministry of Agriculture and Forestry. Wellington. 96p.
- Morrison FT, Lloyd RC 1972. Artificial establishment of New Zealand kauri at Waipoua. *New Zealand Journal of Forestry* 17(2): 264–273.
- Motu 2006. Carbon farming – a new land use opportunity. http://www.motu.org.nz/pdf/Motu_Research_Update/Issue_10.pdf. Motu Research Update 10: 8.
- Pardy GF, Bergin DO, Kimberley MO 1992. Survey of native tree plantations. *Forest Research Institute Bulletin* No. 175. 24 p.
- Pollock KM 1986. Plant materials handbook for soil conservation. Volume 3: Native plants. *Water and Soil Miscellaneous Publications* 95. Ministry of Works and Development, Wellington.
- Porteous T 1993. *Native Forest Restoration: A practical guide for landowners*, QEII National Trust, Wellington. 184 p.
- Preest D 1979. Seed storage of several New Zealand indigenous trees, Part 1: kauri. *New Zealand Journal of Forestry Science* 9(3): 337–343
- Richards CR 2005. Management of indigenous forest. In: Colley M. ed *NZIF Forestry Handbook* 4th Edition. New Zealand Institute of Forestry, Christchurch. Pp. 29–35

- Silvester W, McGowan R eds 2000. Native trees for the future: potential, possibilities, problems of planting and managing New Zealand forest trees. Proceedings of a forum held at the University of Waikato, Hamilton, 8–10 October 1999. University of Waikato. 96 p.
- Smale MC, Beveridge AE, Herbert JW 1998. Selection silviculture trials in North Island native forests : impacts on the residual forest and their implications for sustainable forest management. *New Zealand Forestry* 43(3): 19–30.
- Smith CM, Wilcock RJ, Vant WN, Smith DG, Cooper AB 1993. Towards sustainable agriculture: freshwater quality in New Zealand and the influence of agriculture. MAF Policy Technical Paper 93/10. 208 p.
- Steward GA 2000. The potential for establishment and management of New Zealand native hardwood trees. In: Silvester W, McGowan R eds Native trees for the future. Proceedings of a forum held at University of Waikato, Hamilton, 8–10 October 1999. University of Waikato. Pp 40–44
- Steward GA, Barton IL 2003. Performance and tree health of a six year old planted kauri stand in the Bay of Plenty. Tane’s Tree Trust Bulletin No. 1. Tane’s Tree Trust
- Steward GA, Bergin DO, Winstanley WJ 2003. Two records of kauri regeneration from trees planted south of the species’ natural range. *New Zealand Journal of Forestry Science* 33(1): 3–9.
- Steward GA, Kimberley MO 2002. Heartwood content in planted and natural second-growth New Zealand kauri (*Agathis australis*). *New Zealand Journal of Forestry Science* 32(2): 181–194.
- Steward GA, McKinley RB 2005. Plantation-grown New Zealand kauri: a preliminary study of wood properties. *New Zealand Journal of Forestry Science* 35(1): 35–49.
- Stewart GH 1995. Stand Development in the Red/Silver Beech and Mixed Beech Forests of North Westland. Science for Conservation 8. Department of Conservation. Wellington. 13 pp.
- Tate KR, Giltrap DJ, Claydon JJ, Newsome PF, Atkinson AE, Taylor MD, Lee R 1997: Organic carbon stocks in new Zealand’s terrestrial ecosystems. *Journal of the Royal Society of New Zealand* 27(3), 315–335.
- Watson AJ, Marden M 2004. Live root-wood tensile strengths of some common New Zealand indigenous and plantation tree species. *New Zealand Journal of Forestry Science* 34(3): 344–353.
- Wiser SK, Allen RB, Benecke U, Baker G, Peltzer DA 2005. Tree growth and mortality after small-group harvesting in New Zealand old-growth *Nothofagus* forests. *Canadian Journal of Forest Research* 35: 2323–2331.

Appendix 1 Ruia mai nga kakano, Kia tupu ai nga mokopuna o Tane, Hei orange mo apopo (Growing Common Futures)

RUIA MAI NGA KAKANO, KIA TUPU AI NGA MOKOPUNA O TANE, HEI ORANGA MO APOPO / GROWING COMMON FUTURES Far North District

Work Programme Outline

**Prepared by Peter Nuttall for Forward Planning Unit, Far North District Council
February 2006**

1. Purpose

To initiate a programme of desktop and practical research to investigate and trial the commercial potential of managed plantations of mixed species permanent forests using adaptive management silviculture.

The programme seeks to capitalise on existing research in this emerging field and will be championed and undertaken by a coalition of existing long-term stakeholders: hapu, iwi, established farmers, district council and landcare groups. Support and participation is also sought from national research bodies (Landcare Research, SCION, MfE, ASB Trust, Tane's Tree Trust) as well as Northland Regional Council, the Department of Conservation and Enterprise Northland.

While ascertaining the commercial viability of such plantations is a pre-requisite, the programme also seeks to demonstrate real benefits across all four well-beings. The Programme is considered to be consistent with district and regional obligations under the Resource Management Act and Local Government Act as well as national policies under the National Biodiversity Strategy and regional social and economic development.

A three-year initial work programme is proposed, comprising investigation into economic and institutional barriers; planning and establishing four pilot sites and ascertaining the capacity building/training needs of the Far North to sustain the planning, maintenance and harvest of such plantations in the future.

2. Context

The assumption that mixed species plantations, particularly when comprised of native species, is uneconomic due to the length of growth time has been increasingly challenged, especially with research into key individual indigenous species such as totara, kauri, puriri. Mixed species managed plantations which seek to produce a continual harvest stream of differing timber and non-timber products selectively harvested under a permanent canopy is an ideal that can provide sustainable benefits measurable under all four wellbeings. Adaptive management silviculture, (where species are carefully selected and planted to provide maximum mutual benefit for light training, nutrient supply, soil & water supply enhancement/retention and slope stability/erosion control) has been successfully trialed internationally with production increases of between two and five times natural regeneration. Initial modeling indicates that sustainable cumulative economic returns may be achievable following an initial establishment phase (of 30-40 years) that out performs exiting mono-species exotics such as pinus radiata. Consideration of carbon credits as well as other economic instruments (e.g. taxation, and land rating instruments, economic subsidizes) will be necessary to bridge this establishment phase. Generalized research by Landcare Research and Tane's Tree Trust provides important guidance on some of these issues. However, more detailed and site specific modeling is required for Far North specificities.

The Far North district has special considerations that warrant this work programme. In 2001 there were more than 95,000 ha of plantation forest (47% of the Northland region's plantations), with more than 90% in *pinus radiata* with an average age of 15.8 years. The vast majority of this is un-pruned pulp grade timber returning marginal returns (\$50 – \$280 cu m). Transport infrastructure and wood processing/transportation routes are long, unsuitable and expensive to maintain for high quantity, low quality crops.

Apart from isolated pockets, soils are generally poor in the Far North and most farming outside of the fertile pockets is stock fattening and forestry holdings – often at lower returns than other parts of the country. There has been a strong interest from the established farming community (often 3rd generation+) into new and more sustainable farming practices. The economic sustainability argument needs to be demonstrated to convince this stakeholder group to consider widespread changes although mixed species plantings for riparian and slope management is gaining increasing adoption. There are a small number of established and dedicated landcare groups.

Approximately 18% of the district comprises freehold Maori land in approximately 4,500 property titles. Of these some 2,000 are 20 ha or less, are landlocked and have more than 300 beneficiary owners. *Pinus* planted on these lands is generally of the lowest grade, with little attention being given to pruning and maintenance regimes at time of planting. Several of the large forestry plantations (e.g. Aupouri Forest) are scheduled to come back into tribal ownership via Treaty settlements processes. Forestry of one type or another is the likely use of much Maori land in production in the District. Iwi and hapu are generally supportive of plantings that favour indigenous species for a range of rationale but, again, the economic viability needs to be established.

3. The Four Well-Beings

It is considered the proposed work programme will be able to be measured favourably against all four well-beings:

- **Economic.** Initial modelling indicates sustainable economic returns are achievable over time once the initial 30yr establishment phase is completed. Forestry built around maturity cycles of 70-120 yrs for some target species will build inter-generational capital.
- **Environmental.** All current research, nationally and internationally, points to enhanced environmental benefits for water and watercourse, riparian and soil health as well as slope stability and erosion control. National trends of mono-species plantation forestry are predicted to fall by nearly 50,000 ha in response to poor forestry returns with an associated loss of carbon sinks. Nearly all available Far North land fits the critical lowland forest category – a target of the NBS.
- **Social.** The Far North has traditionally figured disproportionately in most socio-economic indicators with lack of sustainable employment opportunities a major contributing factor. Employment and career opportunities are associated with the potential forestry plantations and, as importantly, with value adding processing of timber and non-timber products from such plantations.
- **Cultural.** The barriers to using freehold Maori land in the Far North are formidable. This programme seeks to provide potential and sustainable alternatives to current non-productive or low productive use of such lands. Forestry is likely to be a cornerstone of several tribal treaty settlements and there is a preference amongst these stakeholders for future forestry use that favours indigenous plantings. Established farming families are also seeking similar alternatives.

4. A Three-Phase Work Programme

The programme seeks to establish three separate but related projects:

1. Identifying and Resolving Economic and Institutional Barriers
2. Establishing four pilot sites and project team.

3. Identifying and resolving capacity and training requirements in the medium to long-term.

The programme looks to bring together a coalition of targeted stakeholders (iwi, hapu, farmers, district council and landcare groups) with targeted funders and research agencies. Ensuring buy-in and ownership of the project is held collectively is essential to the success of the overall programme. FDNC will provide overall project management/ administration support until full funding of the programme can be achieved (at least 12 months).

4.1 PHASE ONE: Identifying and Resolving Economic and Institutional Barriers to establishing commercially viable plantation of mixed species forests. Such plantations are managed using adaptive management silviculture methods plantations designed to ultimately achieve closed canopy permanent forests with ongoing selective extraction of a wide variety of timber and non-timber products. A number of economic and institutional barriers have been identified by the project team to date and by national research (Tane's Tree Trust 2005). Truthing and resolution of these barriers will form part of a wider national debate, however the local applicability of both barriers and solutions needs to be undertaken specifically for Far North scenarios.

Initial modelling indicates economic returns in excess of mono-species plantations after an initial establishment period periods of approx 30 years. This modelling needs detailing and truthing. Various mechanisms might be considered to defray the establishment costs – taxation, carbon credits, rates relief, government subsidies, etc. Included in this analysis needs to be consideration of the national biodiversity/climate change interest versus the private gain to the landowner/forest owner.

Identified institutional barriers include the workability and suitability of mechanisms created under the Forestry Amendment Act (e.g. sustainable management plans, permits, etc) and the strength of provisions in district and regional plans under the Resource Management Act.

It is expected that national research provider(s) will be required to undertake and project manage this phase of the work programme. Landcare Research, SCION, Tane's Tree Trust, Canterbury University Forestry Department are all obvious options.

Proposed Work – Phase 1.

1. **WHAT:** Build relationships with key existing researchers in this field – SCION, Landcare Research, Institute of Environmental Economics, MFE, Tane's Tree Trust. Access scope of existing research and identify any future potential research nationally.
WHO: FNDC internal.
FUNDS: FNDC internal.
WHEN: 2005 ongoing
2. **WHAT:** Initiate Envirolink application (\$5k) to convene hui of external research expertise and targeted stakeholders.
WHO: FNDC/Landcare Research/NRC
FUNDS: Envirolink
WHEN: March 2006
3. **WHAT:** Initiate Envirolink application (\$20k) to construct a business case for detailed research programme. Research to include modeling of four pilot project forests (e.g. Ngati Rehia 300 ha, FNDC 60ha, TROTR 1000ha) economic viability using mixed species, pinus radiata and acacias.
WHO: Agreed research provider (e.g. LR, IEE) supported by FNDC and NRC.
FUNDS: Envirolink

WHEN: Mid – 2006

4. **WHAT:** Apply for research funding to implement 3. above.
WHO: Agreed research provider
FUNDS: ASB Trust, Envirolink, FRST, ACRI funds, Enterprise Northland.
WHEN: 2007–2009

4.2 PHASE TWO: Establishing four pilot sites and project team to scope, plan, secure seedlings and plant four pilots of up to 20 ha each in the Far North. Historically, research for this type of forestry has been hampered by a lack of planned and managed pilot sites. Pilots are considered necessary as practical demonstration sites, training areas, monitoring of growth, species compatibility, seed viability (and future seed sources) and as “early warning” stations. Each pilot site is associated with an existing mono-species plantation where the stakeholders have indicated a strong preference to replace with mixed species forest should such prove viable. Suggested sites have been selected to provide range of soils, climates, tenure, etc. The four sites scoped to date are:

- Ngati Rehia – Takou Block. The site of a failed 300ha pinus plantation adjacent to Takou beach. Freehold Maori land in hapu ownership.
- FNDC – Mangakahia 60ha pinus plantation, used for effluent discharge leading to over saturation of existing crop.
- Te Runanga o Te Rarawa. Whanau land in North Hokianga recently repurchased from overseas owner, 1000ha of recently felled pinus.
- NZ Fed Farmers/Waimate Landcare – NZFF representative has riparian zone between existing eucalyptus plantation and adjacent Maori land block.

Proposed Work – Phase 2.

1. **WHAT:** Establish a coalition of stakeholders (champions), secure agreement to overall programme scope and select project team. Initiate linkages with potential funding and research collaborators. Scope initial sites (completed).
WHO: FNDC internal.
FUNDS: FNDC internal. (approx \$10k + community in-kind contributions)
WHEN: 2004/05
2. **WHAT:** Submit application to SFF (\$20k) to prepare business case for planning and establishing 4 × pilot sites over 3-4 years. TO include site selection, planting plan, seedling sourcing (whether existing suppliers or dedicated nurseries required) management plan (including capacity building and training necessary to maintain the pilots), harvest plan and predicted budget for ongoing management.
WHO: FNDC & project team
FUNDS: SFF.
WHEN: 2006
3. **WHAT:** Submit applications for 3-4yr project based on business case from 2. above.
WHO: FNDC & project team
FUNDS: SFF, ASB Trust, BCF.
WHEN: 2007-2010.
4. **WHAT:** Investigate seed/seedling sources for FNDC for target indigenous species. Establish a seed-bank
WHO: Waimate Landcare Group?
FUNDS: FNDC SNA fund,/NRC Environment Initiatives Fund.
WHEN: 2006.

4.3 **PHASE THREE: Identifying and resolving capacity and training requirements in the medium to long-term** for planning, establishing and maintaining mixed species plantations.

Any successful forestry operation requires capacity in management at all stages of the forestry cycle – planning, establishment, maintenance, harvest, marketing. It is particularly important for the type of forestry being advocated for in this programme with its emphasis on manipulation of natural process, species election and need for selective harvest. The Far North has a high proportion of small forestry blocks with low-grade timber. Much of the cause for this is the lack of capacity amongst forestry owners/managers to maintain their plantations – including pruning, thinning, fencing, pest control, fertilizer application, etc. This is particularly true for the small-scale Maori forestry blocks. For any large scale mixed species plantings to be successful on small blocks, management capacity must be assured, especially during the all too critical establishment phase and through until the first economic returns are made (approx 30 years).

An assessment is required of the potential skill bases that need to be built and retained in the Far North communities to service a mixed species plantation programme, and the available forestry training programmes and their applicability to the unique situation in the Far North. Following such an analysis, recommendations are required as to the suitability and availability of existing courses, what gaps exists in existing curriculum and delivery of courses and options for plugging these gaps.

Proposed Work – Phase 3.

1. **WHAT:** Identify the training/capacity building needs to support the pilot sites in Phase 2 above. Ascertain whether any gaps can be addressed through existing capacity of FNDC (and NRC and DOC).
WHO: FNDC and project team for Phase 2.
FUNDS: FNDC internal
WHEN: 2006
2. **WHAT:** Prepare funding application for ASB Trust (\$10k) to: a) undertake scoping exercise of existing capacity and existing training providers and courses (e.g. Northland Polytechnic, Te Wananga o Aotearoa, Massey University extra-mural studies, etc), b) identify capacity training gaps and recommend solutions for these, c) to model predictions for training needs based on a variety of planting predictions, d) prepare a business case for further funding application to design project specific training programmes.
FUNDS: ASB Trust
WHO: FNDC
WHEN: 2006
3. **WHAT:** prepare funding applications for a project to design (and possibly deliver pilot courses) for training to meet identified capacity gaps to support future mixed species plantation establishment.
WHO: Research provider (identified as outcome of 2. above)
FUNDS: Enterprise Northland, ASB Trust
WHEN: 2007.

5. Project Management

FNDC has accepted the challenge of facilitating this programme to date on behalf of the targeted stakeholders identified and will continue provide project management and administration support pending confirmation of successful funding applications.

As stated above, success of the programme is dependant on ownership of the programme being assumed by all stakeholders and funders alike. The support of regional organisations (in particular NRC and DOC) will be essential. It is assumed that Phase 1 n particular will form part of nationally applicable research currently underway and ownership of this phase will seek to be transferred to a national research provider. Discussion have been initiated in this regard with Landcare Research/Tane's Tree Trust.

Appendix 2 Indigenous Forestry Research (2000–present) by Project

Title	Omaha pilot open-ground indigenous plant nursery
Research Leader	Peter Cole / Jaap van Dorser
Organisation	Open-ground indigenous plants
Funder	Sustainable Farming Fund
Reference	06/041
Period	August 2006–
Total funding	
Programme aims	Establish a pilot nursery to demonstrate, publicise and further develop open-ground indigenous plant propagation methods.
Research sites	Northland
Publicly available outputs	

Title	Sustainable management options for wood production from regenerating totara
Research Leader	Helen Moodie
Organisation	Northland Totara Working Group
Funder	Sustainable Farming Fund
Reference	06/082
Period	August 2006–September 2009
Total funding	\$150,000
Programme aims	Establish 3 demonstration trials evaluating thinning and pruning options (2 in naturally regenerating stands, 1 in a planted stand) Quantify the resource of naturally-regenerating totara on previously cleared land in one Northland District. Evaluate the quality of wood from thinning of selected stands. Compare growth rates, stand productivity and thinning wood quality from naturally-regenerating and planted stands.
Research sites	Northland
Publicly available outputs	Newsletter

Title	Decision support for indigenous forest opportunities
Research Leader	Jason Funk
Organisation	East Coast Indigenous Forest Group
Funder	Sustainable Farming Fund
Reference	L06/014
Period	August 2006–
Total funding	Less than \$20,000
Programme aims	
Research sites	East Coast
Publicly available outputs	

Title	Indigenous forestry – information dissemination
Research Leader	John Wardle
Organisation	NZFFA Indigenous Forestry Section
Funder	Sustainable Farming Fund
Reference	L06/036
Period	August 2006–
Total funding	Less than \$20,000
Programme aims	To make available to land managers information relating to management of existing native forest on private land for conservation or production and to establishment and management of new plantings of indigenous species for riparian protection, biodiversity enhancement and timber production by increasing the distribution of the IFS journal <i>Indigena</i> and holding indigenous forestry field days.
Research sites	
Publicly available outputs	

Title	A pilot inventory of elite native timber trees as seed sources for native afforestation silviculture from lowland environmental domains
Research Leader	Helmut Janssen
Organisation	Native Afforestation Silviculture Group
Funder	Sustainable Farming Fund
Reference	L06/036
Period	August 2006–
Total funding	Less than \$20,000
Programme aims	Develop and deliver to stakeholders a generic and robust rapid-assessment method to identify elite native timber-tree seed-sources Scope and prepare an application for a New Zealand-wide elite native timber-tree seed-sourcing inventory project.
Research sites	
Publicly available outputs	

Title	Improving estimates of growth, recruitment and mortality for selected indigenous forest species
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	SUS 702
Period	July 2006–June 2007
Total funding	Not available
Programme aims	MAF's Indigenous Forestry Unit requires simple models for the prediction of growth of a number of key indigenous species. It is proposed that these be constructed from existing data sets (e.g. National Vegetation System) for use by the IFU and practitioners based on simple graphical depictions of growth rates (diameter growth) for key species from the podocarp, beech and broadleaved–hardwood groups.
Research sites	
Publicly available outputs	

Title	Long-term consequences of single tree and small group harvesting of podocarps
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	SUS 703
Period	July 2006–June 2007
Total funding	Not available
Programme aims	Key questions are: Is single tree/small group harvesting of podocarps as required by the Forests Act appropriate in mixed beech-podocarp forest to ensure podocarp replacement? Are Southland forests “beech saturated” or is beech still displacing other species, including podocarps? Will podocarps retain their presence in these forests without large scale disturbance?
Research sites	Southland
Publicly available outputs	

Title	Target stand structure – Longwood Forest
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	SUS 703
Period	July 2006–June 2007
Total funding	Not available
Programme aims	The results of this study will be a framework for the modelling of silver beech management in regenerated forest, utilising existing knowledge of silver beech autecology, the structure of the second growth forests, the management and ecological requirements of the approved sustainable forest management plan. This form of modelling will also have application to other SFM Plans and Permits in silver beech dominated forest, including SILNA lands in Southland.
Research sites	Southland
Publicly available outputs	

Title	Expanding economic viability and sustainably managed indigenous beech forests and industry
Research Leader	Mike Halliday
Organisation	NZFFA Indigenous Forestry Section, SILNA Community Forest Owners, Office of the Maori Trustee
Funder	Sustainable Farming Fund
Reference	05/048
Period	September 2005–September 2008
Total funding	\$496,250
Programme aims	Identify the main domestic and export product/market value propositions for the primary beech species. Evaluate the beech resource and confirm the commercial supply potential by estimating volumes and product classes across the 3 IFU working circles. Further the understanding of the biological systems related to the economics and sustainability of managing beech forests and re-establish beech forest management guidelines.
Research sites	Canterbury, Southland
Publicly available outputs	

Title	Indigenous forestry
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	Public Good Science and Technology Fund
Reference	C09X0308
Period	July 2003–June 2008
Total funding	\$2,565,000
Programme aims	Develop silvicultural systems that minimize harvesting impacts and in so doing retain the important characteristics of forests. Understand how forests managed for timber production can at the same time provide improved cultural and environmental benefits to Maori owners.
Research sites	Canterbury, North Westland, Southland, Taranaki, Te Urewera
Publicly available outputs	Allen RB 2004. Sustainable indigenous forestry research funding. <i>Tree Grower</i> 25(1): 37–38. Allen RB, Doherty JE 2005. Restoring the Tuhoe Forests. <i>Indigena</i> (December) 13–16. Clinton PW, Davis MR, Hart PBS, Allen RB 2005. Research requirements to develop complete nutrient budgets for

	<p>indigenous forests: a case study from hard beech forest, North West Nelson. <i>New Zealand Forestry</i> 50(3): 12–18.</p> <p>Carswell FE, Richardson SJ, Doherty J, Allen RB, Wisser SK 2007. Where do conifers regenerate after selective harvest? A case study from a New Zealand conifer-angiosperm forest. <i>Forest Ecology and Management</i>: submitted</p> <p>Evans A, Allen RB, Clinton P, Frampton C 2003. The influence of logs on the spatial distribution of litter-dwelling invertebrates and forest floor processes in New Zealand forests. <i>Forest Ecology and Management</i> 184: 251–262.</p> <p>Reay SD, Hachet C, Nelson TL, Brownbridge M, Glare TR 2007. Persistence of conidia and potential efficacy of <i>Beauveria bassiana</i> against pinhole borers in New Zealand southern beech forests. <i>Forest Ecology and Management</i>. In press.</p> <p>Wisser SK, Allen RB, Benecke U, Baker G, Peltzer DA 2005. Tree growth and mortality after small-group harvesting in New Zealand old-growth <i>Nothofagus</i> forests. <i>Canadian Journal of Forest Research</i> 35: 2323–2331.</p> <p>Wisser SK, Allen RB 2006. What controls invasion of indigenous forests by alien plants? In: Allen RB, Lee WG eds <i>Ecological Studies</i>. Vol. 186. <i>Biological Invasions in New Zealand</i>. Springer Verlag, Berlin Heidelberg. Pp. 195–207.</p>
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Title	Indigenous forestry – a comprehensive approach to providing information to the widest possible audience
Research Leader	Ian Barton
Organisation	Tane’s Tree Trust
Funder	Sustainable Farming Fund
Reference	04/150
Period	July 2004–June 2007
Total funding	\$284,500
Programme aims	<p>Improving the flow of information about planted indigenous forest to any person involved in its practice by:</p> <ul style="list-style-type: none"> - running workshops across the country - compiling a database of early indigenous plantation forestry research - preparing a manual on continuous cover forestry - publishing the proceedings of the “Profiting from Biodiversity” seminars - completing preliminary work on setting up an interactive information and database system for recording native tree plantations and trials.
Research sites	National
Publicly available outputs	Barton I Ed. 2004. Profiting from biodiversity. Proceedings of a seminar on the taxation and Resource Management Act impacts on planted indigenous forests. Where and who published?

Title	Silver beech regeneration at Gowan Hill, Southland
Research Leader	Jan Derks
Organisation	TACCRA Ltd
Funder	MAF Operational Research
Reference	POL 113
Period	July 2005–June 2006
Total funding	Not available
Programme aims	To identify ecological attributes influencing natural silver beech regeneration in managed forest and from these, silviculture, whereby attributes may be manipulated or replicated to secure, as early as possible, natural regeneration at sufficient density to result in restoration of forest of similar type and structure to that existing prior to harvest.
Research sites	Gowan Hill, Southland
Publicly available outputs	Summary report at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-pol113.htm

Title	Factors influencing red and silver beech regeneration
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	POL 114
Period	July 2005–June 2006
Total funding	Not available
Programme aims	To examine seedling and sapling regeneration patterns a decade after harvesting and develop relationships between regeneration success and local environment, stand structure and the presence of advanced growth before harvesting, size of, and position within, the harvested area, and the nature of the ground layer (as a measure of the competitive environment).
Research sites	Station Creek, Westland
Publicly available outputs	Summary report at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-pol114.htm

Title	Edge effects on red beech growth rates
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	POL 115
Period	July 2005–June 2006
Total funding	Not available
Programme aims	The goal of this research was to determine whether depressed stem growth in coupe-edge trees is related to compensatory growth by roots, and to examine how depressed rates of stem growth affect stand-level volume increment. This information may be used to revise the Ministry's implementation of sustainability requirements in the Forests Act.
Research sites	Maruia Valley, North Westland
Publicly available outputs	Summary report at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-pol115.htm

Title	Tawa: growth and productivity responses to selective logging, Whirinaki
Research Leader	GA Steward and HS Dungey
Organisation	Forest Research
Funder	MAF Operational Research
Reference	POL 117
Period	July 2005–June 2006
Total funding	Not available
Programme aims	Selective logging of dense podocarp forest in Whirinaki Forest Park, in 1979/80, provided an opportunity to monitor the changes in growth and productivity of selected tawa. Two hundred unmerchantable tawa (less than 30 centimetres diameter at breast height (DBH)) were tagged and assessed in 1981, 1985 and 1999. A further selection of mature and merchantable tawa stems (greater than 30 centimetres DBH) was assessed in 2005 as a comparison.
Research sites	Whirinaki, Eastern Bay of Plenty
Publicly available outputs	Summary report at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-pol117.htm

Title	Regeneration patterns within selectively logged dense podocarp forest, Whirinaki
Research Leader	GA Steward and M van der Colff
Organisation	Forest Research
Funder	MAF Operational Research
Reference	POL 118
Period	July 2005–June 2006
Total funding	Not available
Programme aims	Selective logging of dense podocarp forest in Whirinaki Forest Park, in 1979/80, provided an opportunity to monitor the composition, abundance and success of regeneration and its relationship to altered canopy and ground conditions. 500 plots were established in 1999 and 4638 seedlings were identified and recorded. The data was analysed for the Indigenous Forestry Unit of the Ministry of Agriculture and Forestry.
Research sites	Whirinaki, Eastern Bay of Plenty
Publicly available outputs	Summary report at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-pol118.htm

Title	Exotic weed invasions and the management of indigenous forests for timber production
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 230
Period	July 2004–June 2005
Total funding	Not available
Programme aims	To synthesise existing information on exotic weed invasions into indigenous forests that are managed for timber production, and to suggest ways of integrating that information with management practices.
Research sites	Literature review, synthesis of existing data.
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Opportunities for native trees on farms
Research Leader	Ian Barton
Organisation	Tane's Tree Trust
Funder	Sustainable Farming Fund
Reference	03/204
Period	October 2003–June 2006
Total funding	\$116,000
Programme aims	Gather information on the useful functional roles of native plants on farms from farmers and land managers and disseminate that information to others who are not yet convinced that indigenous species have a place in productive landscapes. Production of a booklet integrating information pertaining to native trees on farms from various sources.
Research sites	Waikato, Northland
Publicly available outputs	Project newsletters (www.maf.govt.nz/sff/about-projects/search/03-204/index.htm)

Title	Exotic weed invasions and the management of indigenous forests for timber production
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 230
Period	July 2004–June 2005
Total funding	Not available
Programme aims	To synthesise existing information on exotic weed invasions into indigenous forests that are managed for timber production, and to suggest ways of integrating that information with management practices.
Research sites	Literature review, synthesis of existing data.
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Deadwood removal from indigenous forests
Research Leader	Susan Wiser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 231
Period	July 2004–June 2005
Total funding	Not available
Programme aims	To review the role of deadwood in indigenous forests and examine principles for harvesting deadwood while maintaining its dynamics and functions in forests. Based on the review, consider how timber harvesting regimes in New Zealand could impact on sustainability of indigenous forests.
Research sites	Literature review
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Indicators of sustainable management in podocarp-tawa forests
Research Leader	Mark Smale
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 233
Period	July 2004–June 2005
Total funding	Not available
Programme aims	To complete remeasurement of, analyse and report on the 1961 sustainable management trial in podocarp/tawa forest at Pureora, to review the accuracy and precision of recruitment, growth, mortality and forest-gap data that will be used by MAF to revise its standards and guidelines for sustainable forest management.
Research sites	Pureora, King Country
Publicly available outputs	Smale MC, Beveridge AE Long-term impacts of selective harvesting on a New Zealand rain forest. Paper being submitted to <i>Forest Ecology and Management</i> . Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Indigenous forest restoration guidelines
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 234
Period	July 2004–June 2005
Total funding	Not available
Programme aims	The goal of this report was to develop the general principles underpinning restoration silviculture in New Zealand forests. General principles of restoration silviculture were illustrated using comparative data from logged and unlogged eastern North Island conifer-hardwood-beech forests.
Research sites	Urewera
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Forest boundary management strategies
Research Leader	Bruce Burns
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 235
Period	July 2004–June 2005
Total funding	Not available
Programme aims	Identify potential risks and deleterious effects to forest health and stability associated with forest edges in managed New Zealand indigenous forests, and provide a framework on which best-practice guidelines for management of forest edges can be based.
Research sites	Literature review
Publicly available outputs	Burns B 2006. Management strategies for forest boundaries: what to do about edge effects in managed indigenous forest. Landcare Research Contract Report LC0506/078. Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/operational-research/project-firm235.htm

Title	Podocarp – tawa growth
Research Leader	Mark Smale
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 223
Period	July 2003–June 2004
Total funding	Not available
Programme aims	To remeasure a sample of trees in 120 ha of upland rimu-beech forest cruised for timber in 1960 to elicit growth rates and impact of site quality.
Research sites	Koranga Conservation Area, Urewera
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Silver beech growth in Southland
Research Leader	Jan Derks
Organisation	TACCRA consulting
Funder	MAF Operational Research
Reference	FRM 224
Period	July 2003–June 2004
Total funding	Not available
Programme aims	To determine a post-harvest period over which natural silver beech regeneration can be expected to establish at sufficient density and grow at sufficient rate to result in restoration of forest of similar type and structure to that existing prior to harvest.
Research sites	Longwoods, Western Southland
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Review ecosystem models
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 225
Period	July 2003–June 2004
Total funding	Not available
Programme aims	To review the concept of ecosystem management and related models, summarise the international research and outline a pathway and research requirements to progressively implement the concept in indigenous forestry in New Zealand.
Research sites	Literature review
Publicly available outputs	Allen RB 2004. Sustainable indigenous forestry research funding. <i>Tree Grower</i> 25(1): 37-38 Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Beech forest health
Research Leader	Gordon Hosking
Organisation	Hosking Forestry
Funder	MAF Operational Research
Reference	FRM 224
Period	July 2002–June 2003
Total funding	Not available
Programme aims	To undertake a final assessment of the forest health plots established in association with Granville Operational Trials of beech management through small coupe harvesting, and report on the final results of the study. A total of 18 coupe edge plots and 17 plots in undisturbed forest were established and their health formally assessed annually from 1994 to 1997, and in 1999 and 2003.
Research sites	Granville forest, Westland
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Sustainability on Maori-owned Indigenous Forest
Research Leader	Nora Devoe
Organisation	University of Canterbury
Funder	Public Good Science and Technology Fund
Reference	UOCX0004, UOCX0205
Period	July 2000–June 2004
Total funding	\$582,000
Programme aims	Increased empowerment of SILNA silver beech forest owners to: <ul style="list-style-type: none"> - undertake long-term asset management - capture greater benefits from forest ownership - generate improved social, economic and ecological results from sustainable forest management
Research sites	Gowan Hill forest, Southland
Publicly available outputs	<p>Armstrong KA 2002. Is <i>Nothofagus menziesii</i> an advance growth regenerator? MForSc. thesis, University of Canterbury</p> <p>Brooks DF 2001. Selective logging in silver beech (<i>Nothofagus menziesii</i>) forest monitoring with beetles. BSc.(Hons) thesis, University of Canterbury</p> <p>Fitzgerald G, Devoe N 2003. Conservation, cost and income: New Zealand farmers' values in forest management. Proceedings of the Australia–New Zealand Institutes of Forestry Conference held in Queenstown, 27 April–1 May 2003.</p> <p>Fitzgerald G 2004. Maori experiences, values and preferences in indigenous forest management in New Zealand. Proceedings of the International Symposium of Society and Resource Management held in Keystone, Colorado, 2–6 June 2004.</p> <p>Olson SM 2003a. A golden age for silver beech. United Kingdom Timber Trade Journal vol, issue, and page numbers..</p> <p>Olson SM 2003b. Re-discovering the New Zealand silver beech sawn timber from Gowan Hill Ltd. United Kingdom Timber Trade Journal issue, vol and page numbers.</p> <p>Olson SM 2003c. The wood properties of New Zealand silver beech (<i>Nothofagus menziesii</i>), a lesser-known hardwood species. Forest Products Journal 53(5): 1–7.</p> <p>Olson SM 2004. Assessing the state of the art for New Zealand beech: building business in the marketplace for sustainable forest management. New Zealand Forestry</p> <p>Thompson KT 2003. Market access report for New Zealand silver beech (<i>Nothofagus menziesii</i>) in the European hardwood market. MForSc. thesis, University of Canterbury</p> <p>van Enter M 2002. Residual stand damage under two intensities of selection harvesting. BForSc.(Hons) thesis, University of Canterbury</p> <p>Zirnhelt SS 2002. Timber processing options for Maori-owned indigenous forests in Southland, Aotearoa New Zealand: towards a collaborative model for sustainable management. MForSc. thesis, University of Canterbury</p>

Title	Guidelines for sustainable management of planted indigenous trees
Research Leader	David Bergin
Organisation	New Zealand Forest Research Institute
Funder	Sustainable Management Fund
Reference	9041
Period	February 2001–Jan 2004
Total funding	\$385,000
Programme aims	Disseminate existing information on planting and management of indigenous trees for timber and non-timber benefits to a range of user groups. Produce comprehensive guidelines as technical bulletins, web pages, and seminar and workshop presentations.
Research sites	National
Publicly available outputs	Bergin DO 2003. Totara: establishment, growth and management. New Zealand Indigenous Tree Bulletin No. 1. Forest Research. Rotorua. 40 p. Bergin DO, Gea L 2005. Native trees: planting and early management for wood production. New Zealand Indigenous Tree Bulletin No. 3. Forest Research. Rotorua. 44 p. Bergin DO, Steward GA 2004. Kauri: ecology, establishment, growth and management. New Zealand Indigenous Tree Bulletin No. 2. Forest Research. Rotorua. 48 p.

Title	Education and consultation process for indigenous forestry best management practices and standards
Research Leader	Colin O'Loughlin
Organisation	Indigenous Forest Certification Steering group
Funder	Sustainable Farming Fund
Reference	01/086
Period	August 2001–July 2003
Total funding	\$167,479
Programme aims	Formation of a technical committee to develop a comprehensive set of indigenous forest management standards under the FSC system by June 2002. Six workshops for forest owners, timber processors and manufacturers on best practice indigenous forest management and marketing opportunities for indigenous forest products by June 2003.
Research sites	National
Publicly available outputs	Draft FSC New Zealand indigenous forest management standards

Title	Promotion and development of planted indigenous forestry (for timber and other uses) as a viable land-use option for farmers
Research Leader	Roger MacGibbon
Organisation	Tane's Tree Trust
Funder	Sustainable Farming Fund
Reference	01/085
Period	July 2001–Jan 2003
Total funding	\$173,700
Programme aims	Collect, collate and disseminate to interested land owners all that is currently known about indigenous forest establishment and management.
Research sites	Canterbury, Otago
Publicly available outputs	MacGibbon R, Barton I, Dodd M eds 2002. Proceedings of the launch of Tane's Tree Trust held at Waharau Regional Park, Auckland 8 September 2001. Tane's Tree Trust. 28 p. Tane's Tree Trust 2002: Workshop on growing native trees: participants notes. Tane's Tree Trust newsletter Tane's Tree Trust website (www.tanestrees.org.nz)

Title	Management guidelines for pinhole borer in beech forests
Research Leader	Ecke Brockerhoff
Organisation	Forest Research
Funder	MAF Operational Research
Reference	FRM 445, 498, 229
Period	July 2000–June 2003
Total funding	Not available
Programme aims	To provide to MAF conclusive management guidelines for minimising the incidence and effects of pinhole borer following harvesting, to underpin policy advice on Part IIIa of the Forests Act by examining the effects of slash and stump treatments.
Research sites	Station Creek, Westland
Publicly available outputs	Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Low impact silviculture
Research Leader	Susan Wisser
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 446, 492, 228
Period	July 2000–June 2003
Total funding	Not available
Programme aims	The goal of this project was to monitor a set of operational research trials of low-impact silviculture with the intention of providing results for long-term protection of beech forest while also providing economic benefit from sustainable production of high-value hardwoods. In particular the research objectives were to test the sustainability of the group-selection system of silviculture, evaluate the immediate and long-term implications of small regeneration fellings (0.04 - 0.20ha), monitor forest health, regrowth, composition, and plant biodiversity within permanent transect plots, and develop an effective and practical approach to minimise damage by pinhole beetles (<i>Platypus</i>) to forest health and wood degrade.
Research sites	Granville forest and Station Creek, Westland
Publicly available outputs	Allen RB, Wisser SK, Coomes DA, Peltzer D 2003. Stability and growth of residual trees following disturbance. <i>In</i> : Proceedings of Joint Australian and New Zealand Institute of Forestry conference, Queenstown. p441. Brignall-Theyer MS, Benecke U, Baker G 2002. Progress report for group-selection research trials in beech forests of Station Creek and Glenhope, Westland. Landcare Research unpublished report LC0102/129. Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Title	Maori Development of Indigenous Forests
Research Leader	Don Hammond
Organisation	Hammond Consulting
Funder	MAF Operational Research
Reference	ICP 511
Period	July 2000–June 2001
Total funding	Not available
Programme aims	The project consisted of two major parts. The first was a determination of the location, extent and quality of the forests in Māori ownership, while the second was to examine the potential for those forests to produce a sustainable harvest of timber and the issues that either enhance or impede that potential.
Research sites	Granville forest and Station Creek, Westland
Publicly available outputs	Hammond D 2003. <i>Development of Maori-owned indigenous forests</i> . MAF Technical Paper No. 2003/04. Ministry of Agriculture and Forestry. Wellington. 80 pp.

Title	Silvicultural management guidelines for indigenous forests
Research Leader	Rob Allen
Organisation	Landcare Research
Funder	MAF Operational Research
Reference	FRM 421
Period	July 1998–June 2003
Total funding	Not available
Programme aims	To develop an approach to ecological site classification that would result in management of indigenous forests on individual properties in a way that retains as full a set of forest values as possible. In particular, to demonstrate how multifaceted ecological information can be collected on individual properties and then used to develop silvicultural systems that take account of variation in structure, composition and growth of existing forest stands. The approach was developed in a podocarp-tawa forest in Taranaki and subsequently developed on small black beech forests in Canterbury and silver beech forests in Southland, before being extended to a 300 ha area red-silver beech forest in the Maruia Valley.
Research sites	Taranaki, Canterbury
Publicly available outputs	Allen RB, Wisser SK, Burrows LE, Brignall-Theyer ME 2000. <i>Silvicultural research in selected forest types: a black beech forest in Canterbury</i> . Landcare Research contract report LC0001/001 for the Ministry of Agriculture and Forestry. Allen RB, Wisser SK, Coomes DA, Peltzer D 2003. Stability and growth of residual trees following disturbance. <i>In: Proceedings of Joint Australian and New Zealand Institute of Forestry conference, Queenstown</i> . p441. Svavarsdottir K, Allen RB, Burrows LE, Coomes DA, Wisser SK, Smale M, Benecke U 1999. <i>Silvicultural research in selected forest types: a podocarp-tawa forest in Taranaki</i> . Landcare Research contract report LC9899/119 for the Ministry of Agriculture and Forestry. 55 pp. Summary reports at http://www.maf.govt.nz/mafnet/rural-nz/research-and-development/research-results

Appendix 3 Summary of the NZIF Indigenous Forest Policy

In 1993 the New Zealand Institute of Forestry established an Indigenous Forest Working Party (convened by Colin O'Loughlin) to prepare an NZIF Policy Statement on indigenous forests that reflected the views of the Institute. This included an examination of the major issues surrounding the management of indigenous forests and a review of existing legislation and policies concerned with indigenous forests.

The establishment of the Indigenous Forest Working Party arose from:

- the Institute's concerns about the apparent poor health of large parts of the indigenous forest estate
- the fragmented and uncoordinated nature of the legislation addressing the management and administration of indigenous forests
- the lack of funding for research concerned with important indigenous forest issues
- the widely divergent views by organisations and the public at large about the future management of indigenous forests.

The main purposes of the policy are to provide a guideline for members of the NZIF when dealing with indigenous forest issues and to raise awareness amongst the NZIF membership of the importance and role of indigenous forests in the New Zealand economy.

The policy is not an end point in forest policy development by the NZIF but merely a stepping stone towards the development of a comprehensive NZIF National Forest Policy. Nevertheless, the NZIF Indigenous Working Party is confident that this Indigenous Forest Policy Statement will fill a void in forest policy documentation, provide useful guidance to NZIF members and help promote the importance of indigenous forests in the New Zealand economy.

Summary of Policy

The New Zealand Institute of Forestry believes New Zealand's indigenous forests have important ecological, cultural, production and scientific values that contribute to the economic and social well-being of the nation. As such, a full range of indigenous forest types must be maintained (or expanded) in a healthy state, for the benefit of present and future generations. To contribute to this overall objective the NZIF advocates and supports:

- a forest ecosystem management approach to manage New Zealand's indigenous forests sustainably and, in particular, to sustain forest productivity, health, biodiversity, soil quality, water quality, natural landscapes, and the full range of natural forest ecological processes
- the development of a strategy to promote the intrinsic values of indigenous forests and enhance their status as a contributor to the New Zealand economy
- the development of a comprehensive national database which continuously updates the condition, health, location and extent of indigenous forests
- the maintenance and enhancement of the current integrated research effort concerned with the development of new methods to manage and control animal and plant pests
- the establishment of a comprehensive national indigenous forest health surveillance system to provide full coverage of the national forest estate on a biennial basis, and incorporating a rigorous system of border control and emergency response
- the protection of indigenous forests against fire through research and improved fire prevention, detection and control policies and practices

- the management for timber and other products removed using silvicultural systems which limit the magnitude of the resulting changes to levels near those that occur naturally in healthy forests
- the initiation of a research and development programme to document and demonstrate ecologically sustainable silvicultural systems for indigenous forests with sustainable timber production potential
- the development and use of reliable and consistent systems to monitor the sustainable management of indigenous forests
- the development of a streamlined 'National Application and Consent System' for the management of indigenous forests for wood production which would be implemented by the Ministry of Agriculture and Forestry under the Forests Act 1949 (1993 Amendment) in cooperation with local government under the Resource Management Act.

Furthermore, the NZIF seeks to assist in promoting:

- improved cooperation and coordination between government departments, local government authorities, research organisations, NGOs, indigenous forest owners, the Indigenous Forests Section of the Farm Forestry Association and other organisations, in the development of strategies, policies and plans for meeting international commitments that affect the management of indigenous forests
- public awareness of the Indigenous Forest Policy, and with the assistance of indigenous forest owners and other interested parties, the maintenance of an overview of indigenous forest management planning and practice.

Appendix 4 Extracts from the New Zealand Biodiversity Strategy and draft National Policy Statement on Biodiversity

New Zealand Biodiversity Strategy

Goal Three: Halt the decline in New Zealand's indigenous biodiversity

Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments, and do what else is necessary to

Maintain and restore viable populations of all indigenous species and subspecies across their natural range, and maintain their genetic diversity

Draft National Policy Statement on Biodiversity

A draft National Policy Statement is under preparation to give effect to the New Zealand Biodiversity Strategy. It includes the following objective and policy statements:

Objective 1.1

To maintain and enhance the ecological functioning of areas and habitats important for halting the decline in indigenous biodiversity.

Policy

- 2) Those exercising functions and powers should, in seeking to halt the decline of indigenous biodiversity:
 - c) recognise the contribution that enhancement and restoration (either onsite or offsite) can make to mitigating the adverse effects of activities
 - d) encourage the restoration and rehabilitation of areas which are important for halting the decline of indigenous biodiversity, including:
 - good representative areas
 - habitats of threatened plants and animals
 - threatened ecosystems
 - areas that can act as buffers or restore connections between priority areas
 - indigenous riparian areas.
 - e) encourage the use of indigenous species (with a preference for the use of the use of local genetic stock) when restoration plantings are carried out
 - f) give priority to working in partnership with others, in particular resource owners and users