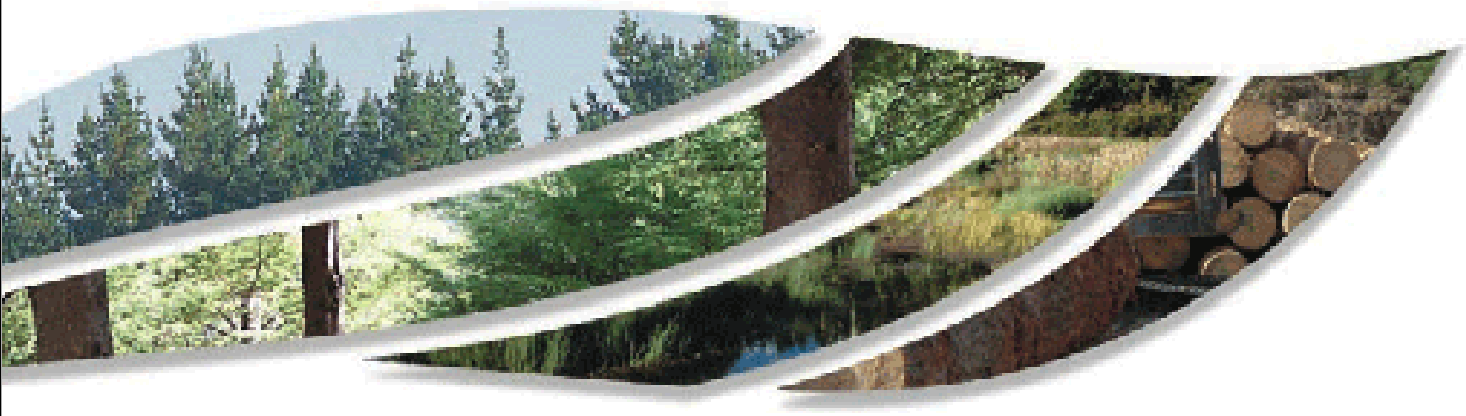
FUTURE FORESTS RESEARCH



ANNUAL SCIENCE REPORT 2009

www.ffr.co.nz

Ensuring a prosperous future for New Zealand's plantation forest industry through innovative, well focused research of a world class standard.

Contents

Scion's contribution to producing this report is gratefully acknowledged.

SCION
Next generation biomaterials

FUTURE FORESTS RESEARCH

Foreword

Phil Taylor FFR Chair,
Managing Director,
Blakely Pacific

Future Forests Research builds on and strengthens the long term partnerships that exist between forestry growers, scientists and government. These partnerships are essential to drive and implement the research which will provide tangible benefit to our industry and to New Zealand - by enhancing forest productivity, improving wood quality, minimising off-site impacts and promoting sustainability.

The engagement of "the industry" in the research programme is vital because if we want value from research we need to drive it. In the past we have relied heavily on our research providers to develop research programmes and on occasions we have been critical as they fall short on meeting our needs. For FFR to be successful and deliver the results the industry wants it takes more than simply money, it requires a commitment to work in partnership with the researchers to drive the research programme forward. Equally importantly, as research is delivered we need to make sure that industry actively picks it up and implements it. Unless we do this final and crucial step along the R&D value chain we are unlikely to realise the full potential of our research.

Engagement with scientists is vital because research and development is needed to ensure we can stay ahead of our competitors. As growers, managers, policy makers and land managers, we must work closely with scientists to derive the benefits that can arise from their knowledge, to extend and enhance the role of forestry, and to improve long-term sustainable land use.

As our programme grows so too does the requirement for competent research capability. We have secured a very significant amount of long term funding – both through government and from industry. Research capacity and competency are major limiting factors in being able to deliver on the programmes supported by this funding. International competition for science talent is huge and we cannot simply create our own – it takes time. FFR is a vitally important initiative for building capacity to get us back where we belong as the international leader in plantation forest research.

As an organisation, FFR is extremely well served by our key research provider Scion and we should not forget that their success is our success. A strong, vibrant and well focussed forestry CRI is critically important to our industry.

Finally, strong relationships with government are vital – not only to secure funding but also to get them to become advocates of forestry in all sorts of other areas. As a Board, one of our visions is to see forestry assume its rightful place as the pre-eminent sustainable land use in the New Zealand rural environment. Government is increasingly recognising the importance of forestry to the New Zealand economy and, perhaps more significantly, of the new opportunities it creates. As a land use, forestry can go a long way towards helping the country meet its challenging climate change obligations.

We have been actively engaging with Regional Councils and government agencies. If we generate value-added research that adds to the profitability of forestry we will, by default, have achieved the goal of promoting an expanded role for forestry in the New Zealand economy and environment.

As we look back over the past year, we can take pride in what we have achieved. We have been successful in generating government funding, and now have funding approved for six years in most areas (with harvesting research as the exception). Industry has, in turn, committed to three years of funding and it is up to FFR to demonstrate results if this support is to continue.

The Board has clear aspirations for FFR and these are about delivering value to the investors through well targeted research and science excellence. A great deal of research is starting to come out of the programme. The purpose of this Annual Science Report is to highlight some of the ways that our science programmes are delivering meaningful research results.

The big challenge for FFR is to demonstrate value to our investors. As a Board we welcome this challenge and look forward to working with industry, our researchers and the government to ensure the potential of your business and the forest sector is realised.

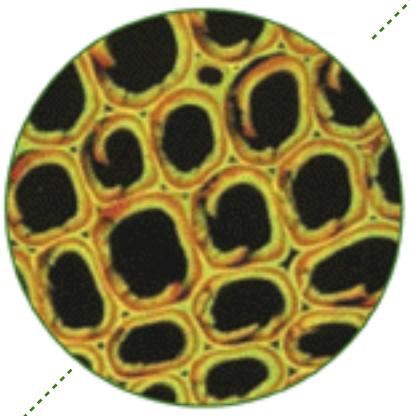
Background

Future Forests Research was formed in 2007, when the forest industry came together to work in partnership with Scion. The purpose of this move was to improve the coordination of forest growing sector research, driven initially by the need to reorganise and consolidate the former research cooperatives. Originating in the late 80s, these coops had served the industry well for two decades. However, as we all know, there have been significant changes to the industry - and research - since then, and a new approach was needed to address the many new opportunities and challenges that lie ahead.

Our Future

FFR's vision is not too dissimilar to those who have preceded us:

'Ensuring a prosperous future for New Zealand's plantation forest industry through innovative, well focused research of a world class standard'.



Our purpose is to ensure that good decisions form the foundations of land and forest management in New Zealand. We will achieve this by working with those who make the decisions about growing and harvesting trees to:

- identify research requirements;
- contract relevant research;
- enhance science capability, and;
- promote the uptake of research outcomes.

FFR Aspirations

The Board's and management's aspirations for FFR are, quite simply, to make investors' businesses more profitable.

We will do this by:

- Creating and delivering meaningful research;
- Improving sector involvement in defining research directions;
- Helping to improve the relationship between the sector and government;
- Building research capability and science quality, and;
- Ensuring high standards of governance.

FFR Organisation

Russell Dale
Chief Executive

The successful establishment of FFR, involving the development of research programmes and business processes necessary to support delivery of outcomes has been a rewarding challenge. Since the decision by the sector in 2007 to establish FFR, organising and delivering research within a commercial framework has been a key objective and I am pleased to report that this objective has been achieved.

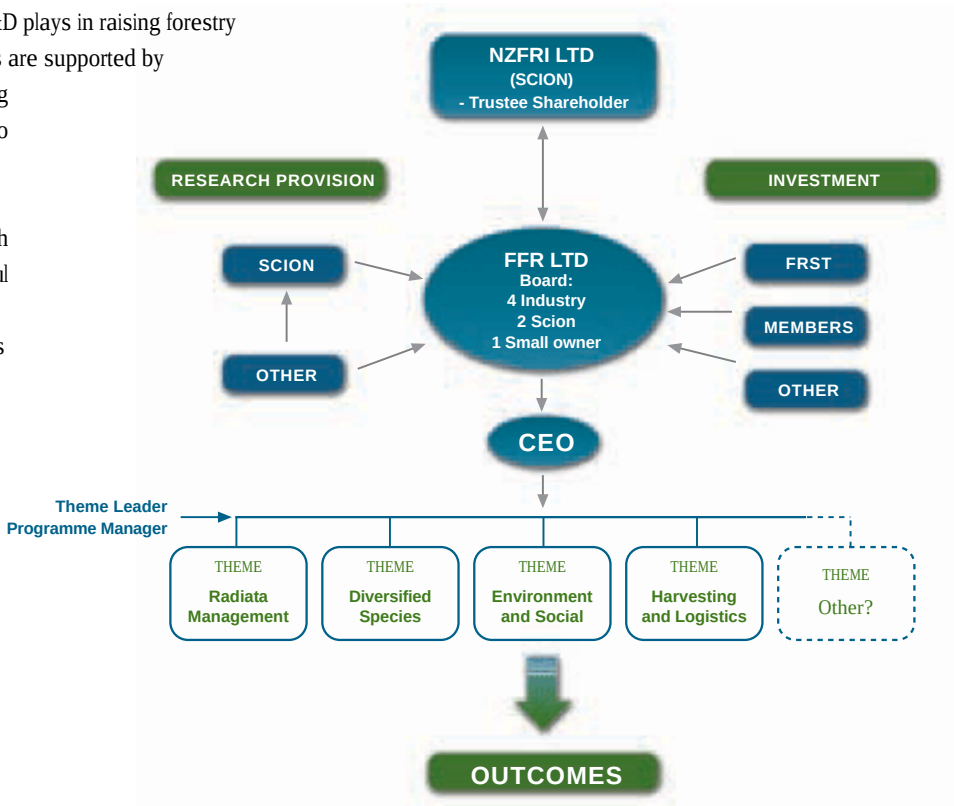
FFR is a company with a Board of Directors that provides governance and oversees management performance. The single share in the company is held by Scion as trustee shareholder for the benefit of the investing members. The structure enables FFR to contract with investors, research organisations and other service providers.

Research is organised into themes, with theme leaders selected for their leadership ability, technical knowledge, industry credibility and commitment to the vital role R&D plays in raising forestry sector performance. Theme leaders are supported by a technical steering team comprising both industry and science experts who provide technical direction to the programme. This engagement with the sector is key to ensuring research is relevant and that there is successful uptake by end users. Progress is monitored through quarterly reviews by the technical steering teams. Twice-yearly member meetings where research results are presented are an important part of technology transfer to end users.

Research projects are currently organised under four themes:

- Radiata Management
- Environment and Social
- Diversified Species
- Harvesting and Logistics

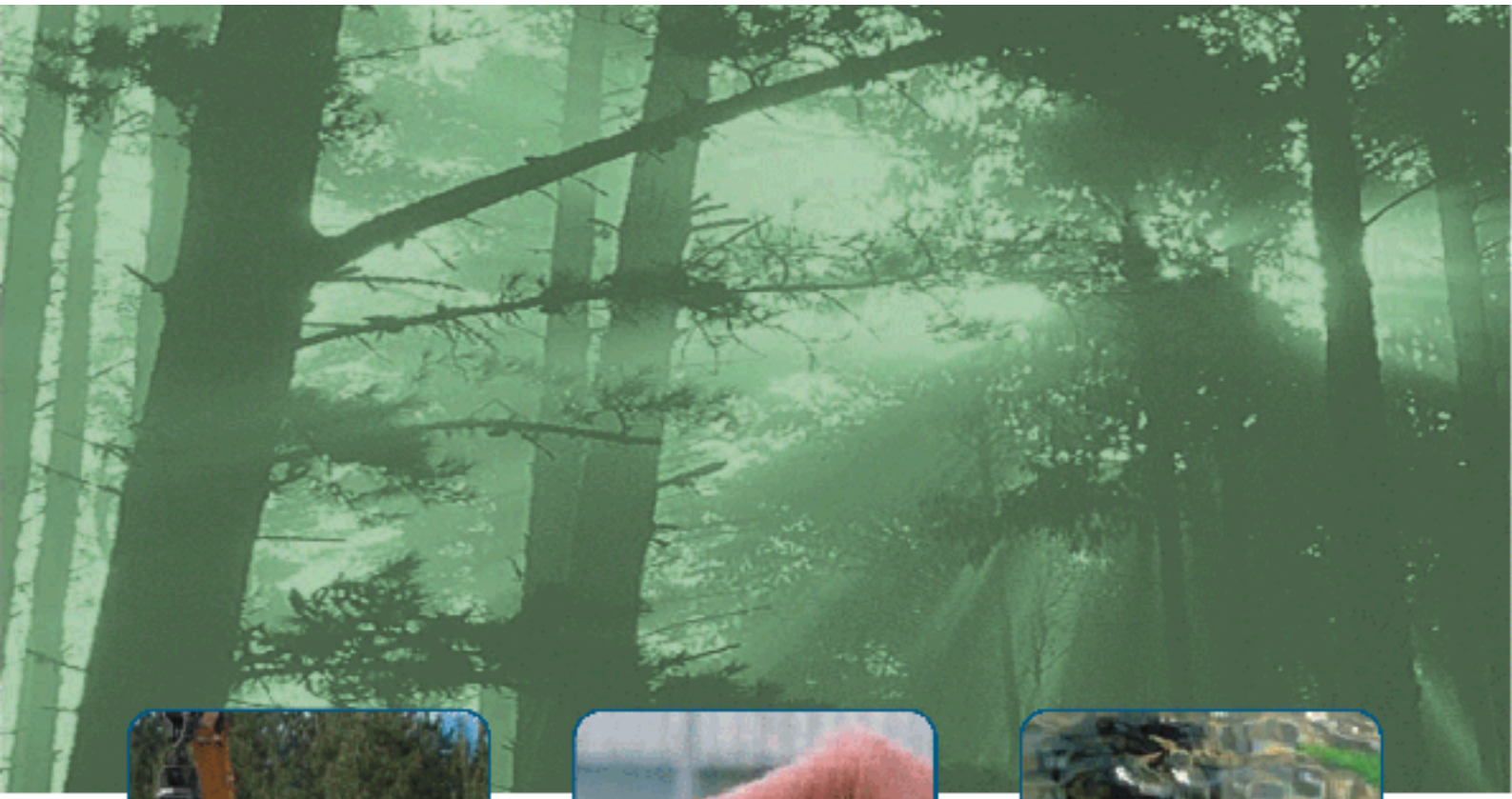
Three core strategies - productivity, quality and sustainability - cross all themes, and support FFR's vision of improved profitability for the sector. We take care to ensure that there are good linkages across the themes to avoid overlap and to identify synergies between the programmes. Close coordination with other research entities such as Radiata Pine Breeding Company (RPBC) and Solid Wood Initiative (SWI) has already resulted in joint projects with these companies for the benefit of investors.



Three core strategies underpin each theme:

Productivity | Quality | Sustainability

By working towards agreed goals under each of these strategies FFR will help achieve the bigger prize - that of enhancing sector profitability



Theme 1: Radiata Management

FFR aims to improve the international competitiveness of New Zealand radiata pine by producing wood that is fit for purpose and extracting more value out of the current crop. The "more for less" approach will allow growers to achieve greater returns, with lower costs and investment risk.

Another important focus for FFR is to help growers protect their freedom to operate, through ensuring compliance with environmental certification (FSC).

The Radiata Management Theme represents the largest proportion of FFR activity in terms of funding and membership. Research carried out within this programme uses the capabilities and knowledge relating to site, growth modelling and silviculture built up over 40 years, 20 through the former forest growing research cooperatives.

Monitoring productivity indicators

A nationally-significant trial series established by Scion indicates that tree growth across a wide environmental gradient is correlated with several soil chemical properties. The key soil indicators identified for radiata pine are:

- Soil carbon to nitrogen ratio (CN ratio);
- Total soil nitrogen and total soil phosphorous;
- Depth of top soil, and;
- Soil porosity.

By monitoring these indicators it will become easier to predict productivity on specific sites. Monitoring of these properties should also provide a basis for site-specific recommendations on management practices necessary to maintain the productive capacity of New Zealand's plantation forests. Steps are now being taken to develop a monitoring programme for these indicator soil properties so as to provide an objective measure of sustainability for forest certification. This research is being carried out in conjunction with industry, regional councils and central government agencies.

Predicting productivity

A new radiata pine productivity prediction model has been developed using data from all major forestry regions, combined with geostatistics and driven entirely by environmental variables. This now offers the exciting potential for predicting 'green-fields' radiata productivity. This capability could be particularly useful on marginal lands where radiata has yet to be established. The model has been combined with a new tree crop productivity index (called the 300 Index) with spatially interpreted climate data, secondary terrain attributes, and locally measured point data for tree growth. National maps of radiata pine productivity have been produced and new models that predict local productivity using local climatic and soil variables have proved successful. This information will be useful in strategically locating forests for regional development and for potential investors in land for carbon forests.

Tree growth and quality

A significant effort has been put into developing a strategy for future research in growth and wood quality modelling. FFR's aims are to link growth and quality to end product performance, and will take short, medium, and long term approaches to developing new models.

New models and algorithms will be delivered to members via modelling systems, (e.g. Forecaster and Silmetra's "YTGen"). The goal is to provide decision support so forest growers can better predict how their management decisions will influence final product performance.

The Radiata Pine Calculator will continue to be supported and has been distributed to all FFR Theme members. This tool already includes "Carbon" modelling, to estimate the quantity of CO_2 sequestered under differing sites and regimes.

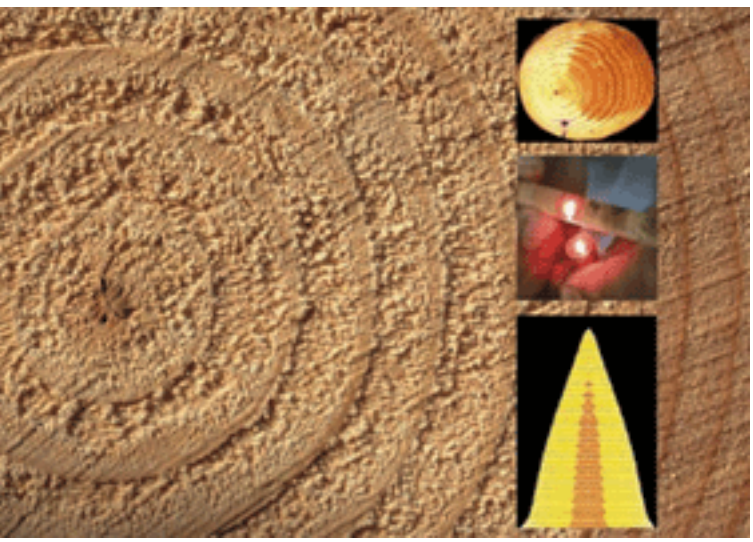
Wood quality impacts

Analysis of intensive sampling of two mature final crop stocking trials has confirmed that silviculture influences wood properties in the following ways:

1. Wood properties related to tree movement (microfibril angle and spiral grain) were influenced in the treatments thinned to very low stockings (100 stems/ha). These effects were not observed at higher stockings.

2. Visible compression wood below branch clusters tended to be more frequent as the diameter of the branches in the cluster increased.

3. Increases in microfibril angle and spiral grain were observed around the time of thinning, and it is considered that these increases result from more tree movement after thinning.



A new model to predict the size of heartwood has been developed and implemented in Forecaster. This will allow growers who are considering longer rotations to examine the size of heartwood zone that may impact on appearance grades in pruned logs. As part of an on-going validation and improvement programme, the branch model Blossim and the wood density models have been updated. The branch index model (BIX) has also been implemented and will be available in the next version of Forecaster (ver 1.5), allowing users to use a simpler model where it is appropriate.

A pilot project has begun to examine the relationship between tree canopy shape, measured by aerial photos, satellite images, or LiDAR, and stem and wood quality. The initial work has begun to characterise canopy shape, roughness, or asymmetry and relate this to stem log grades from ground plots during pre-harvest inventory.

Forest resource monitoring

A collaborative study between CSIRO and Scion has allowed the novel use of CSIRO's remote-sensing based tree counting software to accurately predict the number of trees in a stand. This has been combined with knowledge of sampling theory to develop a new forest inventory system now known as "TimberLine".

The novel sampling method combines total tree counts in a mature stand with ground-based individual tree measurements. Nine stands across a variety of New Zealand's radiata pine plantations were chosen with areas ranging from 5 ha to 104 ha and tree counts were well within 5% of actual stocking. This approach offers the potential of greater precision or significant cost savings compared with currently practised pre-harvest inventory methods.

Using satellite imagery and advanced statistics, a new method has been developed to detect and quantify the infection of pine needle disease (*Dothistroma pini*) in young trees. In a pilot trial using hyperspectral imagery from the NASA Hyperion satellite, the infra red part of the spectrum was found to be the most useful.

Using laser technology (LiDAR) a method has been developed that can accurately count logs in a stack and, with less accuracy, predict log-end diameters. This technology, once fully tested, may be a useful tool in conducting inventories of logs at various marshalling points in the supply chain for billing, auditing, and process control purposes.

Predicting MoE

A national model has been developed by Scion for predicting modulus of elasticity (MOE) across a wide environmental gradient in New Zealand. MOE, or stiffness, is a key determinant of wood quality and structural timber value. To achieve structural grades, timber must have a minimum of 6 GPa, increasing to 12 GPa for high-load applications.

The new model is valuable because it can be used to predict how silviculture at a particular site can be used to modify MOE on any site in New Zealand. It therefore provides growers with a means of tailoring regimes to meet grading standards and gives sawmillers greater certainty of resource quality. FFR has moved quickly to incorporate this model into Forecaster, so that the benefits can be widely gained by growers.

For radiata pine, stiffness increases with age, and research by Scion shows that MOE is also related to stem slenderness (i.e. tree height/dbh) and air temperature. Since stem slenderness is affected by stand stocking, this could lead to an increase in higher stocked framing regimes, which would be compatible with carbon forestry.

Undermining weeds

Weeds threaten the sustainable development of New Zealand's planted forests by reducing product yields, quality and profitability, and through environmental impacts from control methods. However, continued herbicide use is under threat due to pressure from the Forest Stewardship Council (FSC).

FSC has banned two widely used herbicides (terbuthlyazine and hexazinone) in certified forests that are commonly used to control *Cytisus scoparius* (Scotch broom). In order to develop acceptable alternative herbicides, Scion has collaborated with industry to identify and implement alternative herbicides in replicated field trials in dry and wet regions. These trials have successfully highlighted a useful alternative herbicide to those that are banned.

Progress has also been made by Scion over the past financial year to quantify how key properties of the commonly used herbicide, terbuthylazine, vary across New Zealand forest soils in relation to criteria outlined by the FSC. Adsorption of terbuthylazine was found to be within acceptable limits within all soils sampled. This indicated that leaching and bioaccumulation in aquatic organisms are unlikely to be a problem.

For more information about Radiata Management contact:
Mike Riordan, FFR (mike.riordan.@ffr.co.nz)

Theme 2: Diversified Species

The establishment of the Diversified Species Theme marks a new era in New Zealand forestry. Moving away from the 'one species fits all' approach will open up new market opportunities, and improve risk management strategies, with economic, environmental, social and cultural benefits.

The Diversified Species Theme goes further than previous research efforts in this area, enjoying greater industry support (47 member organisations) for a better funded, more focussed and integrated research programme that brings new skills to the task.

The Technical Steering Team is refining the broad programme developed with industry into a programme targeted at increasing the reliability and profitability of growing diverse species in five key species: Douglas-fir, Eucalyptus, cypresses, redwood and indigenous species.

Douglas-fir

Douglas-fir has been used as an untreated framing timber in New Zealand for over 70 years. However, changes to the NZ Building Code following the "leaky building" crisis restrict the use of both untreated radiata pine and Douglas-fir, making no allowance for differences between the species. A three-year experiment directly comparing their loss of stiffness in leaky buildings indicates that some decay in untreated Douglas-fir does not cause the same loss of stiffness observed in untreated radiata pine. Douglas-fir retains its structural integrity once leaks are rectified and the framing timber dried. This information will support the industry's case for a review of the status of Douglas-fir framing in the Code.

At the other end of the value chain, scientists have been working to develop a more reliable propagation system using somatic embryogenesis. This technology has the potential to amplify scarce genetically-improved Douglas-fir seed. Preliminary investigations have been encouraging, with sustained (albeit slower than hoped) embryogenic tissue growth.

The Douglas-fir Calculator is a multi-functional management tool designed to assist decision-making by New Zealand growers. A new version has been developed that can perform batch runs using stand summary information (such as PSP data), enabling growth prediction across multiple stands. This upgrade has already delivered benefits in the validation of the growth model associated with the Calculator.

Redwood

Renewed interest has been shown in planting coastal redwood (*Sequoia sempervirens*) in New Zealand. However, comparatively little work has been done on the wood properties and performance of locally-grown redwoods, which could potentially affect export markets.

In the most comprehensive study of NZ-grown redwood to date, 13 randomly-selected stems from Mangatu Forest, Gisborne, were cut into 5 m logs and disc samples collected. These were measured for heartwood content, wood density and shrinkage. The results confirmed that mature NZ-grown redwood has high heartwood content (averaging 54%) with low, uniform shrinkage. Wood density is relatively uniform within stems but highly variable between individual stems. A sawing study on the logs showed that the pruned quality was relatively poor, impacting on the amount of clear lumber produced.

Eucalypts

Although the range of high value end uses for eucalypt timber is increasingly recognised, it often creates problems for New Zealand sawmillers who are used to radiata. Sawn timber recovery from young small-diameter eucalypt logs using traditional methods is generally uneconomic, with conversion rates around 25-30%. Trials of a new sawing method (a hybrid quarter-sawing slabbing technique) on NZ-grown eucalypt *(Eucalyptus regnans* and *E. nitens*) indicate recovery may be increased to over 50%. This offers an alternative growing regime focussed on shorter rotation crops at higher stocking rates, potentially improving the economics of growing eucalypts in New Zealand.

Indigenous Species

An exciting opportunity under the Diversified Species Theme is the potential to bring indigenous species to a new level in New Zealand forestry. The current emphasis is on totara and kauri.

A review of the production potential of selected New Zealand indigenous tree species has identified several softwood and hardwood species as having potential to be grown or managed for wood production. The review by Scion outlines a range of issues relating to the management of planted indigenous forest, including growth rates, establishment strategies, wood quality, carbon sequestration and continuous cover forestry.

A Master of Forestry Science degree project now under way will develop a robust growth and yield model for plantation-grown kauri. A substantial review of the species includes use, properties and extent of the resource, a summary of the growth data for old-and second-growth kauri and previous attempts to manage the resource by the former New Zealand Forest Service.

Cypresses

Research into Cypress species is aimed at realising the potential of this durable timber for high value end products.

Leyland cypresses are hybrids between *Cupressus macrocarpa* and *Chamaecyparis nootkatensis* and have been propagated vegetatively for at least 100 years, offering the opportunity to study genetically identical individuals of the same clones. A recent study by Scion looked at whether popular Leyland clones differ in heartwood durability and whether site influences heartwood formation.

Cypress hybrids are seen as the solution to the health and wood durability limitations of *Cupressus lusitanica* and *C. macrocarpa*. A 2005 collaboration saw *Ch. nootkatensis* pollen from Canada applied to selected New Zealand *C. lusitanica* and *C. macrocarpa* clones, targeting increased timber durability. The resulting hybrids were planted in September 2008 to compare their performance with other hybrids.

For more information about Diversified Species
contact: Patrick Milne, FFR (patrick.milne@ffr.co.nz)

Theme 3: Environment and Social

The very launch of the Environment and Social Theme has been a major highlight of the past year. This programme reflects industry-wide recognition that our operating sphere touches matters of the environment at every turn, and its guiding framework will ensure research contributes to strategies that will:

- assist the industry to reduce its environmental footprint
- help create an improved policy-making environment
- enable the industry to be recognised for (and ultimately, benefit from) the value of the social and environmental services provided by the commercial forest estate.

Environmental sustainability indicators

Research into improved identification, validation and measurement of sustainability indicators over the next five years will contribute to methods that can be used by industry to justify its "licence to operate". This will support national and international processes for reporting sustainability and provide the science to underpin wood product marketing claims.

For some time there has been a clear need to measure and monitor the sustainability of forest management, with criteria and indicators for these purposes well established. These indicators must be re-examined to identify which can be used to assess the status of these services effectively and efficiently, and what new ones may be required in order to allow monetary value to be placed on environmental services.

A literature review has identified potentially useful indicators and their desirable characteristics. These include indicators of:

- Soil nutrition
- Soil physical and morphological condition
- Slope stability
- Water quality, and
- Terrestrial biodiversity

Putting a price on environmental contribution

FFR aims to provide a valuation of the full costs and benefits of the forest estate's environmental services as well as its traditional timber products. These values will ultimately be incorporated into forest and land use scenario and optimisation models, and used to inform good policy, regulation and land use decision making.

Systems thinking

An important consideration for the forestry sector is how carbon policy might impact on the New Zealand forest value chain. A stakeholder workshop was held to develop an initial qualitative model. This will become the basis of a quantitative model to assist policy makers and forest owners understand the potential implications of an Emissions Trading Scheme (ETS).

While the physical impacts of the ETS were important, workshop discussion showed that the vital leverage point is the 'economic viability of forests'. The model uses these economic inferences to simulate land use and forest management decisions, and the impact that a carbon price may have on these.

Simulating economic impacts of carbon reward schemes

The ETS – or any scheme to reward carbon sequestration – represents a new and potentially high value source of income for forest owners.

A prototype tool has been developed by Scion to simulate the potential outcomes of such schemes. The tool projects changes to land use, timber supply, carbon sequestration and forest management under alternative carbon price scenarios, and will enable forest owners to optimise land use and forest management to maximise economic return.

This information will also help policy makers assess possible impacts of regulations on land use and management, and hence carbon sequestered.

The model shows a large carbon deficit as stands planted during the 1990s reach maturity. However, if the price of carbon were to increase leading to longer rotations, this effect would be both delayed and spread out over a longer period.

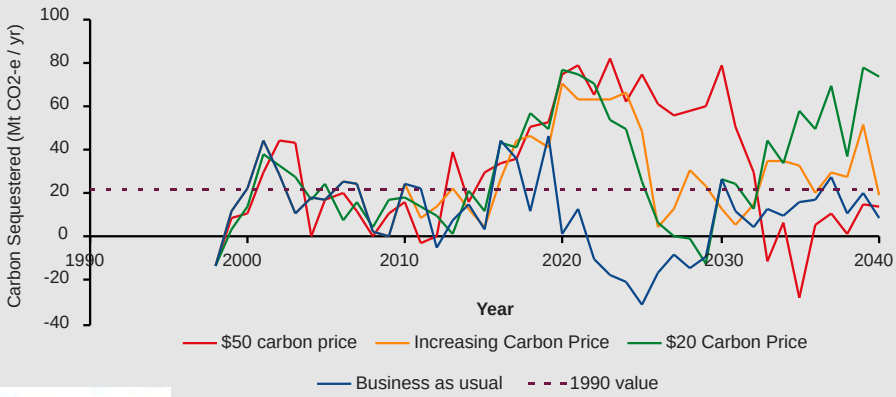


Figure 1: Projected carbon sequestration 1998-2040 under four different scenarios

Economic value of recreation in Whakarewarewa Forest

FFR aims to determine the value users place on being able to enjoy the recreation opportunities provided by a planted forest, using Whakarewarewa forest as a case-study. This pioneering study represents a first step in quantifying the various environmental and social benefits offered by production forests.

High level results indicate 'Whaka' is highly valued as a recreation resource, particularly by Rotorua locals, and that mountain bikers value the forest for recreation more than walkers. Although all users, especially walkers, like the variety of the forest (mix of species, age of trees, etc) modification would be unlikely to affect their level of use, and all users want to maintain access.

For more information about Environment and Social issues contact: Kit Richards, FFR (kit.richards@ffr.co.nz).

Theme 4: Harvesting and Logistics

Following a decade with no harvesting or logistics research in this country, it is an important and positive milestone to report on the first full year of research activity under FFR's Harvesting and Logistics theme.

Depending on location, harvesting and logistics makes up 40-60% of delivered log cost, and the potential to achieve significant productivity gains has been quickly recognised by theme members.

FFR's objectives are:

- To reduce harvesting logistics costs by 2% p.a. (equivalent to $10.00/tonne over 10 years), and
- To enhance value recovery from existing resources by 5% of log value over the next 5 years – equivalent to $4.00/tonne.

These targets are achievable, given opportunities that include:

- Reducing the cost of steep country harvesting
- Increasing productivity through mechanisation
- Reducing the workload and improving the industry's attractiveness as a career.

Productivity Data Collection

You can't manage what you don't measure. It is an old management adage that applies to all activities. Scion is studying automated data collection tools relating to harvesting productivity so operators can identify improvement opportunities and measure gains.

- A series of trials undertaken with a MultiDAT electronic data logger proved its usefulness for monitoring machine utilisation and for research applications.
- During the year, Scion developed a Production Data Unit (PDU) as a cheap tool for logging contractors to record volume per haul. This is a simple push-button counter for manual entry of piece count data, such as the number of butts and tops produced.
- Another trial used an accelerometer to measure grapple openness and then relate this to payload.
- Tension monitors can also be used to estimate payload, enabling productivity to be maximised within safe limits.

Future Felling

FFR is investigating mechanised harvesting systems for potential use on steep terrain. A literature review of research into felling and bunching on steep terrain undertaken globally over the last twenty years has been completed by Scion and some promising options identified. The review has identified potential productivity improvements from bunching on steep terrain, as well as new steep terrain harvesters and the "walking excavator".

Other work involved analysing a sample of New Zealand cable harvest plans based on terrain, piece size and maximum cable payload to determine areas where cable payload and thus productivity, could have been increased through bunching. An innovative harvesting operation on steep terrain in the Nelson area using a safety winch-supported bunching machine was also studied.

Technology Watch

FFR is drawing on harvesting research undertaken previously in New Zealand, and maintains a watching brief on new developments internationally that could be applied here. Technology transfer this year included:

- Publication of all previous brief reports of the Logging Industry Research Organisation on the FFR website (www.ffr.co.nz).
- Regional technical meetings in Gisborne, Mosgiel and Rotorua.
- Biannual publication of Harvesting Technology Watch, highlighting research and technology developments from outside the FFR Harvesting Theme.
- Updating the handbook *Business Management for Logging*, including an updated costing template, which will be available on the FFR website.

Human Factors Research

This project aimed to identify how harvesting and human factors ergonomic research has been taken up by industry, whether it has been effective and where future needs lie. To establish this, feedback was sought from industry specialists and practitioners.

The research indicated continued improvements in initiatives directed at technical and individual factors (such as training developments, behaviour , and improved health and safety management systems). Results also indicated a number of areas where greater information needs are required - in particular relating to the nature of PPE and equipment developments, skid site design and management, new training schemes and inconsistent management of occupational health issues

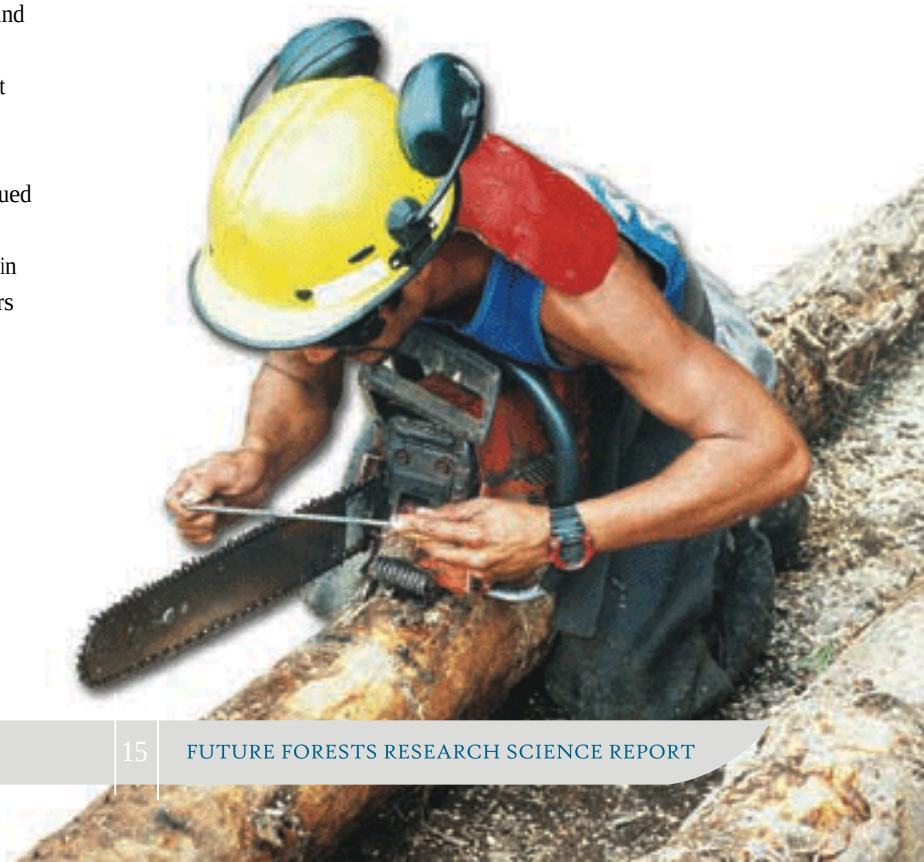
However, interview findings showed an apparent continued lack of progress in interventions relating to work organisation and management factors. Interventions in these areas will form the basis of future human factors research.

Cost and Productivity Benchmarking

Baseline data for harvesting costs and productivity are being compiled so FFR members can judge whether their underlying performance has improved over time and, if not, where they need to focus their efforts. A web-based system for data input, developed for FFR by the University of Canterbury School of Forestry, is up and running on http:/www.foresteng.canterbury.ac.nz/survey.

The aim is to increase the dataset to close to 100 entries (representing about 2 million tonnes of logging production - around 10% of the national annual cut) before publishing benchmark averages for the productivity and cost-related parameters. All FFR Harvesting Theme members are encouraged to participate, not only to increase the sample size but to get better representation from companies and regions across New Zealand. Harvesting production data can be submitted via spreadsheet or inputted directly via the website.

For more information about Harvesting and Logistics contact:
Keith Raymond, FFR (keith.raymond@ffr.co.nz)



FUTURE FORESTS RESEARCH LIMITED

PO Box 1127
Rotorua 3040
Phone: 64 7 921 1883
Fax: 64 7 921 1020
Email: futureforestsresearch@ffr.co.nz

Chief Executive

Russell Dale
DDI: +64 7 921 7258
Cell: 027 493 8061
Email: russell.dale@ffr.co.nz

Veronica Bennett
Business Support Manager
DDI: +64 7 921 7246
Email: veronica.bennett@ffr.co.nz

FFR Theme Leaders:

Radiata Management

Mike Riordan
DDI: +64 7 921 7238
Cell: 021 315 153
Email: mike.riordan@ffr.co.nz

Environment and Social

Kit Richards
DDI: +64 7 921 7206
Cell: 021 355 631
Email: kit.richards@ffr.co.nz

Diversified Species

Patrick Milne
DDI: +64 3 312 6599
Cell: 027 471 0224
Email: patrick.milne@ffr.co.nz

Harvesting and Logistics

Keith Raymond
DDI: +64 7 921 7239
Cell: 027 438 5233
Email: keith.raymond@ffr.co.nz

www.ffr.co.nz

Board of Directors

Chairman

Phil Taylor
Managing Director
Blakely Pacific Limited

Directors:

Steve Couper
Southern North Island Regional Manager
Ernslaw One Limited

Eoin Garden
Chairman
Silver Fern Farms

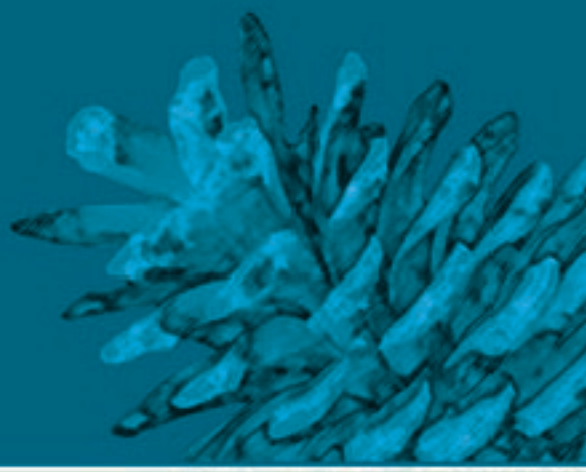
Peter Keach
Operations Manager
PF Olsen Limited

Bruce Manley
Head of School
School of Forestry
University of Canterbury

Brian Richardson
Group Manager
Scion

Tom Richardson
CEO
Scion

FUTURE FORESTS RESEARCH



PO Box 1127
Rotorua 3040
Phone: 64 7 921 1883
Fax: 64 7 921 1020
Email: futureforestsresearch@ffr.co.nz
Website: www.ffr.co.nz

ISSN 1179-4151 (Print) ISSN 1179-416X (Online)