MINISTRY OF AGRICULTURE AND FORESTRY

SUSTAINABLE MANAGEMENT OF NEW ZEALAND'S FORESTS

THE 2008 NEW ZEALAND COUNTRY REPORT ON THE MONTREAL PROCESS CRITERIA AND INDICATORS

OCTOBER 2009

Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere

ACKNOWLEDGEMENTS

This report was prepared primarily by the following Ministry of Agriculture and Forestry (MAF) Policy staff:
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External editing of the draft was undertaken by Jaap Jasperse of South Pacific Publishing Consultancy Ltd.
Photos provided courtesy of Ian Platt, Alan Reid, MAF and Pan Pac Forest Products Ltd (www.panpac.co.nz).
Front cover image is by Ian Platt, showing managed, regenerated black beech forest, North Canterbury.

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PUBLISHED BY

MAF Policy
Ministry of Agriculture and Forestry
PO Box 2526, Wellington 6140, New Zealand
Tel: +64 4 894 0100 or Freephone 0800 008 333
Web: www.maf.govt.nz
ISBN 978-0-478-35183-5 (Print)
ISBN 978-0-478-35184-2 (Online)

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FOREWORD

Sustainable forest management has long been recognised as fundamental to sound forestry. It is the basis for the way we manage forests in New Zealand and will enable current and future generations to continue to benefit from the values and products of forests.

As such, the Montréal Process is of considerable importance to New Zealand as it provides us with a key framework for measuring and monitoring our progress in this area.

This 2008 report, New Zealand's second national report, provides information on the full set of seven criteria and associated indicators adding to an increasing store of information for measuring the status of our natural resources.

A special feature of New Zealand's forest estate is the distinction between our commercial plantation forests and our unique and largely reserved indigenous forests – this report covers both.

The report provides us with an overview of the current state of New Zealand's forests but also provides a benchmark to enable future monitoring of indicators that can help us understand and maximise the benefits of our indigenous and plantation forests.

New Zealand has been a member of the Montréal Process working group since its inception. Participation is important to New Zealand because it provides us with a means to demonstrate our commitment to sustainable management of all our forests and to build enduring relationships with trading nations, organisations and people who are key influencers of international policy and trade, enabling us to effectively participate in international forestry processes.

New Zealand has much to gain from, and much to contribute to, the ongoing development of the Montréal Process. Working together we have put in place a framework that provides the building blocks for a sustainable forestry future.

Hon. David Carter
Minister of Forestry

Thinned and pruned black beech forest, North Canterbury. Photo: Ian Platt.

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INTRODUCTION

Forests are home to 70 percent of the world's terrestrial animals and plants, providing the essential components of food, clothing and shelter. Forests are renewable resources and rich, resilient ecosystems. When managed sustainably, they can provide society with essential goods and services – timber, medicine, food, water and employment – and conserve biodiversity, for generations to come.

The 1987 Brundtland Report highlighted the urgency of progressing sustainable development without depleting natural resources or harming the environment. Five years later, the United Nations General Assembly sought a report on progress made towards sustainable development and convened the United Nations Conference on Environment and Development (UNCED) in 1992 at Rio de Janeiro (the "Earth Summit"). The objectives were to build on the hopes and achievements of the Brundtland Report in order to respond to global environmental problems, and to agree major treaties on biodiversity, climate change and forest management.

One of those agreements was the Principles for Forest Management. Along with Agenda 21 and the Rio Declaration, it was adopted by more than 178 countries, including by the government of New Zealand. The guiding objective of the Principles is:

> *…to contribute to the management, conservation and sustainable development of forests and to provide for their multiple and complementary functions and uses (United Nations General Assembly, 1992).*

The Preamble to the Principles for Forest Management states that:

> *Recognizing that the responsibility for forest management, conservation and sustainable development is in many States allocated among federal/national, state/provincial and local levels of government, each State, in accordance with its constitution and/or national legislation, should pursue these principles at the appropriate level of government (United Nations General Assembly, 1992).*

Mountain beech forest, Castle Hill Basin, Canterbury, New Zealand. Photo: Ian Platt.

Amongst other things, the Principles state that:

> *…forest resources and forest land should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations*

and

> *The provision of timely, reliable and accurate information on forests and forest ecosystems is essential for public understanding and informed decision-making and should be ensured.*

Following UNCED, Canada convened an International Seminar of Experts on Sustainable Development of Boreal and Temperate Forests in 1993 at Montreal. The seminar focused on criteria and indicators (C&I) and how they can help define and measure progress towards sustainable development of forests.

THE MONTREAL PROCESS

The Montreal Process was subsequently formed in Geneva, Switzerland, in June 1994. The Montreal Process is the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests.

Membership of the Working Group is voluntary. Member countries are Argentina, Australia, Canada, Chile, China, Japan, the Republic of Korea, Mexico, New Zealand, the Russian Federation, the United States of America and Uruguay. Together, these countries hold about 90 percent of the world's temperate and boreal forests, and 60 percent of all the world's forests.

European countries with temperate and boreal forests work as a region under the framework of the Ministerial Conference on the Protection of Forests in Europe.

CRITERIA AND INDICATORS

The Montreal Process C&I provide a common framework for member countries to monitor, assess and report on trends in forest conditions with respect to the full range of forest values and, in turn, on national progress towards sustainable forest management (SFM). They represent a holistic approach to forest management, and provide information essential to the focusing of policies and research that promote SFM.

Seven criteria characterise the essential components of SFM, while 64 indicators provide a way to measure those components. The C&I are not performance standards.

The Montreal Process C&I are not static; they are periodically reviewed and refined to reflect new research findings, advances in technology and an increased capability to measure indicators. A review of Criteria 1 to 6 and their associated indicators was completed in December 2007. Revised text for Criterion 7 and a set of indicators agreed by the Technical Advisory Committee in August 2008 were adopted by the Working Group in November 2008[1].

WHY IS NEW ZEALAND INVOLVED IN THE MONTREAL PROCESS?

Participation in the Montreal Process is the principal mechanism through which New Zealand can demonstrate to the international community that it is

1 Note that in the present report, the previous version of Criterion 7 and its associated indicators are used.

Coastal hardwood forest, Pororari River, Punakaiki, Westland. Photo: Ian Platt.

committed to sustainable management of all its forests, and what it is (or is not) achieving. The value for New Zealand arises from:

- fulfilling international obligations and the expectations that arose from UNCED, and in particular from the Principles for Forest Management;
- demonstrating to international audiences, including international trading partners, a national commitment to sustainable forest management;
- demonstrating to international audiences the sustainability of the country's plantation forests;
- establishing the country's credentials in order to enable it to take a position of standing in international fora addressing issues such as deforestation, illegal logging, and unsustainable harvesting;
- assisting to build enduring relationships with countries, organisations and people who are key influencers of international forest policy, in order to effectively participate in international forestry processes;
- monitoring trends against indicators in order to focus domestic policy development and research initiatives towards areas of weakness in sustainable forest management;
- educating the public about SFM;
- facilitating the development of C&I-based reporting for other forms of resource management.

NEW ZEALAND'S ABILITY TO REPORT ON CRITERIA AND INDICATORS

The *2008 New Zealand Country Report on the Montreal Process Criteria and Indicators* includes comment on all 64 indicators. Some of these comments are comprehensive, both qualitatively and quantitatively; others are more descriptive. Where data are not available for inclusion in this report, the indicator reports endeavour to describe what information has nevertheless been collected.

The distinction between New Zealand's commercial plantation forests and its largely protected indigenous forests is a special feature of the New Zealand forest estate. This fundamental difference in the management of the forests is also reflected in the availability of data to support the Montreal Process Criteria and Indicators. In most instances more detailed information is available on plantation forest than on indigenous forest.

Young kauri forest, Waipoua, Northland. Photo: Ian Platt.

CRITERIA AND INDICATORS

The wording of the criteria 1 to 6 and their indicators, their descriptions and rationales, are as revised and reported by the Montreal Process Working Group in the *Technical Notes on Implementation of the Montreal Process Criteria and Indicators, Criteria 1–6* (Second Edition, December 2007). Criterion 7 and its indicators, descriptions and rationales are as applied in the 2003 Montreal Process report.

QUALITY OF INFORMATION AND TRENDS AGAINST INDICATORS

This is New Zealand's second national report. The quality of information used for each indicator was assessed against its availability and coverage, and expressed as

high, medium or low. Trends have been assessed against the positions described in the previous report, and for new indicators on the basis of available information. For some indicators, quantitative data enables these assessments to be made; for others, subjective evaluation has been required. To express these trends "traffic light" symbols have been used to show neutral (amber), positive (green) and negative (red) changes, or where information is insufficient to make a judgement the question mark (?) is used.

NATURAL FOREST OR INDIGENOUS FOREST

The Montreal Process working group uses the term "natural forests". The New Zealand reporting uses the term 'indigenous forests' which is consistent with the Forests Act 1949. For the purposes of New Zealand's report under the Montreal Process criteria and indicators, these terms are equivalent.

CO-ORDINATING AGENCY AND CONTRIBUTORS

The Ministry of Agriculture and Forestry has taken responsibility for co-ordinating information gathering and for writing this report. The Ministry was seen as the appropriate agency as it leads government involvement in domestic and international sustainable forest management.

Other government departments and agencies that contributed to the compilation of the report were the Ministry for the Environment, the Department of Conservation, Scion (Forest Research), and Landcare Research New Zealand Ltd. The Ministry of Agriculture and Forestry acknowledges the contributions made by these organisations.

REVIEW

A draft report was externally reviewed by the Ministry for the Environment, the Department of Conservation, and a representative of the New Zealand Forest Owners' Association. However, responsibility for the contents of the final report lies with the Ministry of Agriculture and Forestry.

Mixed hardwood/alpine scrubs, Fox Glacier, South Westland. Photo: Ian Platt.

THE STATE OF NEW ZEALAND'S FORESTS
SELECTED KEY INDICATORS

Thirteen key indicators have been selected to provide the basis for an overview of the current state of New Zealand's forests. At least one indicator has been selected from each of the seven Montreal Process criteria to give a mix of the environmental, commercial, social and cultural components of sustainable forest management. The 13 indicators are:

INDICATOR 1.1.a *Area and percent of forest by forest ecosystem type, successional stage, age class, and forest ownership or tenure.*

INDICATOR 1.2.b *Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment.*

INDICATOR 2.b *Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production.*

INDICATOR 3.a *Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions.*

INDICATOR 4.2.a *Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources.*

INDICATOR 5.a *Total forest ecosystem carbon pool and fluxes.*

INDICATOR 6.1.a *Value and volume of wood and wood products production, including primary and secondary processing.*

INDICATOR 6.3.a *Employment in the forest sector.*

INDICATOR 6.4.a *Area and percent of forest available and/or managed for public recreation and tourism.*

INDICATOR 6.5.a *Area and percent of forest management primarily to protect the range of cultural, social and spiritual needs and values.*

INDICATOR 7.1.a *Property rights.*

INDICATOR 7.1.b *Planning, assessment and policy reviews.*

INDICATOR 7.4.a *Availability of data.*

THE FOREST ESTATE

New Zealand is a small, geographically young country comprising two narrow, mountainous islands and a number of small offshore islands. It has a total land area of 26.8 million hectares (including inland waterways).

About 85 percent of New Zealand was forested before the first human settlers arrived. Polynesian inhabitants cleared large areas of forest, a process that was continued by European settlers from the mid-19th century and into the 20th century. Forests have been extensively cleared and modified through trade in forest products, expanding agriculture, settlement, and the establishment of human-introduced animals and plants.

In 2008 New Zealand had a total of 8.3 million hectares of forests covering 31 percent of the land area. The indigenous and plantation forest components are fundamentally different in terms of their biological characteristics, management objectives, and respective roles in fulfilling the needs of New Zealand society.

INDIGENOUS FOREST ESTATE

The estimated area of indigenous forest has remained constant since the previous Montreal Process report in 2003, at 6.5 million hectares. These forests are mainly located in the mountain lands, particularly on the West Coast of the South Island. New Zealand has few remnants of the lowland forests that were once prominent.

A condensed classification of New Zealand's indigenous forests (Nicholls and Herbert, 2005) recognises 18 forest classes. The major indigenous tree species[2] in these complex forests include the softwood species kauri, rimu, matāi, and the hardwoods taraire, tawa, and beech. The indigenous forests harbour about 70 species of indigenous birds (some classed as endangered or threatened), two species of bat, reptiles, freshwater fish, amphibians and invertebrates, most notably land snails and giant wētā (*Deinacrida* spp.). Their cultural values include spiritual, recreational, scientific, historical and scenic values.

The Crown is the major indigenous forest owner. Through the Department of Conservation it manages about 5 million hectares (or 78 percent) of the indigenous forest estate for conservation, heritage and recreational purposes. The bulk of this Crown-owned forest resource is protected in perpetuity in national parks, scenic reserves and other conservation areas. The Māori people gifted many of these areas to the Crown. There is no commercial timber harvesting from Crown-owned indigenous forest.

2 See Appendix 1 for a list of common and botanical names of species mentioned in this document.

Podocarp/hardwood forest, Purerora Forest, Central North Island. Photo: Ian Platt.

Indigenous forests are a key part of New Zealand's environment and help protect the many values of the country's natural ecosystems. Thanks to a large plantation forest resource, New Zealand has the opportunity to protect its remaining Crown-owned indigenous forests and sustainably manage the privately-owned indigenous forests.

Aside from an increasing demand for access and recreational opportunities, the main threats to New Zealand's indigenous forests arise from introduced animals and plants. New Zealand has extensive programmes aimed at controlling, or eradicating from designated areas, introduced species such as rats, possum and deer. The aim is to halt the devastating effects these animals have on the indigenous forests and associated fauna. Howell (2008) reported a consolidated list of 328 adventive vascular plant species on the Crown-owned conservation estate considered as having detrimental effects on conservation values. Over 40 percent were trees and shrubs.

There are no reported figures for indigenous forest areas affected by insects or diseases. Scientific literature reports the existence and effect of certain pathogens and pests, and the risk of disturbances to indigenous forests by pathogens is considered real, but unquantifiable at this time.

Since the 2003 report (Ministry of Agriculture and Forestry, 2003) there has been continuing work on gathering data about species, in addition to describing their threat status. More species have been more extensively described, and the information about threat status continues to expand (Hitchmough et al, 2007; Miskelly et al, 2008). An analysis of the threat status of vascular plant species nationally that are either threatened or data-deficient has recently been updated (de Lange et al, 2009). It records an increase over five years in the number of taxa listed as "Threatened" and "At Risk", while the number of taxa regarded as "Data

Deficient" has decreased. Forest species comprise 17 percent of this national list. Other broad taxa, such as bat and frog species, show no change but some, especially invertebrates, show substantial increases in both threatened and data-deficient species.

PLANTATION FORESTS

New Zealand's 1.8 million hectares of plantation forests (as at 2007) are:

- dominated by one species – radiata pine (*Pinus radiata*) which accounts for 89 percent of the planted area;
- predominantly (61 percent) 15 years old or younger;
- fast growing – the average time to harvest for radiata pine is 28 years;
- mostly intensively tended – 61 percent of the radiata pine resource has been pruned to produce knot-free timber;
- mostly managed under the industry-developed Environmental Code of Practice for Plantation Forestry.

In contrast to indigenous forests, 93 percent of the plantation forest estate is in some form of company or private ownership, with the principal management objective being the commercial production of timber. The New Zealand Government owns only 4 percent of the plantation forest estate, and local government (regional and district/city councils) owns a further 3 percent.

From 2005 to 2008 the rates of deforestation have exceeded the rates of new planting (which have been very low), resulting in a decrease of 51 000 hectares (or 3 percent) in the total area of the plantation forest estate since 2003. Deforestation has been primarily driven by conversion to dairy land, particularly of pre-1990 forest before 2008 (to avoid deforestation liabilities during the first commitment period of the Kyoto Protocol).

The plantation forest estate had an estimated standing volume of 434 million cubic metres as at 31 March 2007. In comparison, the estimated standing volume at 31 March 2003 was 398 million cubic metres. Despite the deforestation, the average annual increase in total standing volume over this period is 9 million cubic metres, reflecting the increase in the area-weighted average age from 13.7 to 14.8 years.

Pinus radiata, Lake Pukaki, MacKenzie Basin, New Zealand. Photo: Ian Platt.

Historically, very few insect problems have been noted in plantation forests, apart from one species of bark beetle (*Hylastes ater*) that can be associated with seedling death (Bulman, 2008). Plantation forests are affected by fungal diseases, the most important being: *Cyclaneusma* needle cast (*Cyclaneusma minus*), *Dothistroma* needle blight (*Dothistroma septosporum)*, *Armillaria* root rot (*Armillaria* spp.), and *Nectria* flute canker (*Nectria fuckeliana*). For 2005 it is estimated that 40 000 hectares were subject to disturbance by insects and 320 000 hectares were subject to disturbance by diseases (Bulman, 2009).

INSTITUTIONAL FRAMEWORK

The primary legislation that governs the management of New Zealand's land, water and air resources is the Resource Management Act 1991 (RMA), which is currently under review. The purpose of the RMA is "to promote the sustainable management of natural and physical resources". The RMA is largely implemented by local government (regional and district/city councils) through the preparation and implementation of regional policy statements and regional and district plans. Any forest management (or other) activities that would result in adverse environmental effects, including the disturbance to soil resources, must meet the requirements of the appropriate local authority plan.

The Conservation Act 1987 requires the development of conservation management strategies for the twelve conservancies that cover the country in accordance with the legislation under which the Department of Conservation operates. For areas where there are high levels of activity or complexity, a more detailed conservation management plan may be prepared. A conservation management plan must be prepared for each national park and reviewed at least every 10 years.

Podocarp/hardwood/beech forest, Westhaven Inlet, Golden Bay.
Photo: Ian Platt.

Part IIIA (indigenous forest provisions) of the Forests Act 1949, introduced in 1993, requires the sustainable management of privately owned indigenous forests when timber is being harvested. This means the forests are managed in a way that maintains their ability to provide products and amenities in perpetuity.

New Zealand's isolation has meant that indigenous flora and fauna and the plantation forest estate are free from many of the pests and diseases that affect forests in other countries. Increasing trade and travel, and climate change, are elevating the risks of pests and diseases entering the country and becoming established. A good biosecurity system is essential to protect the environment, the economy and human health. New Zealand has an effective biosecurity system that is based on the Biosecurity Act 1993.

New Zealand has a well established and robust legal framework for the identification and protection of property rights, and for the resolution of disputes. The foundation legal document that recognises the rights of Māori people is the Treaty of Waitangi, signed in 1840. The principles of the Treaty are provided for in the Resource Management Act, the Conservation Act, and a number of other Acts. The Waitangi Tribunal is a permanent commission of inquiry charged with making recommendation on claims by Māori relating to actions or omissions of the Crown that breach promises made in the Treaty.

Important legislation for forestry-related property rights includes the Property Law Act 1952, Resource Management Act 1991, Forests Act 1949, Forestry Rights Registration Act 1983, and the Te Ture Whenua

Māori Act 1993. Dispute resolution through negotiation, mediation, the Small Claims Tribunal, District and High Courts, variously apply depending on the legislation under which a dispute arises.

The availability of objective data is critical to support informed public participation in the development of central government policies and legislation, in local authority policies and plans, and for sustainable forest management. Comprehensive statistical databases are a feature of commercial forestry in New Zealand, now focused on the plantation forest resource. Area-age class and yield table databases are contained within the *National Exotic Forest Description* (Ministry of Agriculture and Forestry, 2008). They provide critical information for understanding the nature and extent of the resource, wood availability forecasting, and sector and infrastructure planning. Coupled with production and trade related statistics, this enables national and regional monitoring of the performances of the commercial forest industries.

International climate change-related reporting requirements and the use of satellite imagery are strengthening information and data on the physical attributes of New Zealand's indigenous forests. The Land Use and Carbon Analysis System (LUCAS) developed by the Ministry for the Environment has identified 1400 permanent plots, and established 1255 between 2001 and 2007, to measure indigenous forest carbon. There are also 700 plots on post-1989 plantation forests. These plots are of essentially the same design as plots used in the ecological-based vegetation monitoring over the last 50 years under the National Vegetation Survey (NVS), which includes 19 000 permanent plots and about 77 000 vegetation survey plots. The intention is to re-measure the LUCAS indigenous forest plots every 5 to 10 years (and the plantation forest plots every 5 years).

The Department of Conservation uses standard measurement techniques to provide information on changes in indigenous forest stand structure and vegetation composition in the presence of herbivores. While data are curated in the NVS database, the monitoring programme has not yet been systematically implemented at the national level.

Redwood forest, Hanmer Springs, North Canterbury. Photo: Ian Platt.

FIGURE 1.1A: MAP OF NEW ZEALAND SHOWING THE DISTRIBUTION OF DIFFERENT TYPES OF FOREST. MANGROVES DO NOT FIT WITHIN THE KYOTO PROTOCOL DEFINITION OF FOREST THAT NEW ZEALAND HAS ADOPTED (SEE INDICATOR 1.1.A). THE THIN LINES MARK ADMINISTRATIVE REGIONS (LISTED IN TABLE 1.8).

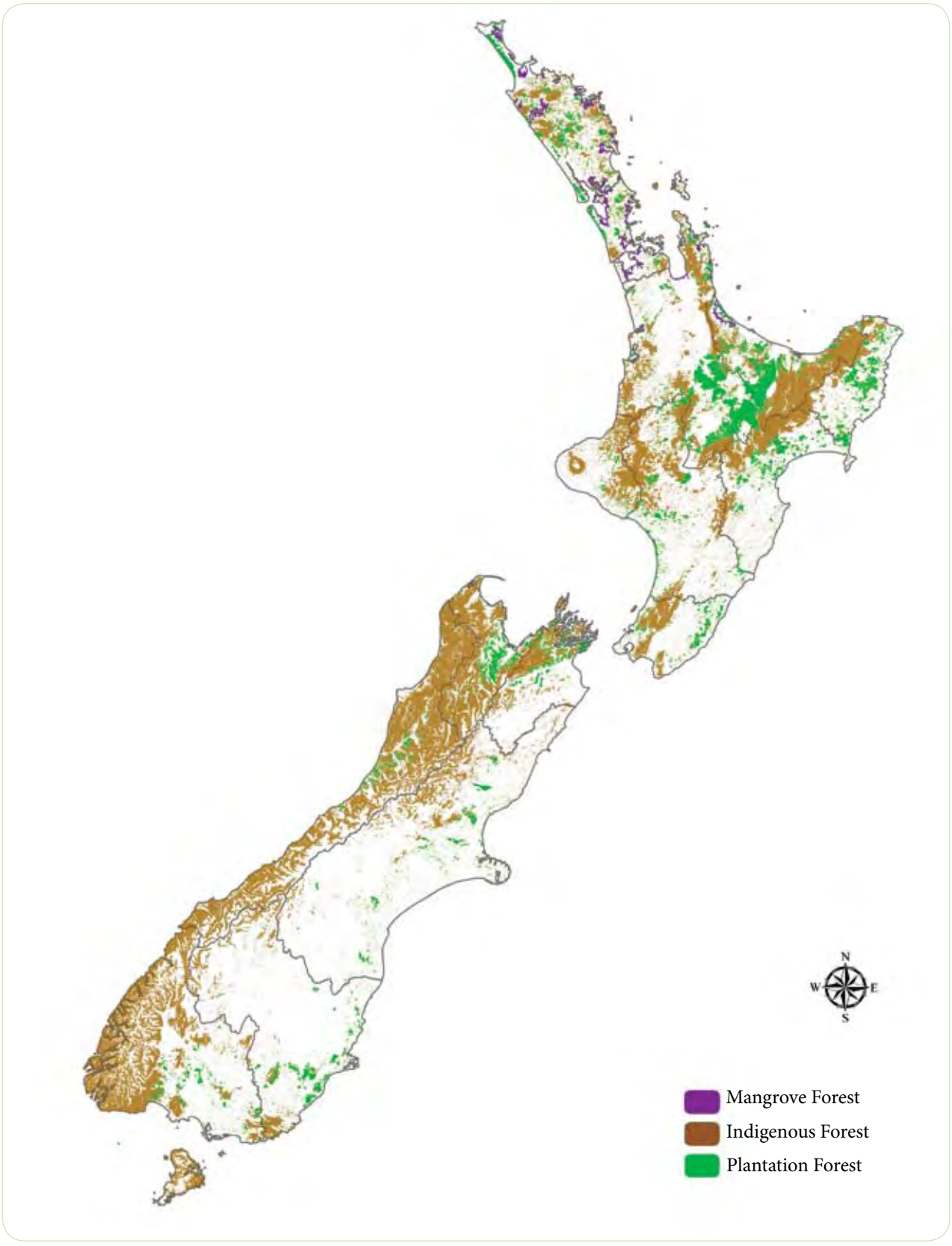
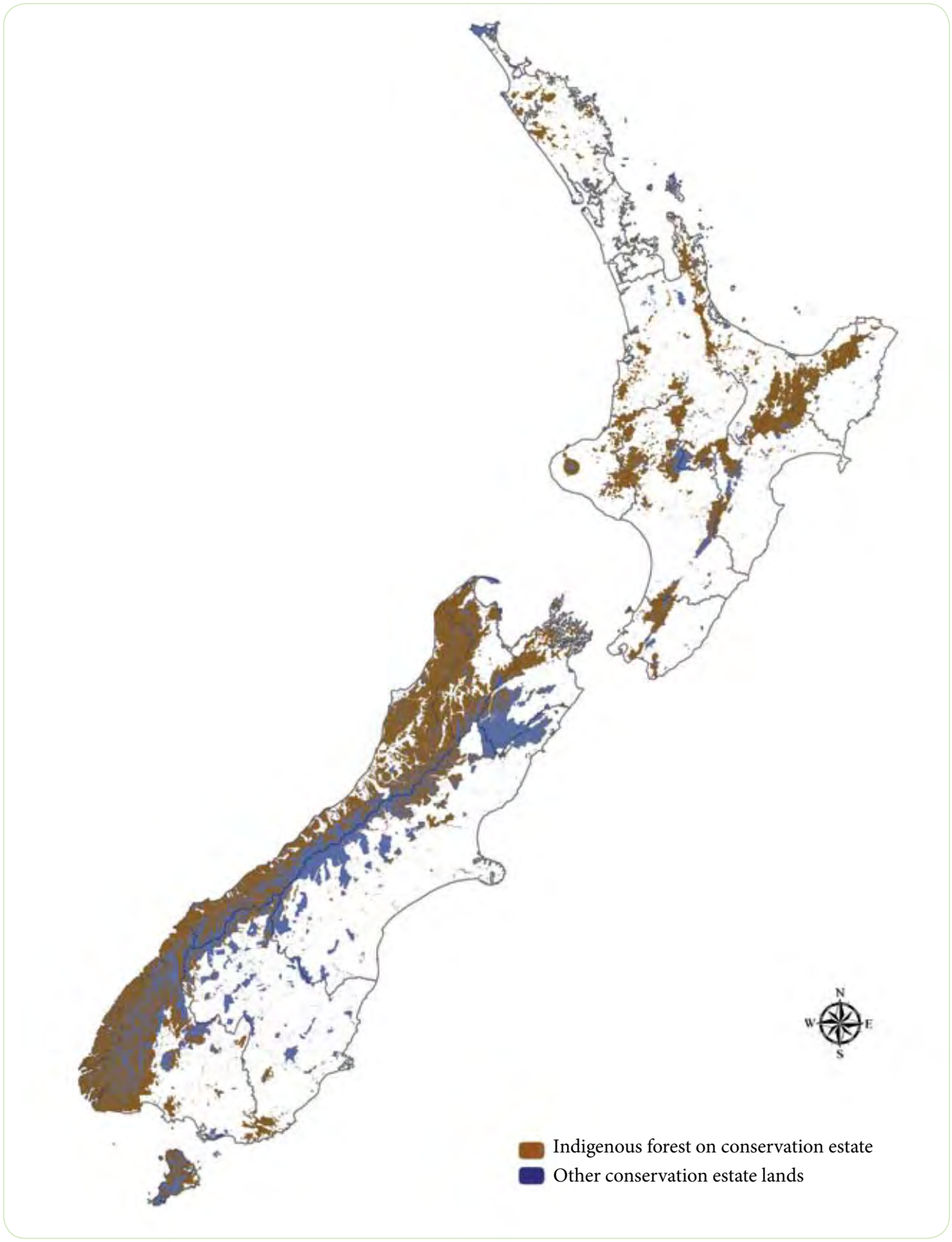


FIGURE 1.1B: MAP OF NEW ZEALAND SHOWING THE DISTRIBUTION OF CONSERVATION LAND. THE MAJORITY OF IT IS FOUND IN THE CENTRAL NORTH ISLAND, AND WEST OF THE MOUNTAIN RANGE TRAVERSING THE SOUTH ISLAND THAT CATCHES MUCH RAINFALL IN THE PREVAILING WINDS. THE THIN LINES MARK ADMINISTRATIVE REGIONS (LISTED IN TABLE 1.8).



MANAGEMENT OF THE FOREST RESOURCE FOR CONSERVATION AND PUBLIC USES

The Department of Conservation manages land and forests under the Conservation Act 1987 and other Acts, and under a range of classifications such as national parks, conservation parks, stewardship areas, scenic and other reserves, and wildlife refuges. Under the Conservation Act, all land is managed for conservation purposes. Conservation is interpreted in section 2 of the Act as:

> *the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.*

The Department of Conservation consults with tāngata whenua[3] and the community about policy, management plans and operations relating to land managed under the Conservation Act. Customary use of traditional materials and indigenous species on conservation land may be authorised under various provisions of the Act.

3 Tāngata whenua includes iwi, hapū and whānau, which are tribal and family groupings of Māori.

Southern rata forest, Karamea Bluffs, Buller. Photo: Ian Platt.

Under the National Parks Act 1980, national parks are to be preserved as far as possible in their natural state. In 2002, New Zealand's fourteenth national park was established, the 157 000-hectare Rakiura National Park on Stewart Island

The area of forested land managed by the Department has increased from about 4.9 million hectares in 2000 to 5.0 million hectares in 2008. While this is about 78 percent of New Zealand's indigenous forest estate, lowland forest ecosystems are poorly represented.

Fostering the recreational use of New Zealand's largely forested conservation estate is one of the principal goals for the Department of Conservation. In the 2006/07 year, $111 million or 41 percent of the Department's total expenditure was devoted to maintaining and developing recreational facilities within this estate. This expenditure included the maintenance of 13 628 structures, 12 860 kilometres of tracks and 950 huts.

In addition to publicly funded facilities, private operators run tourism and other ventures within the conservation estate through a concession system managed by the Department of Conservation. In 2008 there were 488 accommodation concessions, 473 guiding operations, 256 aircraft and boating operations, 25 ski field facilities and 18 education and instructional concessions.

For the 2005/06 year, the Department of Conservation estimated that 33 million visits were made to New Zealand's national parks and reserves. When set against a domestic population of four million people, the visitor estimate represents a high level of patronage by local people and international tourists.

New Zealand has many private organisations actively involved in conservation and environmental issues. These vary from local clubs concerned with the protection or restoration of the local environment, to national and international groups concerned to preserve the

environment for its ecological, scientific, recreational or scenic values.

MANAGEMENT OF THE FOREST RESOURCE FOR THE PRODUCTION OF WOOD AND WOOD PRODUCTS

Plantation forests account for 99.9 percent of New Zealand's harvested roundwood. For the last five years, roundwood removals from the plantation forest estate have hovered around 20 million cubic metres per year. The 20.4 million cubic metres harvested in 2007/08 resulted in the export of 6.6 million cubic metres (roundwood equivalent) of logs and chips (32 percent of the harvested volume), and the production of:

- 4.3 million cubic metres of sawn timber;
- 1.9 million cubic metres of panel products;
- 1.5 million air dry tonnes of pulp;
- 871 000 tonnes of paper and paperboard.

In 2007/08 the commercial forest industries contributed $5.1 billion to New Zealand's gross domestic product (GDP), which represented 3.8 percent of total GDP.

Wood availability forecasts indicate that by 2015 there will be enough wood from plantation forests to increase the annual harvest to a sustainable level of almost 25 million cubic metres. The actual harvest will depend on market conditions, and possibly on "carbon forestry". The first trade of forest-based carbon credits (New Zealand Units – NZUs) under the Emissions Trading Scheme occurred in February 2009, when 50 000 tonnes of NZUs were reported to have been sold at NZ$20 per tonne.

The current level of harvest from indigenous forests is about 18 000 cubic metres per year, although the approved harvest volume is considerably higher under sustainable forest management plans and permits (covering 114 000 hectares of forest). The commercial indigenous forest industry is struggling to compete against imports of wood products that may frequently be sourced from forests not managed under the equivalent of New Zealand's rigorous sustainable management requirements. It is estimated that between 300 000 and 400 000 hectares (5 to 6 percent) of the indigenous forest estate have potential for sustainable commercial wood production.

In 2007 some 20 389 people were recorded as employed in (commercial) forestry and first stage processing, an 18 percent decrease from 2002 when employment was 24 852. The decline resulted from a combination of market and exchange rate conditions, and high shipping costs for exports during the period. About 39 percent of those employed in 2007 were in the central North Island, with other regions contributing between 2 and 10 percent of the employment total. A study in the Otago/Southland region concluded that every one full time equivalent (FTE) employed in the forestry sector generated another 1.3 FTEs elsewhere in the region.

As well as legislative mechanisms to safeguard soil and water resources (primarily the Resource Management Act), most major plantation forest owners have Forest Stewardship Council (FSC) certification. This provides an independent and credible guarantee that the wood products come from well managed forests. The area of plantation forests certified under the FSC has increased from 450 000 hectares in 2004 to 977 000 hectares in 2008 (55 percent of the plantation forest estate). There

Māmaku tree fern, Wellington City. Photo: Alan Reid.

are also 12 000 hectares of indigenous forest with FSC certification (in addition to an approved sustainable forest management plan).

In 2007, the New Zealand Forest Owners' Association (NZFOA) published *The New Zealand Environmental Code of Practice for Plantation Forestry* which replaces an earlier code. The new code includes "Industry Best Management Practices". The NZFOA recommends that their members, who own 80 percent of the plantation forest estate, adhere to the code's principles and practices.

FOREST ECOSYSTEM CARBON POOLS

New Zealand has established its Land Use and Carbon Analysis System for reporting carbon pools and fluxes. Carbon stocks in forests are estimated based on the four biomass pools defined by the Intergovernmental Panel on Climate Change (IPCC) in their Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF). These carbon pools are: above-ground biomass (AGB), below-ground biomass (BGB), coarse woody debris (CWD), and fine woody debris and litter (FWD).

A first LUCAS plot-based assessment of indigenous forests was completed from 2002 to 2007, although the current carbon estimates for plantation forests are based on information from the *National Exotic Forest Description.* The mid-point (2005) analysis estimated a total of 1271 million tonnes of carbon in indigenous forests and 189 million tonnes in plantation forests.

SOURCES OF INFORMATION

Key references are listed below, but additional references are provided in the chapters for each selected key indicator.

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CRITERION 1

Conservation of biological diversity

Forests, and particularly native forests, support a substantial proportion of the planet's biological diversity and terrestrial species. Biological diversity enables an ecosystem to respond to external influences, to recover after disturbances, and to maintain essential ecological processes.

Human activities and natural processes can impact adversely on biological diversity by altering and fragmenting habitats, introducing invasive species, or reducing the population or ranges of species. Conserving the diversity of organisms and their habitats supports forest ecosystems and their ability to function, reproduce, and remain productive.

TABLE 1.1: INDICATORS FOR CRITERION 1, QUALITY OF INFORMATION AND TRENDS

	CRITERION 1: CONSERVATION OF BIOLOGICAL DIVERSITY	QUALITY OF INFORMATION	TREND
	ECOSYSTEM DIVERSITY		
1.1.a	Area and percent of forest by forest ecosystems type, successional stage, age class, and forest ownership or tenure	L/M	▼
1.1.b	Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage	M	▲
1.1.c	Fragmentation of forests	M	?
	SPECIES DIVERSITY		
1.2.a	Number of native forest-associated species	L/M	▲
1.2.b	Number and status of native forest-associated species at risk, as determined by legislation or scientific assessment	L/M	▼
1.2.c	Status of on site and off site efforts focused on conservation of species diversity	L/M	▲
	GENETIC DIVERSITY		
1.3.a	Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes	L/M	?
1.3.b	Population levels of selected representative forest-associated species to described genetic diversity	L	?
1.3.c	Status of on site and off site efforts focused on conservation of genetic diversity	L/H	►



KEY

L = low
M = medium
H = high

Neutral ►
Positive ▲
Negative ▼
Insufficient data ?

NEW ZEALAND OVERVIEW

About 5 million hectares of the about 6.5 million hectares of indigenous forests remaining in New Zealand are managed within the Crown conservation estate by the Department of Conservation: for biodiversity conservation, natural heritage and recreation purposes. Lowland forests were the focus of historic clearance; these are poorly represented in the estate although there are some within private conservation areas. A significant increase in the network of protected lands occurred between 2000 and 2005, resulting from additional government funding of the Nature Heritage Fund, Ngā Whenua Rāhui and the Queen Elizabeth II National Trust. The area of indigenous forest that is legally protected has increased by 7 percent since 2003.

Indigenous forests display a wide range of biodiversity richness, reflecting an array of forest ecosystems across a broad range of altitudes and latitudes. There are an estimated 80 000 indigenous species in New Zealand of which almost 55 000 have been identified and about 30 000 have been scientifically named, described and classified.

The original absence of major mammalian predators left indigenous biodiversity vulnerable to the introduction of some exotic species during human settlement, particularly to terrestrial mammals. In addition, about 10 percent of the indigenous forest estate is in fragments smaller than 500 hectares (and 2 percent is in fragments smaller than 10 hectares), which may result in a higher risk of loss of species concentrated in these areas. Populations of 21 plant species in indigenous forests and shrublands are currently considered to be critical or endangered, with another 17 species identified as vulnerable.

Little information is available about genetic variation for the bulk of New Zealand's indigenous species. With most indigenous forest species occupying a small percentage of their original range, and with lack of gene flow across landscapes, many species will have reduced genetic diversity. There are perceptions that populations of some key tree species are declining, but research is too limited to draw inferences on this subject. A government-funded research programme directed at conserving genetic diversity in threatened species began in 2005.

Plantation forests provide additional habitat for some indigenous species. In addition, a breeding strategy for radiata pine has focused on both the improvement of planting stock and the retention of genetic variation.

Beech/podocarp forest, Aorere River, Golden Bay.

INDICATORS 1.1 ECOSYSTEM DIVERSITY

Maintenance of the variety and quality of forest ecosystems is necessary for the conservation of species. Without sufficient habitat size, adequate connectivity, necessary structural diversity and appropriate protection and management measures, species may decline and become vulnerable to extinction.

These indicators provide information on the areas and extent of ecosystem types, forests area under formal protection, and the effects of fragmentation.

Indicator 1.1.a Area and percent of forest by forest ecosystems type, successional stage, age class, and forest ownership or tenure

New Zealand has a total forest area of 8.3 million hectares. Of this, about 78 percent is indigenous forest, 22 percent plantation forest, and less than 1 percent mangroves. Plantation forest area has decreased about 0.5 percent from the last area reported (2001), and 3 percent since 2003. Private ownership of plantation forest has increased around 67 percent since 2003, as forest areas previously owned by public companies became privately owned. About 78 percent of the indigenous forest area is legally protected.

Quality of information: L/M **Progress against indicator:** ▼

RATIONALE

This indicator provides information on the areas and extent of forest ecosystem types, including successional stage, age class and the nature of tenure or ownership. The sustainability and stability of forest ecosystems may depend on their size and diversity. If these are not maintained, forest may become vulnerable to habitat degradation and loss. Tenures or ownership types may have a variety of management regimes associated with them – each with a different impact on biological diversity.

2008 COUNTRY REPORT

FOREST AREA BY FOREST TYPE

New Zealand's total forest area is 8.3 million hectares, which covers 31 percent of the land area. About 78 percent (6.5 million hectares) is indigenous forest comprising broadleaved, conifer and mixed species communities, such as beech-mixed and single species (25 percent), rimu-general hardwoods-beeches (7 percent), rimu-tawa (5 percent) (Table 1.2).

Plantation forests represent about 22 percent of the forest cover. Commercial plantation forests covered 1.79 million hectares as at April 2007 (Table 1.3): about 70 percent (by area) in the North Island and 30 percent in the South Island (MAF, 2008). Radiata pine is the dominant species, currently making up 89 percent of the plantation forest area (Table 1.3) and 19 percent of the total forest area (Table 1.2).

Other exotic species[1], such as Douglas-fir, cypress species, and broadleaved species, such as eucalypts represent about 8.3 percent of the plantation forest area (Table 1.3), and 1.9 percent of the total forest area (Table 1.2). Other planted hardwood species, such as willow and poplar adjacent to inland lakes and rivers, stands of exotic deciduous hardwoods such as oak, ash and elm, and other softwood species contribute about 2.4 percent of the plantation forest area (Table 1.3) and 0.5 percent of the total forest area (Table 1.2).

1 See Appendix 1 for a list of all common and botanical names of species mentioned in this document.

TABLE 1.2: FOREST AREA AND PERCENTAGES BY FOREST CLASSES (2004–2008)

FOREST	FOREST TYPE	AREA (000 HA)	% OF TOTAL FOREST AREA	% OF TOTAL LAND AREA
INDIGENOUS FOREST	Beech (mixed)	1 447	17.5	5.4
	Beech (single species)	710	8.6	2.7
	Rimu-General hardwoods-Beeches	562	6.8	2.1
	Rimu-Tawa	447	5.4	1.7
	Rimu-Tawa-Beeches	262	3.2	1.0
	General hardwoods	248	3.0	0.9
	Rimu-General hardwoods	202	2.4	0.8
	Highland softwoods-Beeches	193	2.3	0.7
	Tawa	185	2.2	0.7
	Kauri-Softwoods-hardwoods	133	1.6	0.5
	Lowland/Wetland/Steepland/Highland softwoods	127	1.5	0.5
	Podocarp-Hardwood-Beech	106	1.3	0.4
	Rimu-Matai-hardwoods	87	1.1	0.3
	General hardwoods-Beeches	82	1.0	0.3
	Softwoods	75	0.9	0.3
	Podocarp/hardwood forest/rata-kamahi hardwood	71	0.9	0.3
	Podocarps	50	0.6	0.2
	Tawa-Beeches	43	0.5	0.2
	Rimu-Taraire-Tawa	37	0.4	0.1
	Hardwood-Beech	18	0.2	0.1
	Lowland podocarp-hardwood	15	0.2	0.1
	Taraire-Tawa	9	0.1	0.0
	Kauri-softwoods-hardwoods-Beeches	8	0.1	0.0
	Lowland hardwood	4	0.0	0.0
	Kauri	2	0.0	0.0
	Upland podocarp-hardwood	1	0.0	0.0
	Unclassified	1 334	16.1	5.0
	Total indigenous forest	**6 457**	**75.7**	**24.1**
PLANTATION FOREST	Radiata pine	1 597	19.3	6.0
	Douglas-fir	113	1.4	0.4
	Eucalypts	29	0.4	0.1
	Cypress	8	0.1	0.0
	Other softwoods	27	0.3	0.1
	Other hardwoods	16	0.2	0.1
	Total plantation forest[1]	**1 790**	**21.6**	**6.7**
MANGROVES	Total mangroves	26	0.3	0.1
TOTAL FOREST		**8 273**	**100.0**	**30.9**

Note
1 Total area excludes an additional 36 000 hectares that have been harvested and await replanting.

Sources

Ministry for the Environment (2004) – Indigenous forest and mangroves.
Forest Service Maps Series (1999) – Indigenous forest classes.
Ministry of Agriculture and Forestry (2008) – Plantation forest.

The plantation forest area has decreased about 0.5 percent since the last report (from 1.8 million hectares in 2001) and 3 percent since 2003. In 2004, a new trend of not replanting forest after harvesting started on a larger scale. Historically, little conversion of plantation forest to other land use has occurred, however. The average new planting rate over the last 30 years has been 40 000 hectares per year. In the period 1992 to 1998, new planting rates were high (average 69 000 hectares per year) but since 1998 have declined. At about 2000 hectares in 2007, new planting is at its lowest level since 1945 (Ministry of Agriculture and Forestry, 2008).

Mangrove forests[2] are found on estuarine mudflats and tidal creeks in the upper North Island. These monospecific stands of *Avicenna marina var. resinifera* are of particular interest because of their close location within the southern limits of the world mangrove distribution (northward of latitude 38°S). This forest ecosystem currently represents about 0.3 percent of the total forest area. Mangrove forest coverage is increasing in New Zealand (Schwartz, 2003), largely due to increasing sedimentation and nutrient enrichment (National Institute of Water & Atmospheric Research, 2008).

2 New Zealand mangroves do not fit within the definition of forests under the Kyoto Protocol that New Zealand has adopted: "A minimum area of land of one hectare with tree crown cover of more than 30 percent with trees with the potential to reach a minimum height of 5 metres at maturity *in situ*".

FOREST AREA BY AGE CLASSES

Information on forest area by age classes is only available for plantation forests: these have an average forest stand age of 14.8 years (area-weighted); about 27 percent of the plantation forest area is between 11 and 15 years, and 21 percent between 6 and 10 years old (Ministry of Agriculture and Forestry, 2008).

FOREST AREA BY OWNERSHIP

In 2008, about 5 million hectares of indigenous forest (78 percent of total indigenous forest) were legally protected and managed on behalf of the Crown by the Department of Conservation. The remaining 1.5 million hectares are in private or Māori ownership.

By contrast, over 90 percent of the plantation forest estate is privately owned (see Table 1.4). The ownership

TABLE 1.3: PLANTATION FOREST AREA BY SPECIES (2007)

FOREST	SPECIES	AREA (000 HA)	% OF TOTAL PLANTATION FOREST AREA	% OF TOTAL LAND AREA
PLANTATION FOREST	Radiata pine	1 597	89.2	6.0
	Douglas-fir	113	6.3	0.4
	Eucalypts	29	1.6	0.1
	Cypresses	8	0.4	0.0
	Other softwoods	27	1.5	0.1
	Other hardwoods	16	0.9	0.1
Total		**1 790**	**100.0**	**6.7**

Source
Ministry of Agriculture and Forestry (2008).

of the plantation forests is based on forest ownership only. (The land under some of these forests is in Crown ownership). Plantation forests within the "Central Government" category are predominantly Crown-owned forests on Māori leasehold land managed by the Ministry of Agriculture and Forestry. Since 2003, significant changes in ownership have occurred, resulting in forest areas previously owned by public companies becoming privately owned (Ministry of Agriculture and Forestry, 2008).

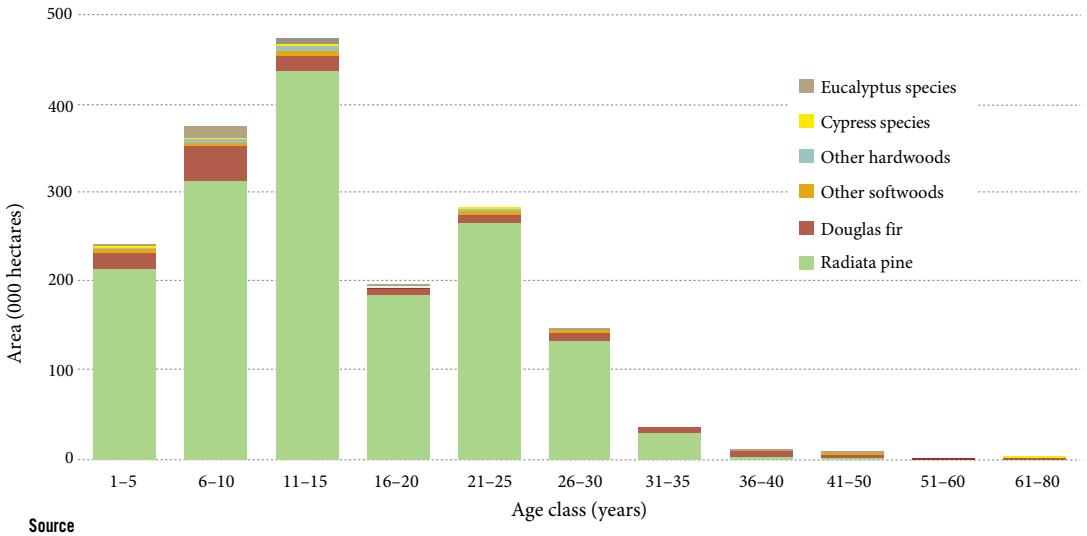
Treaty of Waitangi settlements are agreements between the Crown and Māori claimant groups to settle historical claims against the Crown. Claimants can negotiate a settlement in cash and/or assets. Crown plantation forest land is subject to Treaty claims and is used as part of some Treaty settlements. This will increase Māori forest land ownership in future years. Treaty claims have been lodged over all Crown forest lands, and it is expected that they will all be resolved in the near future. In 2001 it was estimated that when all Treaty claims are resolved Māori,

TABLE 1.4: PLANTATION FOREST AREA BY OWNERSHIP CATEGORY (2003 AND 2007)

OWNERSHIP CATEGORY	2003		2007	
	AREA (000 HA)	% OF TOTAL	AREA (000 HA)	% OF TOTAL
Registered public company	829	45.4	244	13.7
Privately owned	852	46.6	1 421	79.4
State-owned enterprise	42	2.3	32	1.8
Local government	58	3.2	56	3.1
Central government	45	2.5	37	2.1
Total	**1 827**	**100.0**	**1 790**	**100.0**

Sources
Ministry of Agriculture and Forestry (2004, 2008).

FIGURE 1.2: PLANTATION FOREST AREA BY AGE CLASS AND SPECIES (2007)



Source
Ministry of Agriculture and Forestry (2008).

could own up to 41 percent of the plantation forest land if not subsequently sold – as some of it has (Ministry of Agriculture and Forestry, 2001).

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Indicator 1.1.b Area and percent of forest in protected areas by forest ecosystem type, and by age class or successional stage

New Zealand has about 32 percent of its total land area legally protected. About 99 percent of the forests legally protected are indigenous forests. The indigenous forest area legally protected has increased about 7 percent from last area reported (2003).

Quality of information: M **Progress against indicator: ▲**

RATIONALE

This indicator provides information on the area and extent of forest by ecosystem type, age class or successional stage protected to safeguard biological diversity and representative examples of forest ecosystem types. This indicator will also help identify forest types of conservation value that are in need of protection. The level of formal protection given to forests is a reflection of the importance society places on their conservation.

2008 COUNTRY REPORT

FOREST AREA IN PROTECTED AREAS BY FOREST TYPE

Protected land areas are established under the principles of national legislation: Wildlife Act 1953; Reserves Act 1977; Queen Elizabeth the Second National Trust Act 1977; National Parks Act 1980; Conservation Act 1987; Crown Forest Assets Act 1989. The Department of Conservation (DOC) is the leading central government organisation in charge of conserving New Zealand's natural and historic heritage. The role of DOC, as defined by the Conservation Act 1987, is: *"…the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations".*

Currently, New Zealand has about 8.5 million hectares of legally protected land (32 percent of total land area). This area includes public conservation land managed by DOC and local government, as well as covenants with private owners under the Queen Elizabeth II (QEII) Trust, and Ngā Whenua Rāhui funds. DOC is currently developing the Natural Heritage Management System (NHMS). Part of its function will be to provide the processes to identify and prioritise under-represented ecosystems that need to

Coastal beech/podocarp/hardwood forest, Pororari River, Punakaiki, Westland. Photo: Ian Platt.

TABLE 1.5: FOREST AREA IN PROTECTED AREAS BY FOREST TYPE (2008)

FOREST	FOREST TYPE	AREA (000 HA)	% OF TOTAL FOREST IN DOC LAND	% OF TOTAL LAND AREA
INDIGENOUS FOREST	Beech (mixed)	1 299	25.7	4.9
	Beech (single species)	688	13.6	2.6
	Rimu-General hardwoods-Beeches	485	9.6	1.8
	Rimu-Tawa	326	6.5	1.2
	Rimu-Tawa-Beeches	168	3.3	0.6
	General hardwoods	162	3.2	0.6
	Rimu-General hardwoods	177	3.5	0.7
	Highland softwoods-Beeches	182	3.6	0.7
	Tawa	91	1.8	0.3
	Kauri-Softwoods-Hardwoods	80	1.6	0.3
	Lowland-Wetland-Stepland-Highland Softwoods	109	2.2	0.4
	Podocarp-Hardwood-Beech	104	2.1	0.4
	Rimu-Matai-Hardwoods	69	1.4	0.3
	General hardwoods-Beeches	64	1.3	0.2
	Softwoods	67	1.3	0.2
	Podocarp/Hardwood/Rata-Kamahi-Hardwood	62	1.2	0.2
	Podocarp	36	0.7	0.1
	Tawa-Beeches	16	0.3	0.1
	Rimu-Taraire-Tawa	26	0.5	0.1
	Hardwood-Beech	10	0.2	0.0
	Lowland podocarp-Hardwood	13	0.3	0.0
	Taraire-Tawa	5	0.1	0.0
	Kauri-Softwoods-Hardwoods-Beeches	6	0.1	0.0
	Lowland hardwood	2	0.0	0.0
	Kauri	2	0.0	0.0
	Upland podocarp-Hardwood	1	0.0	0.0
	Unclassified	754	14.9	2.8
	Total indigenous forest	**5 003**	**99.2**	**18.7**
PLANTATION FOREST	Radiata pine forest	23	0.5	0.1
	Other exotic species	5	0.1	0.0
	Deciduous hardwoods	10	0.2	0.0
	Total plantation forest	**38**	**0.8**	**0.1**
MANGROVES	**Total mangroves**	**2**	**0.0**	**0.0**
TOTAL FOREST WITHIN THE CONSERVATION ESTATE		5 045	100.0	18.8

Sources
Ministry for the Environment (2004) – Indigenous forest and mangroves.
Landcare Research (1999) – Indigenous forest classes.
Ministry of Agriculture and Forestry (2008) – Plantation forest.
Department of Conservation (2008b).

be integrated in the conservation network (Department of Conservation, 2008a).

The forest area within legally protected land is about 5.1 million hectares (61 percent of the total forest area), with around 5 million hectares (99 percent) being indigenous forest (Table 1.5). This represents about 78 percent of the total area of indigenous forest in New Zealand. This analysis shows an increase in the area of forest legally protected of about 7 percent from last report (4.6 million hectares).

Indigenous forest area within protected areas by International Union for Conservation of Nature (IUCN) categories was estimated through Geographic Information Systems (GIS) analysis for the years 2006 and 2008 (Table 1.6). This analysis was based on the DOC review of the application of the IUCN system for New Zealand protected areas categories, and by then aligning each national category with the nearest IUCN category based on objectives, management and IUCN guidelines (Department of Conservation, 2005). For both years, about 43 percent of the indigenous forest legally protected was within categories I to II – which have more strict management objectives – and 72 percent was within categories 1 to IV.

White pine (kahikatea), South Westland. Photo: Ian Platt.

FOREST AREA IN PROTECTED AREAS BY AGE CLASS OR SUCCESSIONAL STAGE

New Zealand does not have the data available to report on this part of the indicator.

TABLE 1.6: AREA OF INDIGENOUS FOREST WITHIN IUCN CATEGORIES (2006 AND 2008)

IUCN CATEGORY	INDIGENOUS FOREST AREA (000 HA)	
	2006	2008
Category IA: Strict Nature Reserve, Scientific Reserve	160	160
Category IB: Wilderness Area	37	37
Category II: National Park	1 947	1 947
Category III: Natural Monument	1 424	1 444
Category IV: Species Management Area	19	19
SUBTOTAL	3 587	3 607
Category V: Protected Landscape	4	4
Unclassified	1 404	1 392
Total	**4 995**	**5 003**

Sources
Ministry for the Environment (2004); Department of Conservation (2006, 2008b).

SOURCES OF INFORMATION

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Indicator 1.1.c Fragmentation of forests

About 90 percent of indigenous forest is fragmented in areas over 500 hectares, and 2 percent of indigenous forests is fragmented in areas less than 10 hectares.

Quality of information: M **Progress against indicator: ?**

RATIONALE

This indicator provides information on the extent to which forests are being fragmented over time by human activities and natural processes. Fragmentation may lead to the isolation and loss of species and gene pools, degraded habitat quality, and a reduction in the forest's ability to sustain the natural processes necessary to maintain ecosystem health.

2008 COUNTRY REPORT

Forest fragmentation affects and disrupts the spatial continuity of habitats, and occurs mainly as a consequence of human activities. Environmental conditions change within the fragments from the outside boundary to the inside, with edge areas more exposed to solar radiation and wind, having higher temperatures and drier conditions. Fragmentation can be quantified with some indices based on the number of fragments per area, mean fragment size, area-weighted average fragment size, proximity of fragments, and fractal dimension (fragment shape complexity).

The history of land conversion in New Zealand started with the early Māori and then European settlers. Before human settlement, indigenous forests covered around 85 percent of New Zealand's land area. Forests now cover around 31 percent of New Zealand, with about 24 percent in indigenous forest remaining. The indigenous forest areas were cleared in the past for agriculture, horticulture, plantation forestry and urban development (Ministry for the Environment, 2007).

Fragmentation of indigenous forests and mangroves was assessed using spatial analysis (the same approach

TABLE 1.7: AREA AND NUMBER OF FRAGMENTS BY SIZE CLASS (2002)

AREA CLASS (HA)	INDIGENOUS FOREST			MANGROVES			TOTAL AREA (000 HA)
	AREA (000 HA)	% OF FOREST	NO. OF FRAGMENTS	AREA (000 HA)	% OF FOREST	NO. OF FRAGMENTS	
≤10	125	2	50 015	3	12	790	128
>10, ≤50	166	3	8 174	8	31	349	174
>50, ≤100	86	1	1 291	5	19	78	91
>100, ≤500	259	4	1 259	7	27	39	266
>500	5 821	90	561	3	12	4	5 824
Total	**6 457**	**100**	**61 300**	**26**	**100**	**1 260**	**6 483**

Source
Ministry for the Environment (2004).

TABLE 1.8: AVERAGE FRAGMENT SIZE AREA AND EDGE-TO-AREA RATIO FOR INDIGENOUS FOREST BY REGIONS (2002)

REGION	AVERAGE FRAGMENT SIZE AREA (HA)	AVERAGE EDGE-TO-AREA RATIO (KM/KM^2)
Northland	20	1.67
Auckland	21	1.10
Waikato	196	0.83
Bay of Plenty	564	0.84
Gisborne	523	0.60
Taranaki	121	1.28
Hawkes Bay	240	0.62
Manawatu/Wanganui	236	0.90
Wellington	157	0.71
Tasman	713	1.27
Nelson	2 113	1.22
Marlborough	336	0.72
Canterbury	216	0.38
West Coast	690	1.36
Otago	542	0.36
Southland	391	0.93
New Zealand	**61**	**0.81**

Source
Ewers et al (2006) (based on Land Cover Database 2, 2001/2).

as undertaken for the 2003 Montreal Process country report). The number and areas of indigenous fragments indicate that about 90 percent of indigenous forest is fragmented in areas greater than 500 hectares, and around 2 percent in areas smaller than 10 hectares (Table 1.7).

Mangroves have a particular spatial distribution pattern related with tidal flooding (Hackwell, 1989). Therefore it is imprecise to describe fragmentation based only on spatial analysis and not focusing on any anthropogenic influences or natural disturbances such as erosion that could be affecting these ecosystems. As stated in Indicator 1.1.a, mangroves coverage in New Zealand is currently increasing. This local and possibly temporary phenomenon has potential to change with catchments and coastline development (Schwarz, 2003), and there is currently some indication that their habitats are threatened.

Fragment area is inversely associated with the magnitude of species loss. Based on this relationship it could be concluded from Table 1.7 that about 10 percent of the indigenous forest area has a higher risk of species loss. Other factors to measure fragmentation are presented in

Indigenous forest remnants and poplar/willow erosion control planting on farmland, East Coast of the North Island. Photo: Alan Reid.

Table 1.8. A higher edge-to-area ratio is an indicator of complex fragment shapes with an increased amount of edge-affected habitat, and associated reduction in core area. Regions with areas of smaller fragment size and/or higher average edge-to-area ratio could have a higher risk of habitat and species loss.

Another approach to analysis of this indicator is Morphological Spatial Pattern Analysis (MSPA) of New Zealand's indigenous forest fragmentation. This records 74 percent of seven million hectares as "core" (forest interior greater than 100 metres from an edge). Overall, 83 percent or 4.2 million hectares of forest protected as public conservation land is core, whereas 49 percent or 900 000 hectares of other indigenous forest is core. This indicates greater viability of forests protected as public conservation lands. The edge-to-core ratio of all indigenous forest is 1:7, but it is 1:10 in areas protected as public conservation land. In addition, less than 2 percent of indigenous forest New Zealand-wide forms corridors between core areas of forest; this illustrates their importance in helping maintain viability of forest species.

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Mixed plantation and remnant indigenous forest, East Coast of the North Island. Photo: Alan Reid.

INDICATORS 1.2 SPECIES DIVERSITY

The greatest and most readily recognisable aspect of biological diversity is the variety of species and their population levels. A key objective for the conservation of biological diversity is to slow down the rate of population decline, and species depletion and extinction due to human factors. Changes in species population levels and distribution may also provide an early warning of changes in ecosystem stability and resilience, as will increases in the number of invasive, exotic forest-associated species.

Comment

The reporting below on the group of indicators under species diversity focuses on New Zealand's indigenous forests. Measuring and monitoring biodiversity are required to assess the status of biodiversity in ecosystems, determine any appropriate management actions, and monitor progress.

Indicator 1.2.a Number of native forest-associated species

New Zealand's indigenous forests are characterised in some areas by conifer-dominant canopies and in others by hardwoods. The indigenous vertebrate fauna is uniquely bird-dominated. Most of the vertebrate and larger plant taxa have been described, but around 50 percent of the invertebrate fauna is yet to be described. Current research aims to provide more information about changes in species composition within forests, with further aims of better understanding the extent of historic biodiversity changes and ongoing impacts, and to work towards ecological restoration of forests.

Quality of information: L/M **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the health of forest ecosystems through the number of native forest-associated species. Knowledge of the number of native forest-associated species highlights the importance of certain forest types in meeting conservation objectives and in understanding the relationships species have within ecosystems. The loss or addition of species in an ecosystem can provide valuable insights into the overall health and productivity of that system.

2008 COUNTRY REPORT

New Zealand indigenous forests are largely conserved from clearance or significant modification under a statutory framework that applies to forests on both private and public lands. The conservation of remaining indigenous forest is a core objective of Government policy as well as a suite of private initiatives and private/public accords. The New Zealand Biodiversity Strategy has a core objective of reversing the decline of indigenous biodiversity. The decline is largely due to impacts of introduced pest and weeds that are well established in New Zealand.

Measuring and monitoring biodiversity changes across the New Zealand forests, and thereby providing a baseline for assessing progress in biodiversity recovery, are major tasks. Good mapping tools are available and understanding has improved of New Zealand ecosystems, and of what methods are required to measure and monitor recovery across extensive areas of the country's forested ecosystems.

The National Heritage Management System currently being implemented by the Department of Conservation is providing information that will form the basis of a management planning and national biodiversity reporting system. Over time, this system will enable more effective reporting on the outcomes of restoration and recovery programmes, as well as on the broader status of biodiversity in forest ecosystems. It will also assist in

future reporting on the overall status of New Zealand's indigenous forests.

New Zealand indigenous forests display a wide range of biodiversity richness, reflecting an array of forest ecosystems across a broad altitudinal and latitudinal range.

Overall, the New Zealand indigenous forest biodiversity displays characteristics that set it apart from forests in other temperate countries. These characteristics reflect physical and biotic factors and also the sensitivities of these forest ecosystems to modification from human settlement in this country.

Physically, New Zealand has been long isolated from major landmasses; it is geologically young showing a steep and rugged geography that experiences frequent tectonic disturbances. The isolation, climate and geography shaped a strongly endemic biota, with an absence of terrestrial mammals but dominated by avifauna, and by slow-growing evergreen forests without any major influence from natural fire.

The vulnerable New Zealand ecosystems incurred major impacts from human settlement through hunting, forest clearance and the introduction of pest and weed species. Introduced species included mammals (predators and herbivore animals) against which the indigenous forest species had no natural defence mechanisms. Major impacts also arose from forest clearance and the establishment of production landscapes dominated by introduced species. Notwithstanding these effects, much of the forest landscape and species composition of New Zealand still bears a pre-human imprint.

Knowledge of pre-human forest biodiversity, including the number of species present, is the key to better understanding the unique features of our indigenous forests; these features are in turn important for guiding contemporary scientific research, assessment and monitoring.

However, such knowledge is limited by the fact that no comprehensive or systematic description of species across all taxa was gathered at critical times in the past – that is, before the indigenous forests were subject to the major impacts that caused their species numbers and relative balance in ecosystems to change significantly. Higher-taxa plant species and the avifauna were well described;

TABLE 1.9: NUMBER OF INDIGENOUS SPECIES, DESCRIBED SPECIES AND INTRODUCED SPECIES

SPECIES	ESTIMATED NUMBER OF INDIGENOUS SPECIES	NUMBER OF SPECIES THAT HAVE BEEN DESCRIBED	PERCENTAGE OF DESCRIBED SPECIES THAT IS ENDEMIC	DESCRIBED SPECIES KNOWN TO BE THREATENED	NUMBER OF INTRODUCED SPECIES IN THE WILD
Mosses, liverworts and hornworts	c. 1 100	c. 1 060	20–40	c. 85	13
Ferns and fern allies	c. 200	189	46	at least 15	26
Conifers	20	20	100	0	28
Flowering plants	c. 2 100	1 813	84	c. 180	1842
Invertebrates	c. 52 000	c. 20 500	?	c. 200	c. 2 200
Amphibians	4	4	100	4	3
Reptiles	61	61	100	25	1
Terrestrial and freshwater birds	88	88	57	37	34
Terrestrial mammals	2	2	100	2	34

Source
Ministry for the Environment (1997).

but for many others – notably invertebrate species – descriptions are far from comprehensive.

Table 1.9 shows species numbers by major taxa, the level of species description, degree of endemism, numbers known to be under threat and number of introduced species. The last category illustrates the extent of introduced species. Larger vascular plants have economic importance in New Zealand for forestry, horticulture and farming. Introduced species, notably mammals, are also important in agriculture, but include pest species that are a major threat to indigenous plant and fauna species.

The information in Table 1.9 is amalgamated from field research data and surveys over many years, by different agencies for a variety of objectives.

A relevant research project, currently funded by the national Cross Departmental Research Pool, is run by Landcare Research Ltd and the Department of Conservation. The research is investigating the extent to which indicator groups of species for which data are available, can be used to measure species changes in whole ecosystems.

This work is drawing on new measurements as well as historic field data. The latter are from early studies on the palatability of species that can indicate their vulnerability to introduced herbivores – and therefore explain changes in plant species abundance. Palatability was a key focus of early work by forest ecologists seeking to assess forest condition.

The current work is based on 27 identified indigenous forest plant species that are selected on the basis of measured data from plots in the New Zealand Land Use and Carbon Analysis System. The LUCAS data are derived from unbiased measurements of permanent sample plots and provide the core source. Additional information on past changes in New Zealand indigenous forests comes from National Vegetation Survey plots that cover about 50 years of measurements, but are based on a variety of past research goals and different methods of plot location.

Introduced pests, including ungulates and the Australian brushtail possum (*Trichosurus vulpecula*), continue to exert a major adverse affect on forest health. It is important to develop methods for determining the influences of pests on plant populations and size distributions, and how to distinguish these from climatic or tectonic influences.

Work is continuing to refine predictive models that cover species size class variation, changes over time, and other variables such as elevation, latitude and rainfall. All these important variables reflect the range of forest ecosystems within New Zealand.

The current research may help substantiate the extent of modification of forested ecosystems in New Zealand. It will also aid in better understanding the changes and resilience of species within ecosystems.

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Podocarp/hardwood beech forest, Westhaven Inlet, Golden Bay. Photo: Ian Platt.

Indicator 1.2.b Number and status of native forest associated species at risk, as determined by legislation or scientific assessment

Information about species continues to expand, as does that on threat status. In general, higher plant species are well described with fewer species at risk. Other taxa, especially invertebrates, are relatively poorly described and some groups have a high number of species at risk.

Quality of information: L/M **Progress against indicator:** ▼

RATIONALE

This indicator provides information on the number and status of forest-associated species at risk or in serious decline. As a result, these species may require specific action or intervention to ensure their survival. The number of species at risk and their status is a measure of the health of forest ecosystems and their ability to support species diversity.

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Since the 2003 Montreal Process country report, work has been continuing on gathering data about species and describing their threat status. More species have been more extensively described and the information about threat status continues to expand. An analysis has just been published (de Lange et al, 2009) on the threat status nationally, of vascular plant species that are either threatened or data-deficient. It records an increase over five years in the number of taxa listed as threatened and at risk, and a decrease in the number of taxa regarded as data deficient. Forest species comprise 17 percent of this national list. Other broad taxa, such as bats and frogs, show no change. Some taxa, especially invertebrates, show substantial increases in species numbers that are threatened and data-deficient.

The status of selected indigenous forest species is reported in *Environment New Zealand 2007* (Ministry for the Environment, 2007), and in a review of the first five years of the *2000 New Zealand Biodiversity Strategy* (Green and Clarkson, 2005). Both reports focus broadly on indigenous species habitats, many of which are forested (with the exception of specific ecosystems such as alpine herbfields, the coastal zone and other open lands). Forested ecosystems dominated New Zealand's pre-human land cover.

The reports provide information about the number of species as well as about specific habitats and ecosystems that are under threat, including forest ecosystems. The main causes of species loss or threat are those that accompanied human settlement of New Zealand, as reported above for Indicator1.2.a. Large-scale forest clearance is no longer a major cause of species loss. However, fragmentation and degradation of remnant forests combined with the impacts of invasive introduced weed and pest species remain key causes of species loss. This occurs especially in the relatively small areas of remnant indigenous forests in lowland areas.

Young kauri regenerating on forest floor. Photo: Alan Reid.

Indigenous forest-associated species at risk include plant and animal species. Available information on the latter mostly applies to avifauna. Risks for animal species include predation and loss of habitat, including loss of forest cover and food sources. Plants are subject to competition from invasive weed species, browsing or physical damage, loss of soil or other adverse habitat conditions through clearance, fragmentation and degradation. There is also evidence of losses through lack of seed dispersal and pollination required from birds.

The Ministry of the Environment's 1997 *State of the Environment Report* reported comprehensively on the number of threatened species, habitats with endangered species and the type of habitats. The report listed 62 species as the most threatened plants in all habitat types including a high number of small plants.

It noted that a list compiled by the Department of Conservation included nearly 200 species and 20 sub-species of vascular plants (about 10 percent of the total) as being threatened.

The 1997 report noted that about 9 percent of threatened plant species are in forested habitats. The number and type of forest habitats with threatened plant species is set out in Table 1.10.

Other key findings of the 1997 report were:

- that despite historic exploitative logging of forests, none of the timber-producing species are under threat;
- most species on the list are small herbs, grasses and species with limited distributions;
- about 2000 vascular plants were described with 200–300 more awaiting formal identification.

New Zealand is distinctive in having a low threatened vascular plant biodiversity by international standards, although there is high endemism; 18 species of plants are culturally important to iwi[1] (across all habitats and including some forest species) and are rare in some iwi areas, although some are common nationally. Five of these are species introduced to New Zealand by Māori, centuries before the arrival of European colonists.

Threatened species lists have continued to be compiled and updated. There has also been associated work on plant conservation and management programs. The Department of Conservation published a threat classification manual in 2002 (Molloy et al, 2002) which was the basis for further work on classifying the threat status of species. This includes updates by Hitchmough et al (2007) and the most recent analysis available (de Lange et al, 2009) which lists 17 percent of the threatened vascular plant species as being primarily forest species.

Species under threat are documented in lists prepared and published by the Department of Conservation.

1 An iwi is a Māori tribe that traces its collective origin to a founding ancestor or the arrival in New Zealand or a particular waka (canoe). See http://www.aucklandcitylibraries.com/getdoc/e7ec0fb3-a106-4c69-90c2-52e7785cb854/iwi.aspx

TABLE 1.10: NUMBER OF FOREST HABITATS WITH THREATENED PLANTS

HABITAT	EXTINCT	CRITICAL	ENDANGERED	VULNERABLE	RARE	INSUFFICIENT KNOWLEDGE	TOTAL
Coastal lowland forest and tall scrub	2	3	6	7	8	2	28
Inland forest	0	0	3	2	1	0	6
Inland scrub	1	2	7	8	3	1	22

Source
Ministry for the Environment (1997).

Updatable threatened species lists are also maintained and published by the New Zealand Plant Conservation Network (NZPCN). This network promotes collaborative efforts around species listing and conservation. The species lists are available on the websites of the Department of Conservation, the Ministry for the Environment and NZPCN at:

http://www.doc.govt.nz/upload/documents/science-and-technical/sap236.pdf
http://www.mfe.govt.nz/publications/ser/enz07-dec07/index.html
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Young second generation silver beech production forest, Southland.

Indicator 1.2.c Status of on site and off site efforts focused on conservation of species diversity

A number of government and other initiatives are aimed at informing, and providing for, the conservation of species. The efforts reflect growing public awareness and involvement; and include private initiatives to protect habitats and assist with species recovery.

Quality of information: L/M **Progress against indicator:** ▲

RATIONALE

This indicator provides information that describes on site (or in situ) and off site (or ex situ) efforts to conserve species diversity. Some forest species and habitats may have declined to such an extent that intervention is required to safeguard them for the future.

2008 COUNTRY REPORT

The Conservation Act 1987 and Resource Management Act 1991 (RMA) represent the main statutory and policy frameworks for assessing and managing species loss in New Zealand. The RMA provides a structure for sustainable management of natural and physical resources across all land tenures. Local government (regional and district/city councils) implement the RMA through regional and district plans (see Indicator 7.1.b).

The Conservation Act is the principal statute governing legal reservation and conservation management of public lands; it is administered by the Department of Conservation.

Through New Zealand Biodiversity Strategy funding, the Department of Conservation undertakes recovery programmes for species that require specific conservation management beyond simply re-establishing them within forest ecosystems. This work is focused on enhancing the recovery of threatened indigenous plant and animal species in coastal, land and freshwater ecosystems. This is achieved through intensive management of threatened species and of the threats they face. DOC has also developed a species optimisation programme: as part of the Natural Heritage Management System, this will enable prioritisation of effort to maximise species recovery for a given expenditure.

In April 2007 the Government published a *Statement of National Priorities for the Protection of Rare and Threatened Indigenous Biodiversity on Private Land*. This sets out national priorities based on recent research and mapping of New Zealand ecosystems under the Land Environments of New Zealand (LENZ) program. The statement provides guidance to councils and landowners, on ecosystems that have been identified through LENZ as having less than 20 percent of the original indigenous vegetative cover remaining, and/or specific coastal and wetland sites, rare ecosystems and those containing endangered species.

The following initiatives that contribute funding and practical steps in conservation – including raising public awareness about reversing decline in biodiversity – were reported in the 2005 review of the *2000 New Zealand Biodiversity Strategy* (Green and Clarkson, 2005):

- There has been a significant increase to the network of protected lands as a direct result of extra funding to the Nature Heritage Fund, Ngā Whenua Rāhui and the Queen Elizabeth II National Trust.
- "Sympathetic management" is the biodiversity

component of sustainable land management: that is, managing productive lands in a way that recognises or supports the needs of indigenous biodiversity. This was not a priority objective, but there has been substantial progress based on funding support from sources such as the Sustainable Management Fund (SMF) and the Sustainable Farming Fund (SFF). For example, the NZ Landcare Trust, with Ministry for the Environment funding, has 187 Landcare groups encouraging sustainable land management that often includes initiatives to assist indigenous biodiversity.

› There are now more "mainland islands" – where land areas are either enclosed by pest-proof fencing or maintained under intensive pest control, and managed to rehabilitate indigenous vegetation and associated fauna. A number of these, such as the Karori Wildlife Sanctuary "Zealandia" in Wellington, are adjacent to urban areas and attract strong local public support while also serving as key education resources.

› To date, 637 453 hectares of forest have been reserved explicitly for ecosystem and species conservation or recovery. These reserves are listed in Table 1.11 by the organisation responsible and purpose.

LAND ENVIRONMENTS OF NEW ZEALAND (LENZ)

Land Environments of New Zealand is a significant tool with national coverage based on modern mapping and photographic data. This environmental classification is intended to underpin a range of conservation and resource management issues. LENZ was originally envisioned as a framework for conservation management that would take advantage of the natural relationship between the environment and species distributions. Rather than occurring randomly, species tend to occur in areas having similar environmental conditions. As a consequence, similar environments tend to support similar groups of plants and animals, provided they have not been substantially modified by human activity.

LENZ capitalises on the species-environment relationships by identifying climatic and landform factors that are likely to influence the distribution of species. The system uses these factors to define a landscape classification, grouping sites with similar environmental conditions. This classification can then be used to indicate sites that are likely to have similar potential ecosystem character: not necessarily the same in all respects but likely to have similar groups of species, and similar biological interactions and processes.

Mid 2004, Landcare Research completed work for the Ministry for the Environment, Department of

Regenerating indigenous forest, Mana Island, Kapiti Coast. Photo: Alan Reid.

Conservation, and Local Government New Zealand on the national status of legal protection and condition. The work compiled a national dataset of legal protection that included Crown conservation estate, Ngā Whenua Rāhui covenants, Nature Heritage Fund covenants, and Queen Elizabeth II National Trust covenants. The work used Land Cover Database 1 (LCDB 2 was not yet available) as a surrogate for condition. The work reported level of protection and condition by region and by LENZ Level II. An update to that first report is currently in progress.

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TABLE 1.11: SPECIALISED RESERVES

ORGANISATION	AREA (HA)	PURPOSE/TYPE OF RESERVE
Ngā Whenua Rāhui	c. 184 000	Protection of indigenous ecosystems on Māori land
Nature Heritage Fund	339 528	Protection of indigenous ecosystems that represent the full range of natural diversity originally present in the New Zealand landscape
QEII National Trust	106 472	Land Reserve Covenants between the QEII Trust and private landowners
Special purpose sanctuaries	4 716	In situ protection of rare or endangered species, special habitats or ecosystems
Other private reserves	2 737	Reserves on privately owned land for a range of purposes
Total	**637 453**	

Source
Department of Conservation (2009).

INDICATORS 1.3 GENETIC DIVERSITY

Genetic diversity is the variation of genes within populations and species. As the ultimate source of biological diversity at all levels, it is important for the functioning of healthy forest ecosystems. Threats to gene pools come from climate change, catastrophic events, and human activities and pressures.

Loss of genetic variation reduces the ability of species to adapt to environmental change; and for society to maximise the potential benefits available from forest species – for example, for medicines and other bio-resources. High levels of genetic diversity within populations are usually a measure of their greater potential for survival. The loss of genetic variation within species also results in forest ecosystems that are less resilient to change.

Indicator 1.3.a Number and geographic distribution of forest-associated species at risk of losing genetic variation and locally adapted genotypes

Details are not available on genetic variation for most of New Zealand's indigenous forest species. The small population size of many of the threatened indigenous forest species and lack of their gene flow across landscapes will have greatly reduced genetic diversity in many species as a result. Radiata pine plantings have retained genetic variation.

Quality of information: L/M **Progress against indicator: ?**

RATIONALE

This indicator provides information on the number and distribution of forest-associated species at risk of losing genetic variation across their population. This erosion in genetic variation makes species less able to adapt to environmental change and more vulnerable to extinction. Some local populations with unique gene pools may also risk being swamped by larger populations introduced intentionally, by accident, or by natural processes.

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INDIGENOUS SPECIES

Information on the genetic attributes of the large majority of New Zealand's indigenous forest species is lacking.

There are 970 taxonomically determinate threatened and uncommon plants in New Zealand. With respect to major habitats, 157 are indigenous forest plants and 108 are indigenous scrub plants (de Lange et al, 2004). The size of many of these plant populations is small and they lack contemporary gene flow across human-dominated landscapes; hence the genetic diversity of many species is greatly reduced. Some species may be particularly vulnerable to genetic factors due to their reproductive strategies, demographic history, or role within an ecosystem (Landcare Research, undated).

Isozyme[1] studies undertaken on indigenous tree species show low levels of genetic variability, and an absence of population differentiation. Allozyme studies on six indigenous trees species found very low levels of polymorphism and allelic richness. A suggested explanation for the low genetic diversity is the generation of genetic bottlenecks due to range contractions and population reductions, in response to glacial episodes during the Pleistocene (Hawkins and Sweet, 1992; Haase 1992a, 1992b, in Young et al, 2001). However, *Nothofagus* species, whose ranges are extensive, also have low genetic variability.

1 Isozymes are enzymes that perform the same function, but which are coded for by genes at different loci. Allozymes are variant forms of an enzyme that are coded for by different alleles at the same locus (Wikipedia).

A more recent allozyme study was conducted on a seventh tree species that has suffered dramatic range reduction, the pōhutukawa. By contrast, this species was found to be genetically diverse, although there was variability (some small and isolated populations had low diversity). Polymorphism was three times higher than the average for the other indigenous tree species studied, and average allelic richness was twice as high. The differences in genetic variability for pōhutukawa compared to the other six species may result from differences in species biology, evolutionary history, and/or biogeography (Young et al, 2001).

RADIATA PINE

As radiata pine dominates plantation forests, retaining its genetic diversity is important. This is achieved through including a number of unrelated parent clones in the seed production population (Burdon, 1995), and underpinning the seed production population by a larger, more genetically diverse breeding population (Burdon, 2001).

Eucalyptus plantation.

Clonal forestry accounts for about 9 percent of tree stock sales for plantation forests, but such sales are expected to increase in the future. This will increase the risk of reduction in genetic diversity. However, "there is little evidence that forests utilising monoclonal blocks of several different clones must be avoided on grounds of risk of crop failure, provided that a number of clones are used for each year's planting" (Sorensson and Shelbourne, 2005).

OTHER EXOTIC SPECIES

Because radiata pine dominates New Zealand plantation forestry, other exotic species have not been subject to intensive breeding programmes. A recent interest in redwoods focuses on planting stock produced from tissue culture: redwoods produce few seeds and production from cuttings is unreliable. Cultivars are selected from outstanding trees in New Zealand and California (The New Zealand Redwood Company, undated).

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Southern rata forest, Fox Glacier, South Westland. Photo: Ian Platt.

Indicator 1.3.b Population levels of selected representative forest-associated species to describe genetic diversity

Most indigenous forest species occupy a small proportion of their original ranges and there is a widespread perception that populations of some key tree species are declining. The limited research and available data constrain the inferences that can be objectively drawn.

Quality of information: L **Progress against indicator: ?**

RATIONALE

This indicator provides information on the population status of selected forest-associated species that are considered to reflect the genetic diversity present in forest ecosystems. Some forest species support or rely heavily on particular forest structures, patterns, associations and processes and can therefore be used to describe the status of genetic diversity in forests as a whole.

2008 COUNTRY REPORT

Most indigenous forest species occupy a small proportion of their former range, owing to the large-scale forest clearance in New Zealand following original Māori settlement and subsequent European settlement in the 19th century. Exceptions to this are the *Nothofagus* forests in the South Island, that still occur over a large part of their original range.

Allen et al (2002) noted the widespread perception among managers of the indigenous conservation forests that populations of key tree species are declining. These authors present case studies on what is known about the demographic processes. The species[1] covered are:

- kamahi;
- southern rata;
- northern rata;
- hinau;
- red beech;
- pahautea;
- Hall's tōtara.

The principal demographic processes affecting population levels that are considered are: flowering; pollination; seeding; dispersal; establishment; vegetative reproduction; competitive interactions; and mortality.

These processes are in turn influenced by:

- disturbance (changes in biomass of number of trees);
- herbivory (level of defoliation, individual height growth);
- species effects (litter quality);
- climate (temperature, precipitation);
- soil (texture, N-cation availability);
- dispersal (seed dispersal, available regeneration niches);
- time (tree age, relative biomass).

Allen et al (2002) discussed what is known about the vulnerability of the key tree species, but noted that data are often from limited time frames and few sites; these factors constrained the inferences that can be made.

SOURCES OF INFORMATION

Allen, RB; Rogers, GM; Stewart, GH (2002) Maintenance of key tree species. *Science for Conservation* 190. Department of Conservation; Wellington.

1 See Appendix 1 for a list of all common and botanical names of species mentioned in this document

Indicator 1.3.c Status of on site and off site efforts focused on conservation of genetic diversity

A government-funded research programme directed at conserving genetic diversity in threatened indigenous species (not just forest species) has commenced. A radiata pine breeding strategy focuses on maintaining genetic variability in addition to improving the genetic quality of planting stock.

Quality of information: L/H **Progress against indicator:** ▶

RATIONALE

This indicator provides information that describes on site (or in situ) and off site (or ex situ) efforts to conserve genetic diversity within species. Some species have suffered from a loss of genetic variability due to population decline and a reduction in their former range and distribution. Continued loss of genetic variability will threaten the viability of these species and may accelerate a decline that may lead ultimately to extinction.

2008 COUNTRY REPORT

INDIGENOUS SPECIES

Landcare Research has an eight-year government-funded research programme on *Reducing Extinction Risk by Sustaining Genetic Diversity*. The programme began in 2005 and "aims to develop a framework for identifying and conserving genetic diversity in threatened indigenous species in order to reduce the risk of further genetic loss and species extinction."

The programme will:

- identify species likely to be at risk from genetic factors;
- examine relationships between the genetic diversity and key demographic factors that influence the persistence of populations;
- determine the level of relevant genetic variation necessary to maintain population viability;
- generate management guidelines that maximise the probability of population viability and long-term evolutionary potential in plant and animal species with varied ecological attributes.

The three core research areas are biodiversity and conservation, molecular systematics, and biosecurity. Within the biodiversity and conservation research area, current research projects are:

- conservation genetics of threatened New Zealand plants;
- conservation genetics of New Zealand indigenous vertebrates;
- safeguarding maximal extant genetic variation;
- conservation and population genetics of terrestrial invertebrates;
- reproductive technologies for conservation of indigenous frogs and lizards.

Planting indigenous trees as part of a community-based conservation project. Photo: Nga Uruora.

This research aims to develop a framework for identifying and conserving genetic diversity in threatened indigenous plants. It does so with the aim to reduce further allelic losses and decrease the risks of species extinction (Landcare Research, undated).

Initiatives focused at the conservation of species diversity (see Indicator 1.2.c) are also relevant to the on site conservation of genetic diversity. Activities to re-establish indigenous vegetation now commonly focus on "eco-sourcing" (sourcing local plants for local plantings) to ensure retention of the genetic character of local populations. See Wellington Botanical Society (undated) for an example.

RADIATA PINE

A radiata pine breeding strategy has been in place since 1987 under the auspices of the various forest research and industry co-operatives. The strategy's objectives focus on both the delivery of genetically improved planting stock and the maintenance of long-term genetic variability.

It would be possible to introduce a code of practice for ensuring that plantations are established using effective numbers of clones or effective numbers of orchard parents. This has been raised by Burdon (2001) and by Burdon and Aimers-Halliday (2003), but such a code has not eventuated. The latter publication proposes at least 20 clones in a five-year age cohort, or at least 16 unrelated seedling parents, as a guide for a major forest estate unit.

Pinus radiata plantations, Marlborough. Photo: Ian Platt.

SOURCES OF INFORMATION

Burdon, R D (2001) Species diversification, genetic management and genetic engineering, In Bigsby, H (ed) *Assessment and Management of Forest Investment Risks.* New Zealand Institute of Forestry; Christchurch.

Burdon, R D; Aimers-Halliday, J (2003) Risk management for clonal forestry with *Pinus radiata* – analysis and review. 1: Strategic issues and risk spread, *New Zealand Journal of Forestry Science* 33(2): 156–180.

Landcare Research (undated) *Reduced extinction risk by sustaining genetic diversity.* http://www.landcareresearch.co.nz/research/obi.asp?Proj_Collab_ID=24

Wellington Botanical Society (undated) *Eco-sourcing – it's in the genes (Otari-Wilton's Bush).* http://wellingtonbotsoc.wellington.net.nz/articles/2007/Eco-sourcing-Otari.html

FURTHER READING

Jamieson, I G (2009) Loss of genetic diversity and inbreeding in New Zealand's threatened bird species. *Science for Conservation* 293, Department of Conservation; Wellington.

CRITERION 2

Maintenance of productive capacity of forest ecosystems

Many communities depend on forests directly or indirectly for a wide range of forest-based goods and services. The sustainable provision of these services is clearly linked to the productive capacity of the forest. If this capacity is exceeded there is the risk of ecosystem decline and collapse.

For forests to be sustainable it is necessary to understand the levels at which goods and services may be extracted or used without undermining the functioning of forest ecosystems and processes. The nature of goods and services provided by forest's change over time due to social and economic trends, and technological developments. Change in the productive capacity of forests may be a signal of unsound forest management practices or other agents that are affecting forest ecosystems in some way.

TABLE 2.1: INDICATORS FOR CRITERION 2, QUALITY OF INFORMATION AND TRENDS

CRITERION 2: MAINTENANCE OF PRODUCTIVE CAPACITY OF FOREST ECOSYSTEMS		QUALITY OF NFORMATION	TREND
2.a	Area and percent of forest land and net area of forest land available for wood production	H	▶
2.b	Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production	M/H	▲
2.c	Area, percent and growing stock of plantations and native and exotic species	L/H	▶
2.d	Annual harvest of wood products by volume and as a percentage of net growth or sustained yield	H/M	▶
2.e	Annual harvest of non-wood forest products	L/M	▲

KEY

L = low	Neutral	▶
M = medium	Positive	▲
H = high	Negative	▼
	Insufficient data	?



NEW ZEALAND OVERVIEW

The total forest area of 1.9 million hectares that is available for wood production is dominated by the plantation forest estate which contributes 1.8 million hectares. While there has been a 3 percent decrease in the area of plantation forests from 2003 to 2007, the estimated standing volume has increased by 9 percent to 434 million cubic metres – a result of the increasing area-weighted average age.

Radiata pine accounts for 89 percent of the plantation forest estate (by area); the next most common species is Douglas-fir at 6 percent. The current harvest (year ended March 2008) from plantation forests was 20.4 million cubic metres, well below the forecast long-term sustainable harvest of about 30 million cubic metres per year.

The area of indigenous forest available for wood production under approved plans and permits has almost doubled between 2003 and 2007, but the total area remains small at 114 000 hectares. Only about 18 000 cubic metres are harvested annually from this resource. There is a very small area of indigenous plantation forests, but no current inventory information is available for this.

The non-wood forest products industries are not well developed in New Zealand. On a national basis, trapping and hunting of possums and deer for pelts, fibre and meat, and the production of honey, dominate. The number of animals trapped and hunted commercially varies considerably over time in accordance with market conditions. Regionally, the harvesting and exporting of sphagnum moss are significant.

New non-wood forest product industries are slowly developing, based on the use of indigenous plant extracts for skincare and medicinal products, and on the introduction of edible mycorrhizal mushrooms and crops such as ginseng into plantation forests. Māori also traditionally harvest medicinal herbs.

Indicator 2.a Area and percent of forest land and net area of forest land available for wood production

There has been no significant change since 2003 in the total area of forest land or the area available for wood production. Within the latter, a small increase in the available area of indigenous forest land has been offset by a small decrease in the area of plantation forest land.

Quality of information: H **Progress against indicator:** ▶

RATIONALE

This indicator measures the availability of forestland for wood production compared with the total forest area of a country. It provides information that will help assess the capacity of forests to produce wood to meet society's needs.

2008 COUNTRY REPORT

About 8.3 million hectares (or 31 percent) of New Zealand's total land area of 26.8 million hectares have forest cover. With the exception of a small area primarily established to protect highly erodible soils, all reported plantation forests are considered to be available for wood production. Only a small percentage of the indigenous forests (all in private and Māori ownership) is available for wood production, see Table 2.2.

The *National Exotic Forest Description* from which the plantation forest areas are reported (see Ministry of Agriculture and Forestry, 2004, 2008a), records the net stock forest area. This is described as the forest area occupied by trees and excluding mappable gaps such as landings, roads and other unstocked areas. The total available plantation forest area for wood production includes the area awaiting restocking after harvest.

From 2004 there has been annual net deforestation in the plantation forest estate: that is, deforestation has exceeded new planting, and the estate has decreased in area by 3 percent.

The indigenous forest areas available for wood production under approved sustainable forest management plans and permits are largely stocked areas, but include a mix of merchantable and non-merchantable species. Some 300 000 to 400 000 hectares in total may be suitable for wood production under approved plans and permits.

TABLE 2.2: AREAS AND PERCENTAGES OF FOREST LAND AVAILABLE FOR WOOD PRODUCTION (000 HECTARES)

	2003	2007
Total plantation forest area[1]	**1 877**	**1 826**
Area available for wood production	1 877	1 826
Percentage available for wood production	100	100
Total indigenous forest area	**6 457**	**6 457**
Area available for wood production[2]	68	114
Percentage available for wood production	1	2
Total forest area	**8 334**	**8 283**
Area available for wood production	1 945	1 940
Percentage available for wood production	23	23

Notes
1 Areas are net stocked forest areas plus harvested areas awaiting restocking as at 31 March 2003 and 2007.
2 Data are the areas under approved sustainable forest management plans and permits at 31 March 2003 and 2007.

Sources
Ministry of Agriculture and Forestry (2004, 2008a, 2008b).

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2004) *A National Exotic Forest Description.* Ministry of Agriculture and Forestry; Wellington.

Ministry of Agriculture and Forestry (2008a) *A National Exotic Forest Description as at 1 April 2007.* Ministry of Agriculture and Forestry; Wellington.

Ministry of Agriculture and Forestry (2008b) *Statistics of areas of approved and registered sustainable forest management plans and permits*. Ministry of Agriculture and Forestry; Christchurch (unpublished).

Indicator 2.b Total growing stock and annual increment of both merchantable and non-merchantable tree species in forests available for wood production

Despite a small decrease in plantation forest area since 2003, the estimated standing volume available for wood production has increased by 9 percent. The total standing volume available for wood production in indigenous forests is not known. Although it will be small, it will also have increased since 2003.

Quality of information: M/H **Progress against indicator: ▲**

RATIONALE

This indicator measures the growing stock and annual increment of forest area available for wood production to meet society's needs. The annual increment and growing stock can be related to the volume harvested each year to provide a means to demonstrate the sustainable management of forest resources.

2008 COUNTRY REPORT

PLANTATION FORESTS

New Zealand's plantation forest estate of 1.83 million hectares had an estimated standing volume of 434 million cubic metres as at 31 March 2007. In comparison, at 31 March 2003 it was 398 million cubic metres. The average annual increase in total standing volume over this period is 9 million cubic metres, reflecting the increase in the area-weighted average age from 13.7 to 14.8 years.

Total standing volume is the volume of wood contained in stems of all age classes; it includes some non-recoverable volume (commonly about 15 percent), but excludes bark.

All recorded plantation forests are managed with the intention of producing wood or wood fibre from merchantable species, and are dominated by radiata pine. Indicative mean annual increments for this and other common species are provided in Table 2.3.

INDIGENOUS FORESTS

Wood is only harvested from indigenous forests that are managed under approved SFM plans or permits. The documentation for each plan or permit includes an inventory of merchantable species, but information on the growing stock of merchantable species is not available in aggregate form for all plans and permits. As the area covered by approved plans and permits has increased since 2003 (see Indicator 2.a), the growing stock available for wood production will also have increased.

Indigenous forests commonly include a range of merchantable and non-merchantable species, although some beech *(Nothofagus)* forests may be strongly monocultural. Indicative mean annual increments for common merchantable indigenous species are provided in Table 2.4.

Mature rimu tree, South Westland. Photo: Ian Platt.

TABLE 2.3: INDICATIVE MEAN ANNUAL INCREMENTS (MAI) FOR COMMON PLANTATION SPECIES

SPECIES	MAI OF TOTAL STEM VOLUME (M^3/HA/YR)
Radiata pine	28
Douglas-fir	30
Monterey cypress	20
Californian redwood	20
Eucalypt species	25–35

Source
Ministry of Agriculture and Forestry (2008b).

TABLE 2.4: INDICATIVE MEAN ANNUAL INCREMENTS (MAI) FOR COMMON MERCHANTABLE INDIGENOUS SPECIES

SPECIES	MAI OF TOTAL STEM VOLUME (M^3/HA/YR)
Red beech	15
Hard beech	10
Silver beech	12
Rimu	5
Miro	5
Kahikatea	8
Tōtara	12
Tawa	6
Kauri	8

Source
Ministry of Agriculture and Forestry (2008b).

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2004) *A National Exotic Forest Description.* Ministry of Agriculture and Forestry; Wellington.

Ministry of Agriculture and Forestry (2008a) *A National Exotic Forest Description as at 1 April 2007.* Ministry of Agriculture and Forestry; Wellington.

Ministry of Agriculture and Forestry (2008b) *Afforestation Grant Scheme guidelines.* Ministry of Agriculture and Forestry; Wellington.

Red, silver and mountain beech, Victoria Range, North Westland. Photo: Ian Platt.

Indicator 2.c Area, percent, and growing stock of plantations of native and exotic species

The *National Exotic Forest Description* provides comprehensive data on the exotic plantation forest estate, including details on area and growing stock by species or species groups. There is no current inventory of indigenous plantations, but the total area is small.

Quality of information: L/H **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the nature and extent of plantation forests. Changes in the area of plantation reflect society's present and future needs or the impact of competing land uses on forest cover. The use of both native and exotic plantation species may enhance the range and quantity of goods and services available.

2008 COUNTRY REPORT

New Zealand's plantation forests have a reported gross area of 1.83 million hectares (net stocked area of 1.79 million hectares plus 36 000 hectares awaiting replanting). This is 22 percent of the total forest area, and about 7 percent of the country's land area.

This plantation forest area comprises only exotic species. The area, percent of total area and growing stock by species or species groups are provided in Table 2.5.

TABLE 2.5: AREA, PERCENT AND GROWING STOCK BY PLANTATION SPECIES/GROUPS

SPECIES/GROUPS	AREA (HA)	PERCENT OF TOTAL AREA	GROWING STOCK (MILLION M^3)
Radiata pine	1 597 000	89	398
Douglas-fir	113 000	6	23
Cypresses	8 000	< 1	6
Other softwoods	27 000	2	2
Eucalypts	29 000	2	1
Other hardwoods	16 000	1	4
Total	**1 790 000**[1]	**100**	**434**

Note
1 Total area excludes an additional 36 000 hectares that have been harvested and await replanting.

Source
Ministry of Agriculture and Forestry (2008).

There is a small area of plantation forests of indigenous species, probably no more than a few thousand hectares. No survey has been undertaken since 1985/86 (see Pardy et al, 1992). There is anecdotal evidence for an increasing interest in planting indigenous species for a variety of purposes, including wood production and carbon sinks.

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2008) *A National Exotic Forest Description as at 1 April 2007*. Ministry of Agriculture and Forestry; Wellington.

Pardy, GF; Bergin, DO; Kimberley, MO (1992) Survey of native tree plantations. *FRI Bulletin* 175. Forest Research Institute; Rotorua.

Indicator 2.d Annual harvest of wood products by volume and as a percent of net growth or sustained yield

The sustainable future harvest from New Zealand plantation forests is estimated using wood availability forecasts. This can be compared to roundwood removals (an estimate of actual harvest levels) to ensure the level of harvesting is sustainable. The current harvest from plantation forests is significantly below the long-term sustainable volume from the current estate.

Quality of information: H/M **Progress against indicator:** ➤

RATIONALE

This indicator compares actual harvest levels against what is deemed to be sustainable. The purpose is to assess whether forests are being harvested beyond their ability to renew themselves or are being under-utilised for wood products.

2008 COUNTRY REPORT

The annual removal of roundwood from New Zealand's forests is estimated from the quantities of processed wood products, plus the volume exported as unprocessed logs. This estimate is based on applying conversion factors to the output of the processing plants, so it is not a direct measure of harvest. These estimates provide an "inside-bark" volume. Non-industrial roundwood removals are considered to be insignificant in New Zealand.

For plantation forests, the annual volume that can be removed in a sustainable manner is not directly prescribed by any central agency. Instead, the Ministry of Agriculture and Forestry estimates the volumes potentially available for harvesting, by modelling the plantation forest estate under a series of scenarios; these incorporate the harvesting intentions of large-scale forest owners. The scenarios apply assumptions on yields, areas and harvesting constraints. The most significant constraints within the models are the non-declining yield for radiata pine (part of forecasts), and that all clear felled areas are replanted in the following year.

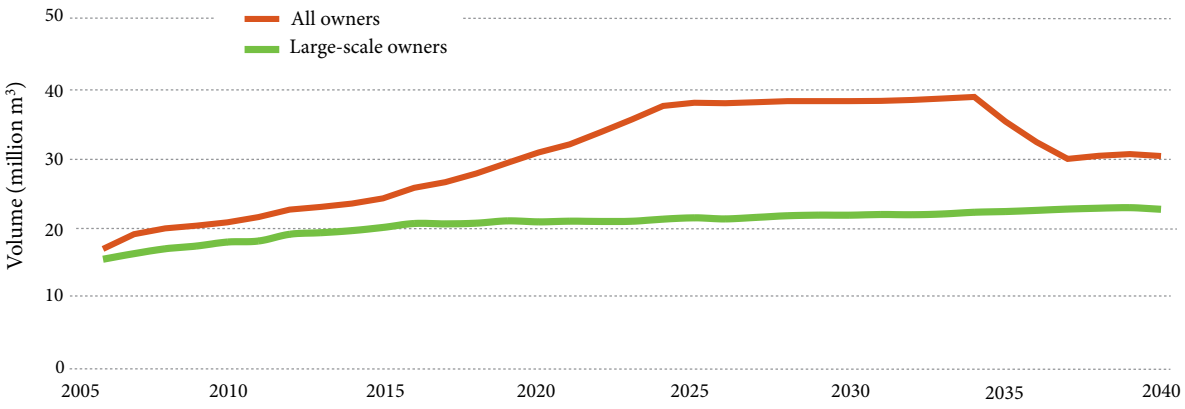
The modelling results provide estimates of potentially available wood. The estimates are not predictions of how forest owners will manage the cut from their forests, nor are they prescriptions for how their cuts should be managed. The scenario shown in Figure 2.1 estimates wood availability based on large-scale forest owners' stated harvest intentions until 2015. From 2015 to 2034, wood availability is assumed to be non-declining. After 2034, reductions in volumes are allowed in the forecast model as the area available for harvesting decreases. Any increase or decrease in volume has been restricted to a maximum of 10 percent of the previous year's harvest.

Over recent years, estimated roundwood removals have been compared with actual harvest data sourced directly from forest owners through the *National Exotic Forest Description* survey. These data have provided checks on the forecasts and indicate they are likely to be within ±5 percent of the actual level of harvest.

Roundwood removals from plantation forests totalled 20.4 million cubic metres in the year ended 31 March 2008.

Sustainable Forest Management plans and permits for indigenous forests specify the maximum volumes that may be harvested in specific periods. These maximums are determined on the basis of the volume that may be

FIGURE 2.1: 2007 INTERIM NATIONAL PLANTATION FOREST WOOD AVAILABILITY FORECASTS[1] (2007–2040), ALL SPECIES



Note
1 These are interim forecasts. MAF is currently working on a finalised national forecast.

Source
Ministry of Agriculture and Forestry (2009).

removed in a sustainable manner over the approved periods of the plans or permits. Roundwood removals from indigenous forests totalled 18 000 cubic metres in the year ended 31 March 2008, only about 20 percent of the approved sustainable harvest volume. This reflects competition from imported wood products (some of which may not be from sustainably managed and legally harvested forests), and the relatively high costs of sustainable forest management under New Zealand legislation.

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2009) *Interim national wood availability forecasts, a forestry sector study 2009.* Ministry of Agriculture and Forestry; Wellington.

Ministry of Agriculture and Forestry (undated) *Statistical releases*. http://www.maf.govt.nz/mafnet/publications/statistics/forestry/forestry-production-and-exports/

Ministry of Agriculture and Forestry (undated) *Wood availability forecasts.* http://www.maf.govt.nz/mafnet/publications/wood-availability/

FURTHER READING

Ministry of Agriculture and Forestry (undated) *Roundwood removals from New Zealand* Forests. http://www.maf.govt.nz/statistics/forestry/other-forestry-releases/mar-08/index.htm

Ministry of Agriculture and Forestry (undated) *A National Exotic Forest Description*. http://www.maf.govt.nz/mafnet/publications/nefd/national-exotic-forest-2007/index.htm

Indicator 2.e Annual harvest of non-wood forest products

New Zealand's forest estate supports a number of smaller industries that are unrelated to timber production. These range from beekeeping and the collection of sphagnum moss, through to game hunting and possum trapping. One of the growth areas involves the use of indigenous plant extracts in skincare and medicinal products. This industry has grown substantially since the last country report and draws on both traditional Māori knowledge and current research. The 2003 country report commented that researchers were examining the opportunities for incorporating secondary crops (such as ginseng and edible mushrooms) into forest management systems. This work has reached the stage of limited commercial plantings.

Quality of information: L/M **Progress against indicator:** ▲

RATIONALE

This indicator reports on the sustainability of the harvest of non-wood forest products. The well being of indigenous and other communities dependent on non-wood forest products may be closely allied to the forest's ability to maintain its productive capacity over time.

2008 COUNTRY REPORT

Non-wood forest products (NWFP) make up a small component of the forest industries, and employ limited numbers of people. The largest employment group (372 workers in 2006) is engaged in the hunting of game meat (wild deer, goats and pigs), the management of pests, and the trapping of the Australian brushtail possum for fur and pelts. None of these animal species is native to New Zealand, and most are considered a threat to the indigenous flora and fauna.

MEDICINAL HERBS AND HONEY COLLECTION

Several plant species from New Zealand's indigenous forests have traditionally been used by Māori for medicinal purposes. These species included:

- karamu – the leaves are boiled down for an extract that is good for the urinary system;
- koromiko – the leaf ends are boiled down as a tonic for dysentery and diarrhoea;
- makomako/wineberry – the leaves make a tea that is soothing and cleansing for sore and dusty eyes;
- mānuka/tea tree – used to soothe burns (a sedative), and treat fevers and colds.

Experience with plant extracts has been passed down over generations of Māori, amongst individuals and families, and small quantities continue to be collected for private use. The harvesting normally involves the collection of new-season leaves. There is minimal disturbance to wood lands as a result of this activity. The Māori population also harvest berries from a number of indigenous trees and shrubs, including the kōtukutuku. The berries are harvested primarily for private use rather than commercial sale, so volumes are small.

The past 20 years have seen renewed interest in these medicinal plant species by Māori, researchers and the wider investment community. There is also expanding interest in skincare and cosmetic products from indigenous plant species. Māori have been turning their traditional knowledge and affinity with the land into profitable export ventures (Growing Futures, undated). Notable has been the growing export trade of mānuka and kānuka oil products.

Another export area that draws on the forest estate is honey and honeydew[1] production. A number of New Zealand's monofloral honeys are derived from the forest estate. These include mānuka, rata, rewarewa and

1 Honeydew nectar is extracted from two species of scale insects that inhabit the bark of beech trees.

tāwari. Apiarists locate their hives along the bush line or within forested areas. The national figures on the number of apiarists and on honey production do not distinguish between those who rely predominantly on pasture or indigenous forest.

Nationally, there were 2602 beekeepers[2] operating in the 2006/07 season, and total honey production amounted to 9660 tonnes (National Beekeepers' Association of New Zealand, undated). Production figures are weather-dependent, and have varied between 4690 and 12 250 tonnes since 2002. The six-year average has been 9260 tonnes. A small number of apiarists also produce honeydew, which is mainly exported to markets in Europe. Bees extract honeydew nectar from two species of scale insects that inhabit the bark of beech trees, principally black beech and red beech. In addition to honey production, apiarists produce beeswax, honey powder, propolis (an antibiotic gum or resin) and bulk bees (principally for export).

2 About 60 percent of beekeepers have five (or fewer) hives. Just 10 percent of beekeepers have more than 250 hives.

The harvesting of honey and honeydew from forests has the potential to affect the ecosystems in terms of the availability of nectar and pollen for indigenous birds and insects. Limited research[3] has been undertaken on this issue; beekeepers have been encouraged to adopt a conservative management approach when assessing stocking rates.

The Department of Conservation monitors the beekeeping concessions within the conservation estate and will revoke concessions if there is evidence of pressure on the local ecology[4]. Stocking density and the physical distribution of hives are constrained naturally by climatic conditions and the physical terrain. When determining hive density, beekeepers are mindful of the variability of the New Zealand climate (Bourn et al, 1999).

MANAGEMENT OF THE POSSUM POPULATION FOR PEST CONTROL AND COMMERCIAL PRODUCTS

Commercial hunting and trapping are important management tools in controlling the possum population in New Zealand, which has been estimated at 70 million (Ritchie, 2000). Possums consume about 21 000 tonnes of foliage each day, which is placing New Zealand's broad-leaved hardwood forests "under threat of major mortality and, in some cases, widespread devastation" (Ritchie, 2000). Their diet also includes indigenous invertebrates and birds (particularly eggs and nestlings), which is threatening the survival of certain species.

The major commercial products derived from possums are pelts, fibre for garments and pet food. Possum pelts and fibre have been collected since the early 1920s, and a significant proportion of the production has been exported (Wardle, 1984). Attempts have been made

3 The two major organisations that research hive management and the properties of honey are the Apicultural Research Unit of HortResearch and the Honey Research Unit at the University of Waikato.

4 The Department of Conservation has produced national guidelines for the location of beehives on conservation land. The guidelines recognise honey production and the wintering over of hives as being generally compatible with conservation land values.

to establish a possum meat industry. However, the areas from which the meat can be sourced are limited, as tuberculosis is present in some regional possum populations.

Yearly harvest volumes have been erratic, owing to fluctuations in the price for fur and pelts[5]. When fur has been out of favour as a fashion item, fewer than 500 000 possums per season have been commercially harvested, as it has been uneconomic for hunters to undertake extensive trapping programmes. In contrast, the annual harvest has been six times higher, exceeding three million, when returns have been strong for fur and skins.

Possum fibre is gaining increased attention as the "fur is 70% warmer than wool. It has superior thermal qualities because the fur is hollow inside so traps heat within its fibres" (Burlingham et al, 2008). The commercial harvest of possums (for fur and pelts) is currently in the order of 1.3 to 1.5 million per annum (Warburton, 2008). The harvest has grown as the price per kilogram of possum fibre (plucked) has more than doubled since the beginning of the decade; it is in the order of $105 per kilogram. *"The use of plucked possum fur as a component in blended yarn is now well established in the New Zealand yarn industry with the total value of this industry estimated to be in the order of $50 to $70 million per annum"* (Warburton, 2008).

An emerging use for possums is as a high-quality pet food. Research has shown that possum meat is high in the unsaturated fatty acids Omega 3 and 6. Initiatives to date have focused on the Bay of Plenty and East Cape from where a small, but growing export industry has been developed.

The current level of commercial harvesting has only a limited impact upon possum numbers. To maintain possums at acceptable levels, extensive control programmes are funded by the Department of Conservation, the Animal Health Board and the agricultural sector.

Existing control mechanisms for possums cost government and councils more than $60 million[6] a year. This sum does not include the significant amount also spent by private individuals, businesses, and organisations on possum control, estimated at $74.8 million per annum (Parliamentary Commissioner for the Environment, 2000).

COMMERCIAL AND RECREATIONAL GAME HUNTING

Game animals hunted in New Zealand include red deer, fallow deer, chamois, Himalayan thar, wild pigs and wild goats. None of these species is endemic to the country. They were introduced by early European settlers for their meat, hides and fur. Without natural predators, they quickly became established in New Zealand's indigenous forests. As their numbers increased, their impact upon the forest ecology grew, which led to their classification as noxious pests. Various control measures are used by the Department of Conservation, forestry companies and private land owners to minimise the environmental (and production) damage caused by these pest animals. One of the principal control measures is recreational and commercial hunting.

Deer are the major game species hunted in New Zealand by recreational and commercial interests. New Zealand's feral deer population has been estimated at 250 000 nationally (McKinnon, 2001). The population is spread across the conservation estate, private forest lands and commercial forests. Recreational hunters take about 50 000 head a year. In the 1990s and the early part of the present decade, commercial deer hunters were removing 10 000 to 30 000 head a year (Stringleman, 2004). Commercial deer recovery (for venison) fell away sharply in 2002–2003 period, when export requirements for wild venison were tightened and the venison price

5 The market for pelts has until recently depended upon overseas fashion trends and the requirements of fashion houses.

6 Unless otherwise stated, the currency used in this document is New Zealand dollars.

schedule declined rapidly. The past two seasons have seen a recovery in venison returns, renewing interest in commercial deer recovery.

New Zealand has developed a strong international reputation for game hunting, and several commercial operators now provide guided hunting tours. The Department of Conservation and the major forestry companies operate concession systems for commercial hunting operations, and issue hunting permits for private individuals[7]. Some game estates have also been established, mainly to cater for overseas trophy hunters. Such estates normally include substantial areas of forest lands.

Generally there are no restrictions on the number of deer that can be taken, except for "popular herds such as Fiordland wapiti and Blue Mountains fallow deer, where systems of ballots and bag limits are in place" (Department of Conservation, 2001). DOC periodically monitors deer populations; generally the numbers removed by commercial and recreational hunters are insufficient to reduce feral deer densities to levels that protect ecosystems from damage[8]. When deer populations build up to the point where they are impacting negatively on the ecology of an area, the DOC supplements commercial and recreational hunting with additional control measures.

SPHAGNUM MOSS COLLECTION

A regionally important non-wood forest product is sphagnum moss, principally the variety *Sphagnum cristatum*. It is gathered from swamp areas in the forests lands of the West Coast of the South Island. Harvested areas normally return to a stable condition after three to five years. The moss beds are scattered over an area of about 1.3 million hectares (Moutere River Company Limited, undated). The harvest is mainly exported to Japan and South East Asia. The annual value of exports during the 1990s ranged from $13 million to $18 million, and has fallen back to $9 million in the June 2007 year.

New Zealand exporters target the premium orchid market, which requires long sphagnum strands from mature plants. The Department of Conservation now manages the majority of sphagnum moss collection sites. The harvesting operations on conservation land are monitored through DOC's concession system[9], and are assessed for sustainability and environmental impact.

NEW OPPORTUNITIES FOR NON-WOOD FOREST PRODUCTS

Research trials on the potential for incorporating secondary crops into the plantation forest estate have been underway for some years. The emphasis has been upon edible mycorrhizal mushrooms[10] and ginseng roots. The intention is to incorporate these crops into the normal plantation forest regimes for exotic species[11]. The crops under investigation are high-value, low-volume

7 The concession and permit system is used to monitor the number of hunters and to control access to blocks of land where there are high visitor numbers, or where forestry operations are underway.

8 Even at low densities, deer can prevent the regeneration of key native plant species.

9 Previously, Timberlands West Coast audited the operations to ensure they were consistent with its environmental management principles.

10 Mycorrhizal mushrooms live in a symbiotic relationship on and in the roots of suitable host plants.

11 In the case of high-value mycorrhizal mushrooms, such as Périgord black truffle, the returns would justify setting up dedicated plantations for their production (a so-called. truffière), rather than incorporating the harvest into the normal plantation system.

commodities, which could significantly increase the viability of plantation forestry. Successful inoculations have occurred with Périgord black truffle, Italian white truffle, porcini and saffron milk cap. Scientists involved in these trials are conscious that the management practices for these new crops must be sustainable and in line with those used in commercial forestry. The advantage of growing these forest-based mushrooms in New Zealand is that growers can supply significant quantities to the Northern Hemisphere during their traditional off-season.

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CRITERION 3

Maintenance of forest ecosystem health and vitality

The maintenance of forest health and vitality is dependent upon the ability of the ecosystem's functions and processes to recover from or adapt to disturbances. While many disturbance and stress events are natural components of forest ecosystems, some may overwhelm ecosystem functions, fundamentally altering their patterns and processes and reducing ecological function.

Decline in forest ecosystem health and vitality may have significant economic and ecological consequences for society including a loss of forest benefits and the degradation of environmental quality.

Information gained on the impacts of biotic and abiotic processes and agents may inform management strategies to minimise and mitigate risk. The maintenance of forest ecosystem health and vitality is the foundation of sustainable forest management.

TABLE 3.1: INDICATORS FOR CRITERION 3, QUALITY OF INFORMATION AND TRENDS

CRITERION 3: MAINTENANCE OF FOREST ECOSYSTEM HEALTH AND VITALITY		QUALITY OF INFORMATION	TREND
3.a	Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions	M	▼
3.b	Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions	M	▶

KEY

L = low	Neutral	▶
M = medium	Positive	▲
H = high	Negative	▼
	Insufficient data	?



NEW ZEALAND OVERVIEW

New Zealand is largely free of serious forest pests and diseases that exist overseas, but increases in trade and travel over time increase the risk of incursions.

The Australian brushtail possum is a notable forest pest, particularly for the indigenous forests where it is virtually ubiquitous. The exact impacts of browsing by possums on forest dynamics are still the subject of debate. The impacts are not monitored at a national level, but the area treated for possum control by the Department of Conservation and the Animal Health Board has increased significantly over the last 10 years.

An estimated 18 percent of the plantation forest estate was affected by diseases in 2005. Major outbreaks of *Cyclaneusma* needle cast and *Dothistroma* needle blight are generally similar in extent on a year-to-year basis. The diseases involved mostly affect tree growth rates and wood quality, rather than resulting in mortality.

Wind is the major abiotic agent affecting New Zealand's forests. For indigenous beech forests windthrow is common and a key factor in the natural ecology. Wind damage is less common in other indigenous forest types and the damage varies with species. No national estimate of wind damage in indigenous forests is available.

Historical records indicate that about 0.38 percent of the net stocked plantation forest area is lost annually due to wind damage. Wind also has a significant impact on wood quality, but the extent of this is not recorded.

The forest area affected by fire varies significantly from year to year, but by international comparisons the impact is small. Plantation forests are generally more vulnerable than indigenous forests, and in 2007 an estimated 419 hectares were subject to fire.

Mixed tawa/hardwood/podocarp forest, Otari Reserve, Wellington City. Photo: Alan Reid.

Indicator 3.a Area and percent of forest affected by biotic processes and agents (e.g. disease, insects, invasive species) beyond reference conditions

In 2005, about 2 percent of the total plantation forest area was affected by insects, mainly bark beetle (*Hylastes ater*). About 18 percent of the total plantation forest area was affected by diseases, the most important being: *Cyclaneusma* needle cast, *Dothistroma* needle blight, *Armillaria* root rot, and *Nectria* flute canker. The introduced Australian brushtail possum affects indigenous forests throughout New Zealand. In 2005, it was estimated that possums affected about 8 percent of the plantation forest estate.

Quality of information: M **Progress against indicator:** ▼

RATIONALE

This indicator identifies the impact that biotic processes and agents have on forests. Where change due to these agents and processes occurs beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover could be reduced or lost. Monitoring and measuring the effects of these processes provide information helpful in the formulation of management strategies to mitigate risk.

2008 COUNTRY REPORT

FOREST AREA AFFECTED BY INSECTS AND DISEASES

Historically, very few insect problems have been noted in plantation forests, apart from one species of bark beetle (*Hylastes ater*) that can be associated with seedling death (Bulman, 2008). Plantation forests are affected by fungal diseases, the most important being: needle cast (*Cyclaneusma minus*), needle blight (*Dothistroma septosporum)*, root rot (*Armillaria* spp.), and flute canker (*Nectria fuckeliana*).

Figures for plantation forest areas affected by insects and diseases and major outbreaks are based on expert estimate (Lindsay Bulman, Scion, 2008) (Tables 3.2 and 3.3).

Economic losses from diseases affecting plantation forests have been estimated to cost about $82 million per annum (Table 3.4). When compared with estimates reported in 2003, *Cyclaneusma* needle cast and *Dothistroma* needle blight are still the pathogens that cause most loss, although their effect has decreased. Aerial surveys for *Cyclaneusma* were undertaken in 2005 and 2006: the results indicate that disease levels were lower than seen in previous surveys of the mid 1980s. It is thought that drier-than-normal autumns, and tree breeding to remove very susceptible trees, are responsible. *Dothistroma* needle blight damage was lower due to the reduced susceptible area and several dry summers. Damage from other diseases affecting radiata pine has increased due to the spread of *Nectria* flute canker in the lower South Island of New Zealand. This disease was first recognised in the early 2000s. There has also been a small increase in biosecurity research funding and surveillance activity for all plantation forests species since 2003 (Bulman, 2009).

Forest remnants, Banks Peninsula. Photo: Alan Reid.

TABLE 3.2: PLANTATION FOREST AREAS AFFECTED BY INSECTS AND DISEASES (2005)

DISTURBANCE	PLANTATION FOREST AREA AFFECTED (000 HA)	% OF TOTAL PLANTATION FOREST
By insects	40	2
By diseases	320	18

Sources
Bulman (2008).
Ministry of Agriculture and Forestry (2006) – Net stocked area.

TABLE 3.3: MAJOR OUTBREAKS OF DISEASES IN PLANTATION FORESTS

DISEASE	TREE SPECIES OR GENERA AFFECTED (SCIENTIFIC NAME)	YEAR(S) OF LATEST OUTBREAK	AREA AFFECTED (000 HA)
Dothistroma needle blight	*Pinus radiata*	2006	130
		2002	183
		1995	115
		1989	119
Cyclaneusma needle cast	*Pinus radiata*	2000	150
		1999	200

Source
Bulman (2008).

There are no reported figures for indigenous forest areas affected by insects or diseases. Scientific literature reports the existence and effect of certain pathogens and pests in indigenous forests. A study by Ridley et al (2000) assessed the threats to New Zealand indigenous forest by exotic pathogens and pests. This study presents an extensive literature review, and demonstrates there has not been any extensive effect of exotic pathogens and insects on any of the most important indigenous forest species. The risk of disturbances to indigenous forests by pathogens is considered real, but unquantifiable at this stage.

FOREST AREA AFFECTED BY POSSUMS

The introduced Australian brushtail possum (*Trichosurus vulpecula)* is a major forest pest in New Zealand. It affects the overall structure and composition of indigenous forests, and affects plantation forests. Possums are also important predators of forest birds and indigenous invertebrates.

Figures for plantation forest areas affected by possums are based on forest health inspection records that are held in the forest health database and provided by Bulman, 2008 (Table 3.5). All major exotic plantation forests are inspected at least once a year for signs of newly

TABLE 3.4: ECONOMIC LOSSES FROM DISEASES AFFECTING PLANTATION FORESTS

DISEASE	TREE SPECIES OR GENERA AFFECTED (SCIENTIFIC NAME)	LOSS ($ MILLION PER ANNUM)
Cyclaneusma minus	*Pinus radiata*	38
Dothistroma septosporum	*Pinus radiata*	20
Sphaeropsis sapinea	*Pinus radiata*	4
Others	*Pinus radiata*	15
Phaeocryptopus gaeumannii	*Pseudotsuga menziesii*	1
Cypress cankers	*Cupressus* spp.	1
Research diagnosis and surveillance	All plantation species	3
Total		**82**

Source
Bulman (2009).

established pests or diseases: forest health assessments are undertaken, and damage by biotic and abiotic agents estimated and recorded. Reports of possum damage were significantly more common in the late 1990s and early 2000s. Why, is difficult to determine. One possible explanation is that forest companies reduced efforts to control possums before that period, so populations increased to levels where significant damage resulted. From 1998 to 2005, the number of reports of possum damage in forest plantations declined consistently.

Possums are a pest in New Zealand because of their high density. The exact consequences of possum browsing in indigenous forest dynamics and soil erosion have been debated for decades. The impact of possums can vary within plant populations, communities and ecosystems. It is influenced by a range of biotic and abiotic factors that may predispose plant communities to possum damage. Selective browsing may have a gradual effect in forest composition, with some species disappearing from certain areas and being replaced by other species. Within forest stands, possum browsing could be concentrated on a few trees that could be heavily defoliated or even killed. Possum browsing may have secondary effects such as weakening canopies and making them susceptible to wind throw, salt damage, pathogens, insects or climatic extremes. Browsing of leaves may also reduce the production of flowers and fruit (Payton, 2000; Cowan, 2005; Bellingham and Lee, 2006; Landcare Research, undated).

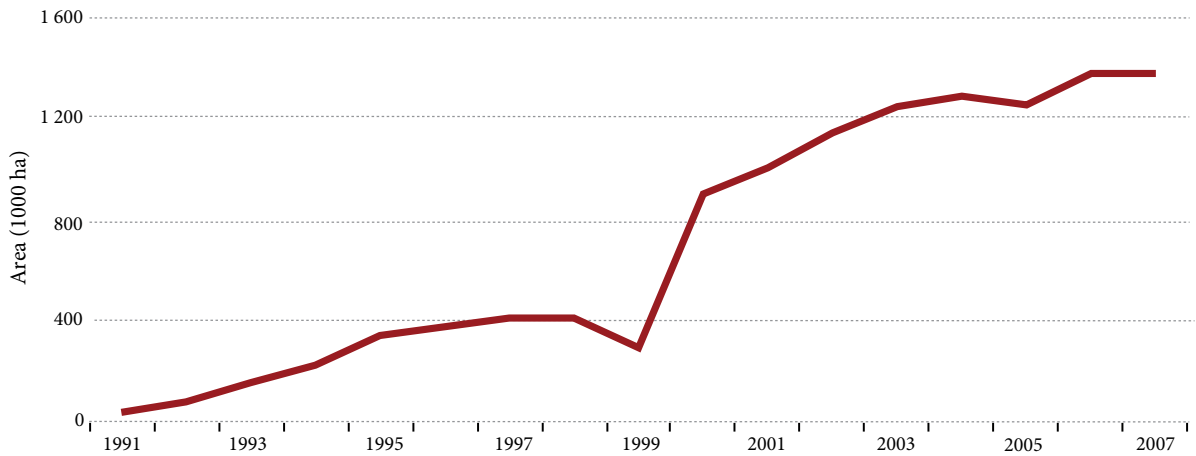
Because the effect of possums is widespread in indigenous forests in New Zealand, most of the forest could be assumed to have been affected by possums to some degree. Since they impact on forest composition – an effect not monitored in a national scale – it is difficult to provide an exact estimate of indigenous forest area affected by possums.

TABLE 3.5: PLANTATION FOREST AREA AFFECTED BY POSSUMS (2005)

DISTURBANCE	PLANTATION FOREST AREA (000 HA)	% OF TOTAL PLANTATION FOREST
By possums	140	8

Sources
Bulman (2008).
Ministry of Agriculture and Forestry (2006) – Net stocked area.

FIGURE 3.1: AREA TREATED FOR POSSUM CONTROL ON DEPARTMENT OF CONSERVATION LAND



Source
Department of Conservation (2008).

The Department of Conservation has established possum control measures at priority sites within land under their authority. Possum control work undertaken by DOC (Figure 3.1) is mostly within indigenous forest (Wright, 2008). The Animal Health Board also maintains control of possums over at least an equivalent area of forest, primarily to control bovine tuberculosis, for which the possum is a vector.

FOREST AFFECTED BY WOODY INVASIVE SPECIES

Indigenous forests in protected areas could be increasingly threatened by weeds, as surrounding land uses intensify and fragmentation of the natural landscape occurs (Timmins and Williams, 1991). Howell (2008) provides a consolidated list of 328 vascular plant species present on DOC land, that are considered to have detrimental effects on the conservation values of sites. Over 40 percent of these species are trees and shrubs. Wilding tree spread, due to wind-blown seeds, can affect forest with indigenous trees and plants through competition for space. As there is no monitoring of the impact of weeds in forests at a national scale, an estimate of the forest area affected is difficult to provide.

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Indicator 3.b Area and percent of forest affected by abiotic agents (e.g. fire, storm, land clearance) beyond reference conditions

About 7000 hectares of the total plantation forest area were affected by wind damage in 2007. Physiological needle blight (PNB) was considered as a disturbance caused by abiotic factors, and affected about 1 percent of the total plantation forest area in 2005. Wildfire incidents affected about 0.02 percent of the total plantation forest area in 2007.

Quality of information: M **Progress against indicator:** ▶

RATIONALE

This indicator identifies the impact that abiotic processes and agents have on forests. Where change due to these agents and processes occurs beyond a critical threshold, forest ecosystem health and vitality may be significantly altered and a forest's ability to recover could be reduced or lost. Monitoring and measuring the effects of these processes provide information helpful in the formulation of management strategies to mitigate risk.

2008 COUNTRY REPORT

FOREST AREA AFFECTED BY WIND DAMAGE

Wind is the main abiotic factor affecting plantation forests in New Zealand. The weighted average of the net stocked area loss per year due to catastrophic wind damage risk was estimated to be 0.38 percent by Somerville (1995), based on figures from 1900 to 1990. This approach does not account for any genetic quality improvements made in the planting stock since 1990 that could have reduced wind damage risk (Table 3.6). Reported wind damage refers to plantation forests only. Wind damage in indigenous forests is regarded as a natural occurrence and not monitored.

FOREST AREA AFFECTED BY OTHER ABIOTIC FACTORS

Physiological needle blight (PNB) is considered as a disturbance caused by abiotic factors. It occurs in radiata pine plantations in late winter or early spring. This disorder affects trees from 15 years and older. It causes foliage to turn red brown and die, while still attached to the tree. PNB outbreaks have often been associated with high mid-winter rainfall and non-porous soils (Forest Biosecurity Research Council, 2006). Figures for the plantation forest area affected by PNB are based on expert estimate (Bulman, 2008) (Table 3.7).

FOREST AREA AFFECTED BY FIRE

Forest fire figures are based on statistics provided by Rural Fire Authorities (New Zealand Defence Force, local government, Department of Conservation, or a forestry company), and co-ordinated by the National Rural Fire Authority. As Rural Fire Authorities are mainly operational, incident reporting has not been a priority through the years. In additional, the Fire Service has gone through changes in systems with an official database system starting to operate in July 1998; monitoring to identify type of vegetation burned has improved since late 2005. Only wildfire figures are included in the statistics. Controlled fires are no longer widely used as a site preparation tool in New Zealand forest management.

TABLE 3.6: ESTIMATED PLANTATION FOREST AREA AFFECTED BY WIND (2007)

DISTURBANCE	PLANTATION FOREST AREA (000 HA)
Total plantation forest area in 2007	1 790
Disturbance by wind damage	6.8

Source
Ministry of Agriculture and Forestry (2008) – Net stocked area.

TABLE 3.7: PLANTATION FOREST AREA AFFECTED BY PHYSIOLOGICAL NEEDLE BLIGHT (2005)

DISTURBANCE	PLANTATION FOREST AREA (000 HA)	% OF TOTAL PLANTATION FOREST
Physiological needle blight	20	1

Sources
Bulman (2008).
Ministry of Agriculture and Forestry (2006) – Net stocked area.

TABLE 3.8: PLANTATION FOREST AREA AFFECTED BY WILDFIRES

VEGETATION FIRES	AREA AFFECTED BY WILDFIRES (000 HA)			
	2004	2005	2006	2007
Forest fires	0.149	0.355	0.589	0.419
% of total forest area	0.01	0.02	0.03	0.02

Sources
New Zealand Fire Service (2008).
Ministry of Agriculture and Forestry (2005, 2007, 2008) – Net stocked area.

SOURCES OF INFORMATION

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CRITERION 4

Conservation and maintenance of soil and water resources

Soil and water underpin forest ecosystem productivity and functions. Forest ecosystems play an important role in the regulation of surface and groundwater flow and, together with associated aquatic ecosystems and clean water, they are essential to the quality of human life.

The interaction of soil, water and topography influence the character and health of streams and rivers flowing through and from forests. Monitoring change in the chemical, physical, and biological characteristics of soil, water and aquatic systems provides valuable information to support sustainable forest management.

Forest management activities can significantly alter forest soils, water quality and associated aquatic habitats. Inappropriate management may result in soil compaction, the loss of the soil A horizon, loss of riparian buffering capacity, increased sediment loads in streams, degradation and destruction of aquatic habitats and altered flow regimes. Change in water flow can also create an increased risk of flooding or the complete desiccation of streams. Both have harmful implications for human safety, property and economies.

Soil and water resources may be protected through the allocation of land for that purpose or through appropriate management regimes and best management practices.

TABLE 4.1: INDICATORS FOR CRITERION 4, QUALITY OF INFORMATION AND TRENDS

	CRITERION 4: CONSERVATION AND MAINTENANCE OF SOIL AND WATER RESOURCES	QUALITY OF INFORMATION	TREND
	PROTECTIVE FUNCTION		
4.1.a	Area and percent of forest whose designation or land management focus is the protection of soil and water resource	L	▶
	SOIL		
4.2.a	Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources	M/H	▲
4.2.b	Area and percent of forest land with significant soil degradation	M	▲
	WATER		
4.3.a	Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources	M	▲
4.3.b	Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions	L	▶



KEY

L = low
M = medium
H = high

Neutral ▶
Positive ▲
Negative ▼
Insufficient data ?

NEW ZEALAND OVERVIEW

The geology, geography and climate of New Zealand produce significant natural soil erosion in many mountainous and hilly landscapes. Much of the landscape is vulnerable to accelerated soil erosion if inappropriate land and forest management occur. It is therefore surprising that land and forest management planning does not commonly embrace a specific designation for the protection of soil and water values. Yet, several million hectares of indigenous forest estate were historically regarded as "protection forests".

About 25 percent of indigenous forests and 16 percent of plantation forests are located on land with moderate or higher degrees of soil erosion

Black beech forest, South Canterbury. Photo: Ian Platt.

The Resource Management Act 1991 is the overarching legislation for the sustainable management of natural and physical resources. Forestry (or other land management) activities that have the potential to result in significant adverse effects on soil and water values are subject to provisions of plans prepared under the RMA. Resource consents from the administering local government may be required. Sustainable (indigenous) forest management plans and permits under Part IIIA of the Forests Act 1949 are also required to maintain the natural values of forest ecosystems.

In 2007, the New Zealand Forest Owners' Association published *The New Zealand Environmental Code of Practice for Plantation Forestry,* which replaces earlier codes of practice. The Association recommends that all its members adhere to the principles and practices within the Code, which addresses soil and water quality values in most of the Best Environmental Management Practices.

Independent third-party forest certification provides a market-driven mechanism ensuring well managed forests that protect soil and water resources. The area of forests under third-party certification continues to increase, with about 55 percent (by area) of the plantation forest estate now under Forest Stewardship Council certification.

Analysed national information is not available on changes in physical, chemical or biological properties of streams in forest catchments.

INDICATORS 4.1 PROTECTIVE FUNCTION

Healthy and productive forests depend on the maintenance of their soil and water resource. Forests also regulate these resources by moderating the flow of water, controlling erosion and preventing catastrophic events such as flooding, avalanches and mudslides.

Indicator 4.1.a Area and percent of forest whose designation or land management focus is the protection of soil and water

New Zealand has significant areas of natural and accelerated soil erosion, but the designation of protection forest land is no longer applied in most management planning. Although forest land may still be managed with the conservation of water and soil values as a specified or implied objective, no national data on the extent of such management are available.

Quality of information: L

Progress against indicator: ▶

RATIONALE

The area and percent of forest designated or managed primarily for the protection and regulation of soil and water reflects the importance of these resources to society, including the trade-offs made between other uses.

2008 COUNTRY REPORT

Much of the indigenous forest on the mountain and hill country of New Zealand has historically been referred to as "protection forest". This reflects the naturally unstable nature of the terrain and also the important roles the forest vegetation plays in reducing soil erosion and maintaining water values.

The Forests Act 1949 specifically recognised the use of state forest land for water and soil conservation, and a forest zoning system that evolved in the 1970s had a specific soil and water protection category. However, since the management of state indigenous forests was transferred from the disestablished NZ Forest Service to the new Department of Conservation in 1987, these forests have been managed "…for conservation purposes…" under the Conservation Act 1987, section 6(a). The term "protection forest" is not now commonly used in forest management planning.

McKelvey (1995) identified 4.3 million hectares (or 69 percent) of indigenous forests as being protection forests. This area comprised 1.68 million hectares of upland forest and 2.62 million hectares of lowland forest. All upland forest was considered important for the protection of water and soil values. No subsequent update of the area of indigenous protection forests is available.

These forests are considered to have a strong slope-stabilising influence with low-intensity storms. However, natural erosion processes coupled with high-intensity/low-frequency storm events may initiate mass movements on steep, forested slopes (McKelvey, 1995).

Plantation forests have also been established for water and soil conservation purposes, although most of the land involved is not formally designated as such. This includes the planting of Aupouri, Woodhill, Santoft and Bottle Lake forests to stabilise sand dunes. More recently, 33 000 hectares have been established under the East Coast Forestry Project (ECFP). Some 26 percent of the land in the East Coast is susceptible to severe soil erosion.

The ECFP was established in 1992 to control erosion on the worst eroding or erosion-prone land in this district. The government provides financial grants for establishing effective tree cover through planting or encourages natural reversion to indigenous forest. Grant recipients are required to register against their land title a covenant, that is, a legal arrangement specifying certain management actions or constraints.

The Sustainable Land Management (Hill Country Erosion) Fund has also been recently established by government. It supports projects helping hill country farmers treat erosion-prone land and implement sustainable management practices. The total hill country land area involved is about 1.17 million hectares. Soil conservation initiatives under this fund, including afforestation, are co-ordinated by regional councils who can apply for funding from an annual pool of $2 million.

Some forested catchments are also managed for the supply of domestic drinking water, for example Wainuiomata Catchment in Wellington, and the Hūnua Ranges in Auckland.

SOURCES OF INFORMATION

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Ministry of Agriculture and Forestry (undated) *Sustainable Land Management (SLM) hill country erosion* fund. http://www.maf.govt.nz/mafnet/rural-nz/slm-hill-country-erosion-programme/

Douglas-fir plantation and tree fern understorey, Holt Forest, Hawkes Bay. Photo: Alan Reid.

INDICATORS 4.2 SOIL

Forest soils support forest productivity and other ecological and hydrological functions through their ability to hold and supply water and nutrients, store organic matter and provide habitats for plant roots and for a wide range of soil organisms. Not maintaining the soil resource may result in a decline and degradation in forest health and the provision of other environmental services.

Indicator 4.2.a Proportion of forest management activities that meet best management practices or other relevant legislation to protect soil resources

New Zealand has regulatory mechanisms through the Resource Management Act and the Forests Act that relate to the control of activities that may result in loss of soil values. In addition to regulatory mechanisms, more plantation forests have been certified under the Forest Stewardship Council scheme, a new environmental code of practice and guidelines for plantation forests has been adopted, as have new standards and guidelines for the sustainable management of indigenous forests.

Quality of information: M/H **Progress against indicator:** ▲

RATIONALE

This indicator provides information about the extent to which soil resource protection, legislation and best management practices have been identified and integrated into forest management activities. Inappropriate activity may result in the loss of soil nutrients, forest productivity and other ecosystem services that soils provide.

2008 COUNTRY REPORT

In addition to legislative and regulatory requirements relating to soil resources, there are standards and guidelines for indigenous forestry, an environmental code of practice for plantation forestry, and forest certification schemes. Government recently introduced a number of schemes to encourage the planting of forests, especially on erosion-prone land.

THE RESOURCE MANAGEMENT ACT 1991

All forest management activities that may affect the soil are subject to the requirements of the Resource Management Act 1991. Proposals that will result in disturbances or changes to soil-related resources will usually require a resource consent to be granted by the appropriate local authority.

The approach of the RMA to environmental management is centred on the ideas of sustainable management and the integrated management of resources. Regional and district plans are prepared by 85 regional and district councils, to assist them carry out their functions under the RMA. These plans deal with issues relating to soil disturbance through activities such as earthworks, cultivation, and removal of vegetation.

Regional councils collect and hold a large amount of soil resource information , the extent of which has not been assessed for this report. Their substantial resource is used for the monitoring, planning and reporting of activities that relate to soil resources at sub-national level.

THE FORESTS ACT 1949

Part IIIA of the Forests Act focuses on privately owned indigenous forests. It promotes the principle of sustainable management by allowing a level of timber harvest that provides for the management of natural (non-timber) values. Landowners and forest managers

seeking approvals for sustainable forest management plans and permits on private land must comply with Part IIIA of the Act. The Forests Act is administered by the Ministry of Agriculture and Forestry and contains requirements relating to soil values.

The third edition of the MAF *Standards and Guidelines for the Sustainable Management of Indigenous Forests* was published in 2007. It reflects the statutory requirements under Part IIIA of the Forests Act and includes a criterion and standards with indicators relating to soil quality. These cover the siting and construction of earthworks to minimise soil disturbance.

The East Coast Forestry Project is administered under The Forestry (East Coast) Grants Regulations 1992. It targets 60 000 hectares of the most at risk lands, plus immediate surrounding areas. The project provides grants for establishing effective tree cover through planting or encouraging natural reversion to indigenous forest. To date, 33 000 hectares have been afforested under the project.

CODE OF PRACTICE

Codes of practice focus on promoting sound management practices and are particularly important for soil conservation. In 2007, the New Zealand Forest Owners' Association (NZFOA) published *The New Zealand Environmental Code of Practice for Plantation Forestry*. This code replaced the 1993 New Zealand Forestry Code of Practice and now includes a section setting out Industry Best Environmental Management Practices.

The Code was developed in accordance with the UN Food and Agriculture Organisation (FAO) Planted Forest Code. Members of the NZFOA and the Farm Forestry Association own or manage more than 85 percent of the country's plantation forests. Both groupings strongly endorse the environmental code of practice to all forest owners throughout New Zealand and recommend that all their members adhere to its principles and practice. Soil conservation and quality values and issues are covered in most of the Best Environmental Practices, and in particular, for earthworks, harvesting, and mechanical land preparation.

FOREST CERTIFICATION

Forest certification schemes recognise good forest management, including safeguarding soil and water resources. Most large-scale forest owners in New Zealand have taken up Forest Stewardship Council certification. This is an international labelling scheme for forest products providing an independent and credible guarantee, that the products come from forests that have been managed in accordance with FSC Principles and Criteria. In FSC terms, this verifies that the forest products come from well managed forest.

Its Principle 6, Environmental Impact, includes the

requirement for preparation and implementation of written guidelines to control erosion, for road construction and all other mechanical disturbances.

The area of plantation forest certified by FSC has increased from 450 000 hectares in 2004 to 977 000 hectares in 2008. This represented 55 percent of New Zealand's plantation forest estate. Some 12 000 hectares of indigenous forest managed under Part IIIA of the Forests Act are also FSC-certified.

SOURCES OF INFORMATION

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Forest Stewardship Council (2002) *FSC international standard – FSC principles and criteria for forest stewardship.* FSC-STD-01-001 (version 4-0) EN Amended 2002. http://www.fsc.org/fileadmin/web-data/public/document_center/international_FSC_policies/standards/FSC_STD_01_001_V4_0_EN_FSC_Principles_and_Criteria.pdf

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Sub-alpine forest, Mt Arthur, Kahurangi National Park. Photo: Alan Reid.

Indicator 4.2.b Area and percent of forest land with significant soil degradation

About 25 percent of indigenous forests and 16 percent of plantation forests are located on land with moderate or higher degrees of soil erosion. Eroded sites can contribute to decreases in nutrient supply. Soil compaction can be an issue where the concentrated use of heavy machinery occurs. There is now a code of practice for plantation forestry that addresses soil erosion and compaction.

Quality of information: M **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the extent of significant soil degradation in forests likely to affect productivity, hydrology, ecosystem processes or social and cultural benefits. This indicator is primarily concerned with degradation caused directly or indirectly by human activity.

2008 COUNTRY REPORT

Much of the New Zealand landscape is mountainous or hilly, undergoing uplift, and subject to high intensity rainfalls. As many areas are underlaid by soft, erodible materials, natural rates of soil erosion are high.

Before human settlement, the extensive indigenous forest land cover provided protection for the soil mantle, except during extreme rainfalls. With much of this indigenous forest cleared, parts of the country are prone to mass-movement soil-erosion processes, particularly in the East Coast of the North Island. Further information is available from *Environment New Zealand* 2007 (Ministry for the Environment, 2007).

The remaining indigenous forests often continue to fulfil critical soil conservation roles, mostly unaffected by human activities. However, the introduction of wild animals in the 19th and early 20th centuries, particularly possums and deer, has impacted on the health and regenerative capacity of some forest types. Hence there is likely to be some influence on the soil conservation role provided by these forests, despite these wild animal populations being subjected to control operations.

Much of the plantation forest estate was established on sites that failed to sustain agriculture after clearance of indigenous forest. Some of these sites had been subject to soil degradation through erosion processes. Several current government initiatives are focused on the afforestation of areas with high levels of actual or potential soil erosion.

National level monitoring of New Zealand soils by major land use types has been undertaken through the 500 Soils Project. This broad-scale survey conducted between 1995 and 2001 covered 511 sites, including 67 in plantation forests and 58 in indigenous forests. From this survey, Sparling and Schipper (2004) reported on the influence of management practices associated with the land uses for seven key soil quality characteristics. For all land uses, a high proportion of the sites had at least one soil property that did not meet the target ranges to define satisfactory soil quality. Nutrient status was a concern on about a quarter of the plantation forestry sites. Soil compaction was widespread under all land uses including indigenous forest, although the forests appeared to be in good health. Further information is available from the *National Soil Database* (Landcare Research, 2009).

SOIL EROSION

A broad indication of the levels of soil erosion for land

under forest cover in New Zealand can be derived from the New Zealand Land Resource Inventory (LRI) and the New Zealand Land Cover Database, see Table 4.2).

Soil erosion peaks may occur during harvesting operations in plantation forests, and the period between harvesting and the re-establishment of good vegetation cover. The construction of roads and tracks can be a major source of sediment (Payn, 2005). Earthworks are addressed by the *New Zealand Environmental Code of Practice for Plantation Forestry.* They are commonly subject to provisions of local government plans prepared under the Resource Management Act 1991 (see Indicator 4.2.a).

Very little harvesting occurs in indigenous forests. However, where harvesting is undertaken it concerns single trees, small groups of trees or small coupes under the sustainable forest management requirements of the Forests Act, and often by helicopter.

Eroded sites can contribute to decreases in nutrient supply and damage can be long-term (Payn, 2005).

TABLE 4.2: SOIL EROSION AREA BY FOREST TYPE

DEGREE OF EROSION	FOREST AREA AFFECTED (000 HA)	
	INDIGENOUS FOREST	PLANTATION FOREST
Negligible	1 240	721
Slight	3 504	934
Moderate	1 309	256
Severe	248	38
Very severe	47	9
Extreme	14	3
Total LRI areas[1]	**6 362**	**1 961**

Note
1 New Zealand Land Resource Inventory (LRI) areas don't have full coverage of New Zealand, therefore total areas differ from those reported in other tables.

Sources
Ministry of Works and Development (1979).
Ministry for the Environment (2004).

NEW ZEALAND EMPIRICAL EROSION MODEL

Scientists from the Sustainable Land Use Research Initiative have developed the New Zealand Empirical Erosion Model (NZEEM) for gauging the effects of erosion in New Zealand. Their work will help regional councils identify and target the most vulnerable land, and minimise erosion and flood damage. NZEEM predicts mean annual soil loss from annual rainfall, type of terrain, and percentage of woody cover, for large and small catchments. The model can calculate the likely extent of erosion under different types of land cover. This will enable prioritising soil conservation work and defining those areas that would benefit from tree cover.

Landcare Research has also developed two erosion models for North Island regional councils where most of the hill country erosion is located. The first model produces spatial maps of highly erodible land at a resolution of 15 by 15 metres per pixel. The second model gives erosion rates in tonnes/km^2/year at the same resolution.

SOIL COMPACTION

The major cause of soil compaction on forested sites is

Gully erosion following land clearance, East Coast of the North Island. Photo: Alan Reid.

the concentrated use of heavy machinery (for example, on landings for harvesting operations), particularly when soil moisture levels are high. This issue is also addressed under the *New Zealand Environmental Code of Practice for Plantation Forestry.*

There are no national data available on soil compaction under forested land.

NUTRIENT SUPPLY

There is no evidence in New Zealand that successive harvests cause severe decrease in soil nutrient supply, but an early classification by Hunter et al (1988) suggested some soils will be less able to maintain nutrient supply than others. Landing sites for harvesting where topsoil has been removed are likely to show problems (Payn, 2005).

Large-scale plantation forest managers commonly monitor nutrient levels through foliage and/or soil analyses. Fertilisers are applied where nutrient deficiencies would adversely affect tree growth, and to maintain long-term productivity.

GOVERNMENT SUSTAINABLE LAND MANAGEMENT INITIATIVES

Several sustainable land management initiatives supported by government are designed to increase the level of forest establishment in New Zealand. These include the Afforestation Grant Scheme (AGS), the Permanent Forest Sink Initiative (PFSI), and the Sustainable Land Management (Hill Country Erosion) Fund. The AGS and PFSI focus on carbon sequestration and storage, but some of the afforestation is likely to be on eroding land. While not specifically implemented for soil erosion control, this is likely to be a secondary benefit.

SOURCES OF INFORMATION

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Ministry for the Environment (2004) *New Zealand Land Cover Database* (LCDB2). Ministry for the Environment; Wellington.

Ministry for the Environment (2007) *New Zealand Environment 2007*. Ministry for the Environment; Wellington; 456 p. http://www.mfe.govt.nz/publications/ser/enz07-dec07/index.html

Payn, T, (2005) Forest soils, in Colley, M (ed) *NZIF forestry handbook* (4th edition). New Zealand Institute of Forestry (Inc); Christchurch.

Sparling, G; Schipper, L (2004) *Soil quality monitoring in New Zealand: trends and issues arising from a broad-scale survey*. Agriculture, Ecosystems and Environment 104: 545–552.

FURTHER READING

Landcare Research (2004) *EcoSat project.* http://www.landcareresearch.co.nz/services/informatics/ecosat/

Landcare Research (2009) *National Soil Database.* http://www.landcareresearch.co.nz/databases/nsd.asp

Mead, DJ (2005) Fertilising. In Colley, M (ed) *NZIF forestry handbook* (4th edition). New Zealand Institute of Forestry (Inc); Christchurch.

New Zealand Forest Owners' Association (2007) *New Zealand environmental code of practice for plantation forestry*. NZFOA; Wellington.

INDICATORS 4.3 WATER

Water is one of the most valuable of forest ecosystem services. Forests and how they are managed, influence the quantity, quality and timing of surface and ground water flows. Changes to water quality and flow can have a severe impact on forest resources as well as human wellbeing. In addition, associated forest aquatic and riparian habitats are some of the most biologically diverse and productive forest ecosystems.

The quality and quantity of water flowing from forested areas is commonly regarded as an indicator of the quality of forest management. Water quality is widely understood to be a measure that captures many potential impacts on forest sustainability and a good indicator of overall ecosystem health.

Indicator 4.3.a Proportion of forest management activities that meet best management practices, or other relevant legislation, to protect water related resources

New Zealand has regulatory mechanisms through the Resource Management Act and the Forests Act relating to activities which may affect riparian zones, water quality and quantity. As well as these legislative mechanisms there has been an increase in the area of plantation forest that has been certified by the Forest Stewardship Council (FSC). New environmental codes of practice for plantation forestry and standards and guidelines for the sustainable management of indigenous forests have been published in 2007.

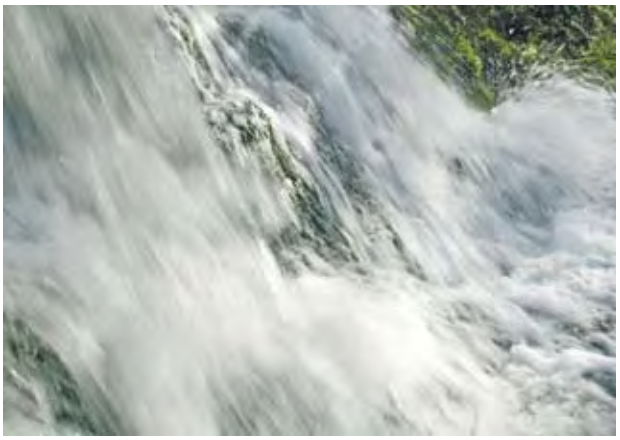
Quality of information: M **Progress against indicator: ▲**

RATIONALE

This indicator provides information about the extent to which water resources have been identified and safeguarded during forest management. This indicator is primarily concerned with activities that may affect riparian zones, water quality, quantity and flow rather than the designation of land for water-related conservation. The protection of the water resources and associated forest and aquatic ecosystems is vital for the human populations dependent on them.

2008 COUNTRY REPORT

New Zealand manages its water resources in accordance with the Resource Management Act 1991. In addition to the legislative requirements relating to water resources, there are standards and guidelines for indigenous forestry, an environmental code of practice for plantation forestry, and forest certification schemes.



THE RESOURCE MANAGEMENT ACT 1991

All forest management activities that may affect the riparian zones, water quality, quantity and flow are subject to the requirements of the Resource Management Act 1991. Local authority plans prepared under the RMA deal with issues relating to water quality and quantity, and may include rules relating to riparian areas, set-backs for plantation forestry, requirements for stream and river crossing, the classification of rivers and streams according to their values, and requirements for water monitoring.

As a consequence of the RMA requirements, regional councils collect and hold a large amount of water resource information, which has not been analysed specifically for this report. Their substantial resource is used for the monitoring, planning and reporting of activities that relate to water resources at sub-national level. The National Institute of Water and Atmospheric Research maintains a national river quality network not directly driven by RMA requirements (Ministry for the Environment, 2009).

The discussion on the RMA under Indicator 4.2.a is also relevant to the protection of water resources.

THE FORESTS ACT 1949

Landowners and forest managers seeking approvals for sustainable forest management plans and permits on privately owned indigenous forest land must comply with Part IIIA of the Forests Act 1949. The Act is administered by the Ministry of Agriculture and Forestry who consider water values in their processes.

The third edition of MAF's *Standards and Guidelines for the Sustainable Management of Indigenous Forests* was published in 2007. They reflect the statutory requirements under Part IIIA of the Forests Act and include a criterion and standards with indicators relating to water quality. These include the protection of permanent stream beds and stream margins.

FOREST CERTIFICATION

Most large-scale forest owners in New Zealand have taken up Forest Stewardship Council certification. This provides an independent and credible guarantee that the products come from forests that have been managed in accordance with FSC Principles and Criteria. In FSC terms, this verifies that the forest products come from well managed forests.

Principle 6, Environmental impact, covers the conservation of water resources and includes written guidelines being implemented to protect water resources.

See Indicator 4.2.a for data on the area of forests with FSC certification.

CODES OF PRACTICE

Indicator 4.2.a discusses *The New Zealand Environmental Code of Practice for Plantation Forestry*. Water quality values and issues are covered in most of the Best Environmental Management Practices.

SOURCES OF INFORMATION

Forest Stewardship Council (2002) *FSC international standard – FSC principles and criteria for forest stewardship*. FSC-STD-01-001 (version 4-0) EN Amended 2002. http://www.fsc.org/fileadmin/web-data/public/document_center/international_FSC_policies/standards/FSC_STD_01_001_V4_0_EN_FSC_Principles_and_Criteria.pdf

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FURTHER READING

Ministry for the Environment (2009) *An assessment of regional council water quality data (1996–2002) in support of national state of environment reporting (ENZ07)*. http://www.mfe.govt.nz/publications/ser/regional-council-water-quality-data-mar08/index.html

Indicator 4.3.b Area and percent of water bodies, or stream length, in forest areas with significant change in physical, chemical or biological properties from reference conditions

Although national river quality data are available, no analysed national information is available on changes in physical, chemical or biological properties of streams in forest areas. The quality of water from forest catchments is generally considered to be high. Some forest catchment studies have been undertaken. For plantation forests, the most significant measured water quality changes have been increases in suspended sediment.

Quality of information: L **Progress against indicator:** ▶

RATIONALE

This indicator provides information relating to water quality in forests. Significant changes in the physical, chemical or biological properties of water in forest lakes, rivers and streams may reveal the extent to which management activities or natural events are affecting water quality. Maintaining water quality is important for human use and consumption and to support healthy forest and aquatic ecosystems. Where water quality is being adversely affected by human activity, forest management practices may be adapted to protect water values.

2008 COUNTRY REPORT

There is no quantitative national information readily available to identify changes in physical, chemical or biological properties of water bodies that flow through New Zealand's forested lands. Many regional councils collect information to monitor water quality of catchments. Individual catchment studies provide some information to describe changes that have occurred after the historical clearance of indigenous forests and the development of plantation forests (and pastoral agriculture).

An analysis of the *River Environment Classification* and the *Land Resource Inventory* enables estimates to be made of the distances of rivers flowing across forested land areas against the degree of surrounding land soil erosion. This provides one indication of the potential for sedimentation (see Table 4.3).

The quality of stream water that drains indigenous forests and maturing plantation forests is generally high; concentrations of nutrients and suspended solids are low in forest streams (O'Loughlin, 2005).

The majority of indigenous forests are located in higher-altitude catchments, and most properties of their water bodies have not been significantly affected by human activities. However, the historical introduction of browsing animal pests has adversely impacted on the health of some forests, leading to accelerated soil erosion

Lake Brunner, West Coast, South Island.

and sedimentation in streams (O'Loughlin, 2005).

The protozoan parasite Giardia (*Giardia lamblia*) has become widespread in New Zealand water bodies, including those in forested catchments. Little information is available on *Cryptosporidium*, *E. coli* (*Escherichia coli*) or other bacteria in forest water bodies, and there is no certainty that these organisms do not exist in concentrations sufficient to be a threat (O'Loughlin, 2005).

For water bodies in plantation forests, the most serious change that has been measured in water quality are increases in suspended sediment concentration. This is associated with the construction of forest roads, tracks and landings; accelerated landsliding; and other forms of erosion after harvesting from steep, unstable slopes (Fahey et al, 2003 in O'Loughlin, 2005).

Plantation forest managers generally recognise that the management of riparian zones is an important mechanism for maintaining the physical and biological properties of water bodies.

Quinn et al (1997) researched water quality, habitat and biota in streams of the Hākarimata Ranges: these drain indigenous forest, pasture converted from indigenous forest 60 years earlier, and pine plantations established on pasture 15 years before. The effects on streams from converting indigenous forest to pasture, and subsequently converting some of the pasture to plantation forests, are summarised in Table 4.4.

The Pakuratahi Land Use Study (Eyles and Fahey, 2006) collected information for 12 years from two adjacent catchments, one in radiata pine plantation forest and the other in pasture. Key findings related to water included:

- In the pre-harvest period, annual water yields from the plantation forest catchment were 6 percent lower than from the pastoral catchment.
- Over two years post-harvesting, annual water yields were on average 22 percent greater in the forested catchment than the pastoral catchment.
- Seven years after harvesting, the difference in the annual water yields had declined to 5 percent.
- The pasture catchment yielded three to four times more suspended sediment than the mature plantation forest catchment.
- During harvesting, sediment yields increased two to three times above those from the pasture catchment.
- With oversowing and rapid replanting, sediment yields returned to pre-harvest levels within 2 to 3 years.
- Streams draining pasture and mature forest had similar levels of turbidity, nitrate-nitrogen, total phosphorus, and dissolved phosphorus.
- Harvesting did not cause any statistically significant increase in the concentration of any of the parameters mentioned above.
- Immediately after harvesting, stream invertebrate communities changed to being dominated by more impact-tolerant taxa.

SOURCES OF INFORMATION

Eyles, G; Fahey, B (2006) *The Pakuratahi Land Use Study.* Hawkes Bay Regional Council; Napier. http://www.hbrc.govt.nz/WhatWeDo/Land/PakuratahiLandUseStudy/tabid/299/Default.aspx

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O'Loughlin, CL (2005) Forestry and hydrology. In Colley, M (ed) *NZIF forestry handbook* (4th edition). New Zealand Institute of Forestry (Inc); Christchurch.

Quinn, JM; Cooper, AB; Davies-Colley, RJ; Rutherford, JC; Williamson, RB (1997) Land use effects on habitat, water quality, periphyton and benthic invertebrates in Waikato, New Zealand hill-country streams. *New Zealand Journal of Marine and Freshwater Research* 31: 579–597.

TABLE 4.3: DISTANCE OF RIVERS WITHIN FORESTED AREAS BY DEGREE OF SURROUNDING LAND EROSION (KILOMETRES)

DEGREE OF EROSION	INDIGENOUS FOREST	PLANTATION FOREST
Negligible	23 215	8 955
Slight	47 663	8 620
Moderate	16 049	2 522
Severe	2 855	462
Very severe	475	153
Extreme	217	89
Total stream distance	**90 474**	**20 801**

Sources
Ministry of Works and Development (1979) – Subjected to updating.
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FURTHER READING

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TABLE 4.4: EFFECTS ON STREAMS OF PASTURE DEVELOPMENT AND SUBSEQUENT PLANTATION FORESTRY COMPARED TO ORIGINAL INDIGENOUS FOREST

VARIABLE	PASTURE DEVELOPMENT	PLANTATION FOREST
MORPHOLOGY		
Shade	reduced	restored
Channel width	narrower	widening?
Current velocity	increased	restored
Bed sedimentation	increased	increased
Woody debris volume	reduced	>indigenous
WATER QUALITY		
Temperature	increased	restored
Dissolved nitrogen	increased	declining?
Clarity	reduced	reduced further
CARBON RESOURCES		
Stored CPOM[1]	reduced	restored
DOC[2]	increased	increased further
Algal epilithon	increased	restored
INVERTEBRATES		
Species richness	no change	no change
Sensitive species	reduced	largely restored
Density and biomass (reduced)	increased	restored

Notes
1 CPOM = coarse particulate organic matter.
2 DOC = dissolved organic carbon.

Source
Quinn et al (1997).

CRITERION 5

Maintenance of forest contribution to global carbon cycles

Forests are renewable and one of the largest terrestrial reservoirs of biomass and soil carbon. They have an important role in global carbon cycles as sinks and sources of carbon. Carbon stocks in forests include above ground biomass, below ground biomass, dead and decaying organic matter and soil carbon. Carbon is also stored in wood products.

The biosphere has a significant influence on the chemical composition of the atmosphere. Vegetation draws CO_2 from the atmosphere, through photosynthesis and returns it through respiration and the decay of organic matter. The interchange between the biosphere and atmosphere is large; approximately a seventh of total atmospheric CO_2 passes into vegetation each year.

Global climate change could have significant impacts on the structure, distribution, productivity, and health of temperate and boreal forests as well as impacts on forest carbon stocks and fluxes, and the prevalence of forest fires, disease and insect outbreaks, and storm damages.

Forest management practices also affect the carbon cycle and fluxes. Deforestation has a negative impact, but management activities that maintain and enhance the carbon stored in forests and forest products over the medium to long-term can make a positive contribution to mitigating atmospheric carbon dioxide levels. In addition, biomass from forests can be used as a substitute for fossil fuels thereby reducing greenhouse gas emissions.

Change in the global carbon cycle and associated climate change will have major impacts on human wellbeing, especially rural communities and indigenous peoples dependent directly on the natural environment.

TABLE 5.1: INDICATORS FOR CRITERION 5, QUALITY OF INFORMATION AND TRENDS

CRITERION 5: MAINTENANCE OF FOREST CONTRIBUTION TO GLOBAL CARBON CYCLES		QUALITY OF INFORMATION	TREND
5.a	Total forest ecosystem carbon pools and fluxes	M	▲
5.b	Total forest product carbon pools and fluxes	H	▲
5.c	Avoided fossil fuel carbon emissions by using forest biomass for energy	M	▲



KEY

L = low
M = medium
H = high

Neutral ▶
Positive ▲
Negative ▼
Insufficient data ?

NEW ZEALAND OVERVIEW

New Zealand has established a Land Use and Carbon Analysis System for reporting carbon pools and fluxes. Carbon stocks in forests are estimated based on the definitions of the four biomass pools as defined in the Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF) brought out by the Intergovernmental Panel on Climate Change (IPCC). These carbon pools are: above-ground biomass, below-ground biomass, coarse woody debris, and fine woody debris and litter.

A first LUCAS plot-based assessment of indigenous forests was completed from 2002 to 2007, although the current carbon estimates for plantation forests are based on information from the *National Exotic Forest Description.* The mid-point (2005) analysis estimated a total of 1271 million tonnes of carbon in indigenous forests and 189 million tonnes in plantation forests.

Harvested wood products (HWP) store carbon, and the stock of these products has significance in national carbon reporting. This pool has increased over time.

Forest biomass accounts for about 7 percent (35.4 petajoule, PJ) of New Zealand's total primary energy supply, and about 25 percent of the renewable energy supply. If it was assumed that all biomass was replacing coal, then the avoided emissions would be about three million tonnes of CO_2-equivalent.

Pinus radiata plantations, Wairau Valley, Marlborough. Photo: Ian Platt.

Indicator 5.a Total forest ecosystem carbon pools and fluxes

New Zealand has established a Land Use and Carbon Analysis System (LUCAS) for reporting carbon pools and fluxes. A first LUCAS plot-based assessment of indigenous and plantation forests was completed between 2002 and 2007, although the current carbon estimates for plantation forests are based on information from the *National Exotic Forest Description*. The mid-point (2005) analysis estimated a total of 1271 million tonnes of carbon in indigenous forests and 189 million tonnes in plantation forests.

Quality of information: M **Progress against indicator: ▲**

RATIONALE

This indicator provides information about the total amount of carbon stored in forest ecosystems. It also describes changes, fluxes or flows in carbon between forests and the atmosphere. A better understanding of these processes will aid the development of appropriate responses to the effects of climate change.

2008 COUNTRY REPORT

Carbon stocks in New Zealand forests are estimated based on the definitions of the four biomass pools defined in the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC, 2000). These pools are: above ground biomass, below ground biomass, coarse woody debris, and fine woody debris and litter.

The New Zealand data are being collected through the Land Use and Carbon Analysis System (LUCAS). The aim of LUCAS is to develop a robust and comprehensive data gathering, management, analysis and reporting system appropriate for reporting on the LULUCF sector under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. LUCAS will also support and underpin New Zealand climate change policy development through to 2012 and beyond. Data collection methodologies have been designed to provide unbiased carbon estimates at the national scale, with methods supported by relevant scientific research. Analysis of the data will provide nationally applicable values for carbon stock and stock change for the four carbon pools.

The forest carbon inventory involves the use of plots located on a systematic grid across New Zealand (8 km grid for indigenous forest and 4 km grid for plantation forest). Historic plots for soil carbon measurement have been established in different land uses.

Indigenous forest carbon estimates were based on data collected from 2002 to 2007 through the New Zealand's Carbon Accounting System inventory and analysed by Beets et al (2009). The results of this analysis were assumed to be an average for 2005. The reported estimates for carbon in indigenous forests are preliminary.

Plantation forests carbon stocks for these pools are quantified every year for the national greenhouse gas inventory (Wakelin, 2008). These are currently based on *National Exotic Forest Description* data. Plantation forests data for all the pools have been collected through New Zealand's Carbon Accounting System inventory and will replace NEFD-based estimates in the future.

TABLE 5.2: TOTAL CARBON IN PLANTATION AND INDIGENOUS FORESTS IN 2005

BIOMASS POOL	CARBON (MILLION TONNES)		
	INDIGENOUS FOREST	PLANTATION FOREST	TOTAL
Carbon in above-ground biomass	893	121	1 014
Carbon in below-ground biomass	223	26	249
SUB-TOTAL: LIVING BIOMASS	1 116	147	1 263
Carbon in coarse woody debris	119	24	143
Carbon in fine woody debris and litter	36	18	55
SUB-TOTAL: DEAD WOOD AND LITTER	155	42	198
Total	**1 271**	**189**	**1 461**

Source
Beets et al (2009) – Indigenous forest.
Wakelin (2008) – Plantation forest.

SOURCES OF INFORMATION

Intergovernmental Panel on Climate Change (IPCC) (2000) *Good practice guidance and uncertainty management in national greenhouse gas inventories*. Penman J; Kruger D; Galbally I; Hiraishi T; Nyenzi B; Emmanuel S; Buendia L; Hoppaus R; Martinsen T; Meijer J; Miwa K; Tanabe K (eds). IPCC/OECD/IEA/IGES, Hayama, Japan.

Beets, PN; Kimberley, MO; Goulding, CJ; Garrett, LG; Oliver, GR; Paul, TSH (2009) *Natural forest plot data analysis: carbon stock analyses and re-measurement strategy*. Scion Research contract for the Ministry for the Environment; Wellington.

Wakelin, SJ (2008) *Carbon inventory of New Zealand's planted forests – calculations revised in October 2008 for New Zealand's 2007 greenhouse gas inventory*. Scion; Rotorua. Contract report for the Ministry of Agriculture and Forestry; Wellington.

FURTHER READING

LUCAS project. http://www.mfe.govt.nz/issues/climate/lucas/

New Zealand's UNFCCC reporting. http://maindb.unfccc.int/public/country.pl?country=NZ

New Zealand 2009 National greenhouse gas inventory submission (2008 inventory). http://unfccc.int/files/national_reports/annex_i_ghg_inventories/national_inventories_submissions/application/zip/nzl_2009_nir_15apr.zip

Indicator 5.b Total forest product carbon pools and fluxes

Harvested wood products store carbon, and the stock of these products has significance in national carbon reporting. The Intergovernmental Panel on Climate Change has developed different methods for calculating HWP contribution. As the HWP pool is increasing, including it in national reporting would demonstrate increased net removals of carbon dioxide by the forestry sector.

Quality of information: H **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the role that forest products play in storing, cycling and releasing carbon. Forest products delay the release of carbon into the atmosphere and are more sustainable than products with manufacturing processes that have significant carbon footprints.

2008 COUNTRY REPORT

The carbon stocks in New Zealand's harvested wood products have been estimated using a New Zealand HWP model developed by Wakelin et al (2008). The estimated carbon stocks use statistics from the *United Nations Food and Agriculture Organization for production, export and import of forest products in New Zealand* (FAO, 2009). The model is based on Chapter 4 of the *Agriculture, Forestry and Other Land Uses* (AFOLU) volume of the revised *2006 IPCC guidelines for greenhouse gas inventories* (IPCC, 2006). The Conference of the Parties to the United Nations Framework Convention on Climate Change accept the 2006 IPCC guidelines for the preparation of national greenhouse gas inventories. However, they provide more detailed methodologies to account for HWP when compared with the currently used inventory guidelines (IPCC, 1996, 2000, 2003).

The lifespan of carbon in wood products is divided by the lifespan in-use (accounted as HWP) and after the product is discarded (accounted in the waste sector). IPCC default values for half-life in-use for different HWP were used, since there are no country-specific values available. Some of the default values applied to New Zealand's HWP are[1]:

- Sawn wood 35 years
- Veneer, plywood and structural panels 30 years
- Non-structural panels 20 years
- Paper 2 years

The 2006 guidelines present four approaches for HWP reporting. The first three are as defined by Brown et al (1999):

Stock change approach – Estimates net changes in carbon stocks in the forests and the wood products pools within national boundaries. Changes in carbon stock in forests are reported in the country in which the wood is grown (producing country). Changes in the products pool are reported in the country where the products are used (consuming country). These stock changes are reported within national boundaries, where and when they occur.

Atmospheric flow approach – Reports net emissions or removals of carbon to/from the atmosphere within national boundaries, where and when emissions and removals occur. Removals of carbon from the atmosphere due to forest growth are reported in the producing country, while emissions of carbon to the atmosphere from oxidation of harvested wood products are reported in the consuming country.

1 Table 3a.1.3 in *Good Practice Guidance for Land Use, Land Use Change and Forestry* (IPCC, 2003).

Production approach – Estimates the net changes in carbon stocks in the forests and the wood products pools, but attributes both to the producing country. This approach inventories domestically produced stocks only and does not provide a complete inventory of national stocks. Stock changes are reported when, but not where they occur if wood products are traded.

The fourth methodology defined in similar terms by Ward (2004):

Simple decay approach – Estimates the net emissions or removals of carbon to/from the atmosphere when, but not where they occur if wood products are traded. Removals of carbon from the atmosphere due to forest growth, and emissions resulting from forest harvesting are accounted for in the producing country.

The New Zealand HWP model uses default conversion factors from product units to carbon[2] and a carbon fraction of 0.5.

2 Table 12.4 in *2006 IPCC Guidelines for National Greenhouse Gas Inventories* (IPCC, 2006).

Mahinapua Scenic Reserve, West Coast, South Island.

TABLE 5.3: ESTIMATION OF HWP CONTRIBUTION BY EACH IPCC APPROACH, IN MILLION TONNES (MT) CO_2-EQUIVALENT (CO_2-E) PER YEAR

APPROACH FOR HWP REPORTING	CHANGE IN HWP STOCK (MT CO_2-E/YR)		
	1990	2003	2008
Stock change approach	1.08	2.65	2.45
Atmospheric flow approach	5.31	13.62	13.65
Production approach	2.29	6.96	7.35
Simple decay approach	6.04	10.84	7.73

The results presented in Table 5.3 presents the HWP contribution estimated for each approach (total CO_2 removals). These results indicate that overall the HWP pool is growing (Table 5.4). This trend is consistent with the information reported in 2003, with all reporting methods indicating an increase in carbon stored in HWP since 1990. In 2008, it was estimated that HWP stored between 2.5 (stock change approach) to 13.7 (atmospheric flow approach) million tonnes of carbon dioxide. The atmospheric flow approach represents the highest HWP contribution, favourable for a country like New Zealand which exports more than half of the forest products it produces and has relatively low imports.

SOURCES OF INFORMATION

Brown, S; Lim, B; Schlamadinger, C (1999) *Evaluating approaches for estimating net emissions of carbon dioxide for forest harvesting and wood products*. Report from IPCC Expert workshop, Dakar, May 1998. IPCC/OECD/IEA. OECD; Paris; France; 20 p.

Wakelin, SJ (2008) *Carbon inventory of New Zealand's planted forests–calculations revised in October 2008 for New Zealand's 2007 greenhouse gas inventory*. Scion; Rotorua. Contract report for the Ministry of Agriculture and Forestry; Wellington.

TABLE 5.4: TOTAL NET REMOVALS WITHOUT AND WITH HWP CONTRIBUTION, IN MILLION TONNES (MT) CO_2-EQUIVALENT PER YEAR

NET FOREST REMOVALS WITHOUT AND WITH HWP CONTRIBUTION	NET FOREST REMOVALS (MT CO_2-E/YR)		
	1990	2003	2008
NET PLANTATION FORESTS REMOVALS WITHOUT HWP CONTRIBUTION (WAKELIN, 2008)	18.17	24.07	23.97
NET REMOVALS WITH HWP CONTRIBUTION			
Stock change approach	19.25	26.73	26.42
Atmospheric flow approach	23.47	37.69	37.62
Production approach	20.46	31.03	31.32
Simple decay approach	24.21	34.91	31.69

Food and Agriculture Organisation (FAO) (2009) *FAOStat: FAO statistical databases*. Food and Agriculture Organisation of the United Nations, Rome. http://faostat.fao.org/site/626/default.aspx#ancor

Intergovernmental Panel on Climate Change (IPCC) (2006) *2006 IPCC guidelines for national greenhouse gas inventories*. Prepared by the National Greenhouse Gas Inventories Programme, Eggleston, HS; Buendia, I; Miwa, K; Ngara, T; Tanabe, K (eds). IGES; Japan.

Intergovernmental Panel on Climate Change (IPCC) (2003) *Good practice guidance for land use, land use change and forestry*. Penman, J; Gytarsky, M; Hiraishi, T; Krug, T; Kruger, D; Pipatti, R; Buendia, L; Miwa, K; Ngara, T; Tanabe, K; Wagner, F (eds). IPCC/OECD/IEA/IGES; Hayama; Japan.

Ward, M (2004) *Harvested wood products – a beginning guide to key issues*. http://homepages.paradise.net.nz/murrayw3/documents/pdf/HWP%20article.pdf

Wakelin, SJ; Turner, JA; Love, S; Nebel, B (2008) *New Zealand's harvested wood products carbon accounts*. Scion; Rotorua. Contract report for the Ministry of Agriculture and Forestry; Wellington.

FURTHER READING

Intergovernmental Panel on Climate Change (IPCC) (1997) *Revised 1996 IPCC guidelines for national greenhouse inventories*. Houghton JT; Meira Filho, LG; Lim, B; Treanton, K; Mamaty, I; Bonduki, Y; Griggs, DJ; Callander, BA (eds). IPCC/OECD/IEA; Paris; France.

Intergovernmental Panel on Climate Change (IPCC) (2000) *Good practice guidance and uncertainty management in national greenhouse gas inventories*. Penman, J; Kruger, D; Galbally, I; Hiraishi, T; Nyenzi, B; Emmanuel, S; Buendia, L; Hoppaus, R; Martinsen, T; Meijer, J; Miwa, K; Tanabe, K (eds). IPCC/OECD/IEA/IGES; Hayama; Japan.

Indicator 5.c Avoided fossil fuel carbon emissions by using forest biomass for energy

New Zealand forest industries use about 250 000 tonnes of forest biomass per year as a source of energy. There is potential for this to increase considerably in the future. About 7 percent of the country's primary energy comes from forest biomass. The degree of fossil fuel carbon emission avoidance depends on which type of energy source the forest biomass replaces.

Quality of information: M **Progress against indicator:** ▲

RATIONALE

This indicator provides information about the amount of energy produced from forest biomass and the extent to which it offsets the need to burn fossil fuels, thereby benefiting the global carbon budget and lowering carbon emissions.

2008 COUNTRY REPORT

New Zealand has about 1.8 million hectares of plantation forests throughout the country. Residues from harvesting operations offer a significant source of biomass that has a potential to be used for energy. Harvest residues currently yield about 250 000 tonnes per annum, largely used in the wood processing industry. The volume of residues potentially available from forest harvesting is significant and will increase over the time, estimated to peak at 5 million tonnes by 2030.

Forest biomass plays a small role in New Zealand's consumer energy supply. Its share has been around 7 percent of the total primary energy supply and 25 percent of the renewable energy supply. In 2007, 6.9 percent (35.4 petajoules) of New Zealand's total consumer energy of 508.2 PJ came from biomass. Biomass residues could provide another 60 PJ per annum. The contribution from residues could theoretically rise to 90 PJ in the future. The potential also exists to substantially increase the nation's biomass contribution to energy from dedicated energy forests.

Figure 5.1 illustrates the contribution of biomass and other renewables to the New Zealand's total primary and renewable energy supply since 2000. In 2007, biomass was the second largest source of renewable consumer energy in the country. Figure 5.2 illustrates the breakdown of the New Zealand's renewable consumer energy supply in 2007.

The use of biomass for energy has not been increasing in New Zealand because there are cheaper indigenous sources of other renewable and fossil energy available: hydro, wind and coal. However, there is a potential of a step-change if bioethanol from biomass becomes competitive in price with fossil fuels.

The use of biomass in New Zealand involves mainly combusting wood residues to provide process heat in the wood processing industry, and to a lesser extent for co-generation and residential space heating. In the forestry industry, heat plants fuelled by biomass are common. Biomass, usually wood waste, is also supplemented by fossil fuels such as coal and gas. The use of biomass for process heat and electricity generation also has the advantage of reducing waste disposal costs while utilising a renewable resource. Co-firing is used to improve boiler performance when using low-quality primary fuels.

FIGURE 5.1: PRIMARY, RENEWABLE AND BIOMASS ENERGY SUPPLY IN NEW ZEALAND 2000–2007

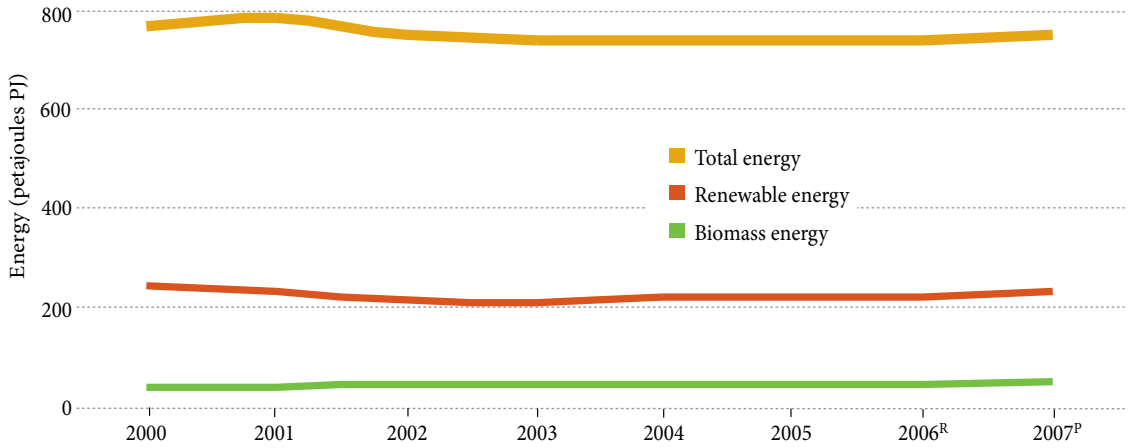
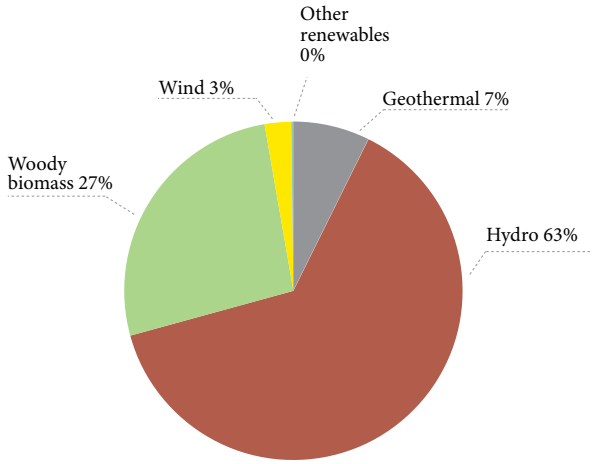


FIGURE 5.2: RENEWABLE CONSUMER ENERGY IN NEW ZEALAND



Source
Ministry of Economic Development (2008).

The use of biomass can be considered as avoiding use of fossil fuels, thereby benefiting the national carbon budget and lowering carbon emissions. However, there are some complexities in calculating avoided emissions. The biomass energy could be replaced by renewable sources (geothermal, wind and hydro) or fossil fuels, hence avoided emission depend upon the choice of the energy source.

If it is considered that all the current biomass energy (35 PJ in 2007) was replacing coal, the avoided emission would be about three million tonnes of CO_2-e using an average emission factor of 89.4 kilo tonnes of CO_2-e per PJ.

SOURCES OF INFORMATION

Ministry of Economic Development (2008) *New Zealand energy data file*. Available at: http://www.med.govt.nz/templates/StandardSummary____15169.aspx

SCION (2007) *Bioenergy options for New Zealand: situation analysis – biomass resources and conversion technologies*. Scion; Rotorua.

CRITERION 6

Maintenance and enhancement of long-term multiple socio-economic benefits to meet the needs of society

Forests provide a wide variety of social, cultural and economic goods, services and other benefits that contribute to meeting the needs of society. Many people and communities, including indigenous peoples, are dependent on forests for their livelihood and well being. Information on the production and consumption of forest products, investment and employment in the forest sector, forest-based recreation and tourism, and other social and cultural forest values illustrate the many benefits forests provide.

TABLE 6.1: INDICATORS FOR CRITERION 6, QUALITY OF INFORMATION AND TRENDS

CRITERION 6: MAINTENANCE AND ENHANCEMENT OF LONG-TERM MULTIPLE SOCIO-ECONOMIC BENEFITS TO MEET THE NEEDS OF SOCIETY		QUALITY OF INFORMATION	TREND
	PRODUCTION AND CONSUMPTION		
6.1.a	Value and volume of wood and wood products production, including primary and secondary processing	H	▶
6.1.b	Value of non-wood forest products produced or collected	L	▲
6.1.c	Revenue from forest based environmental services	L/M	▲
6.1.d	Total and per capita consumption of wood and wood products in round wood equivalents	H/M	▶
6.1.e	Total and per capita consumption of non-wood products	L	▶
6.1.f	Value and volume in round wood equivalents of exports and imports of wood products	H	▶
6.1.g	Value of exports and imports of non-wood forest products	L/M	▶
6.1.h	Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption	M	▶
6.1.i	Recovery and recycling of forest products as a percent of total forest products consumption	M	▶
	INVESTMENT IN THE FOREST SECTOR		
6.2.a	Value of capital investment and annual expenditure in forest management, wood and non-wood forest product industries, forest-based environmental services, recreation and tourism	L/M	▶
6.2.b	Annual investment and expenditure in forest-related research, extension and development, and education	M/L	▶

CRITERION 6: MAINTENANCE AND ENHANCEMENT OF LONG-TERM MULTIPLE SOCIO-ECONOMIC BENEFITS TO MEET THE NEEDS OF SOCIETY		QUALITY OF INFORMATION	TREND
	EMPLOYMENT AND COMMUNITY NEEDS		
6.3.a	Employment in the forest sector	H	▼
6.3.b	Average wage rates, annual average income and annual injury rates in major forest employment categories	M/H	Wages ▶ Injury ▲
6.3.c	Resilience in forest-dependent communities	L/M	▶
6.3.d	Area and percent of forests used for subsistence purposes	L	▶
6.3.e	Distribution of revenues derived from forest management	L	▶
	RECREATION AND TOURISM		
6.4.a	Area and percent of forest available and/or managed for public recreation and tourism	M	▲
6.4.b	Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available	M	▲
	CULTURAL, SOCIAL AND SPIRITUAL NEEDS AND VALUES		
6.5.a	Area and percent of forest managed primarily to protect the range of cultural, social and spiritual needs and values	M	▲
6.5.b	The importance of forests to people	M	▲



KEY

L = low
M = medium
H = high

Neutral ▶
Positive ▲
Negative ▼
Insufficient data ?

NEW ZEALAND OVERVIEW

FOREST VALUES

New Zealand's forests are well recognised for a range of natural, cultural, social and economic values, although the relative importance of each value and mixes of values vary with the nature and location of the forests. Māori have strong cultural, spiritual and economic connections with forests and forestry.

The area of forest land in the Crown-owned conservation estate has increased from 4.9 million hectares in 2000 to 5.0 million hectares in 2008. The purpose of management of this forest land by the Department of Conservation is to maintain the intrinsic values.

THE COMMERCIAL FOREST INDUSTRIES

New Zealand has good time series of statistical datasets for the commercial production of wood, processed wood products, and trade in wood products. These now apply very largely to the plantation forests, as there is little wood harvested from New Zealand's indigenous forests.

Roundwood removals from 2002 to 2008 have hovered around 20 million cubic metres per year. The volumes/quantities of processed wood products similarly show modest increases and decreases over this period in accordance with market conditions. Log exports have fluctuated from 5.8 to 8.4 million cubic metres per year.

Annual apparent domestic consumption of wood and wood products from 2000 to 2007 has ranged from 7.0 to 9.4 million cubic metres (roundwood equivalent) per year. It is not clear what has driven the yearly variations that peaked in 2003/04. Annual imports of wood and wood products (in roundwood equivalents) have comprised between 20 and 30 percent of apparent domestic consumptions over this period (assuming all imports are consumed domestically).

About 70 percent of the harvested volume is exported as logs or processed wood products. The value of exports of wood and wood products has decreased (with the exception of one year) from $3.5 billion in 2003 to $2.9 billion in 2008. This reflects the often weak global markets, high shipping costs and a high exchange rate (NZD/USD) over this period. Over the same time, the value of imports increased from $1.2 billion to $1.5 billion ($NZ).

Although the commercial forest industries are significant employers in many regions and major employers in a few, the past five years have seen an 18 percent decrease in direct employment. Wage trends within the industries have been variable between 2001 and 2008, with a 14.1 percent real increase in hourly earnings for sawmilling and wood product manufacturing, but a 1.6 percent real decrease for forestry and logging.

Thanks to an increasing focus on health and safety within the forest industries, claims involving financial entitlements as well as fatal accidents have reduced in number.

With the exception of paper, limited progress has been made on the recycling of wood products. About 30 percent of domestic consumption of paper and paperboard is recycled. Significant volumes of waste timber and other wood products go to landfills.

NON-WOOD FOREST PRODUCTS

The non-wood forest products industries are generally limited in their development, often regional in focus, and sometimes not specific to forest, such as the

production of honey. Consequently, reliable and up-to-date information on production, consumption and trade is difficult to obtain. Exceptions are recreation and tourism, the latter being of high economic importance to New Zealand. In 2006/07 the Department of Conservation spent $112 million on the management and review of recreational opportunities in the Crown-owned conservation estate. It is estimated there were 33 million international and domestic visits to national parks and reserves in 2006, with 85 percent being for short stays or day visits. This is 18 percent higher than the estimated number of visits in 2001.

Many of the large-scale plantation forest managers now provide for recreational activities, with several plantation forests providing significant tourist attractions.

ENVIRONMENTAL SERVICES

Forests provide environmental services that support sustainable resource management; such roles are increasingly being acknowledged from parts of the New Zealand community. Mitigating soil erosion is possibly the principal environmental service that forest provide for New Zealand. Two regionally focused government funded schemes provide grants for tree planting for this purpose: the East Coast Forestry Project and the Sustainable Land Management (Hill Country Erosion) Fund. The Emissions Trading Scheme (ETS, currently under review) and the PFSI can provide financial recognition to forest owners for these services. No other environmental services provided by forests obtain financial recognition.

RESEARCH AND DEVELOPMENT

Total expenditure on research and development is difficult to assess: firstly because of the number of research providers and funding sources, and secondly because it is difficult to define investment that is forestry-related. However, the Foundation for Research, Science and Technology reduced its funding of forestry-related research between 2002/03 and 2006/07, even though total research funding through the Foundation for all areas increased by 37 percent.

INDICATORS 6.1 PRODUCTION AND CONSUMPTION

These indicators provide information on the contribution of wood and non-wood products, and environmental services, to national economies. The value, volume and revenues associated with domestic production and consumption of forest products and services, including through international trade, demonstrates the type and magnitude of the contribution of forests to domestic economies. They also provide information about market conditions relevant to forest management and the forest sector.

Indicator 6.1.a Value and volume of production of wood and wood products, including primary and secondary processing

New Zealand has readily available time series of statistical data on the production and trade of harvested wood and wood products. The annual values and volumes of wood and wood products vary with market conditions. National accounts provide information on the industries' financial contributions to the country's economy.

Quality of information: H **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the value and volume of wood and wood products at various stages of processing. The value and volume of wood and wood products reflects one aspect of the importance of forests and the wood processing sector to domestic economies.

2008 COUNTRY REPORT

New Zealand can estimate the contributions from commercial forest industries in terms of value to the economy or to New Zealand's gross domestic product through the following production groups in the New Zealand System of National Accounts (NZSNA) : "Forestry and logging" and "Wood and paper products". The units of value are New Zealand dollars of the year concerned, or in constant 1995/96 prices. The value added through downstream processing is estimated as the contribution to GDP of production groups "Wood and wood products", and two-thirds of the value of the "Paper, printing and publishing" group.

Table 6.2 illustrates the type of data that are available for value estimates, in this example in constant 1995/96 prices. This means that changes in the values shown reflect changes in the volume of output rather than price level changes. A similar table in dollars of the year would reflect the value changes due to both price and output quantity changes.

The volumes of output from the forests (roundwood removals) are provided in Table 6.3, and from the sawmilling, panel products, pulp and paper, and log and chip export industries in Table 6.4.

Further data on quarterly and annual production of major forestry products are available on the Ministry of Agriculture and Forestry's website, see below.

TABLE 6.2: FOREST INDUSTRIES CONTRIBUTIONS TO GDP EXPRESSED IN 1995/96 PRICES ($ MILLION MARCH YEAR)

INDUSTRY GROUP	FORESTRY AND LOGGING	WOOD AND PAPER PRODUCTS	TOTAL GDP
2000	1 323	2 126	104 090
2001	1 390	2 200	106 554
2002	1 480	2 105	110 403
2003	1 562	2 277	115 829
2004	1 493	2 259	120 814
2005	1 412	2 431	125 362
2006	1 393	2 361	128 947
2007	1 453	2 324	131 311
2008	1 453	2 394	135 475

Source
Statistics New Zealand (2008).

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2008) *Forestry Production & Trade Statistics*. http://www.maf.govt.nz/statistics/forestry/

Statistics New Zealand (2008), *Gross domestic product by industry*. http://www.stats.govt.nz/NR/rdonlyres/79217417-010E-457B-8BE4-182F8B257AC8/0/gdpJun08qtrqgdppchainvolume.xls

TABLE 6.3: ESTIMATED ROUNDWOOD REMOVALS FROM NEW ZEALAND FORESTS (000 CUBIC METRES OF ROUNDWOOD)

YEAR ENDED 31 MARCH	INDIGENOUS FOREST TOTAL	PLANTATION FOREST					TOTAL REMOVALS
		SAW LOGS	PULP LOGS	EXPORT LOGS	OTHER	TOTAL	
2000	76	6 985	3 049	5 806	2 280	18 120	18 196
2001	55	7 221	3 566	5 917	2 528	19 232	19 287
2002	57	7 326	3 504	7 382	2 671	20 883	20 940
2003	38	8 369	3 288	8 087	2 690	22 434	22 472
2004	32	7 742	3 057	7 313	2 766	20 878	20 911
2005	27	8 013	3 286	5 123	2 855	19 277	19 303
2006	23	7 641	3 234	5 067	2 860	18 802	18 825
2007	18	7 768	3 284	5 973	2 872	19 897	19 915
2008	18	7 839	3 492	6 199	2 858	20 388	20 406

Source
Ministry of Agriculture and Forestry (2008).

TABLE 6.4: ANNUAL PRODUCTION VOLUMES/QUANTITIES BY FOREST INDUSTRIES

YEAR ENDED 31 MARCH	SAWN TIMBER (000 M^3)	PANEL PRODUCTS (000 M^3)	PULP (000 AIR-DRY TONNES)	PAPER AND PAPERBOARD (000 TONNES)	LOG & CHIP EXPORTS (000 M^3 ROUNDWOOD EQUIVALENT)
2000	3 806	1 551	1 528	830	6 965
2001	3 848	1 651	1 572	872	7 136
2002	3 864	1 744	1 524	847	7 604
2003	4 447	2 016	1 513	852	8 423
2004	4 222	2 077	1 463	845	7 024
2005	4 392	2 179	1 587	921	5 764
2006	4 234	2 214	1 561	940	5 840
2007	4 301	2 203	1 529	872	6 875
2008	4 341	1 939	1 546	871	6 630

Source
Ministry of Agriculture and Forestry (2008).

Indicator 6.1.b Value of non-wood forest products produced or collected

The economic benefits that New Zealand derives from the forest estate are not confined to timber production. The indigenous and plantation forests are key components of the $14.1 billion tourism and recreation industry. Nature-based tourism activities are among the principal attractions for overseas visitors; and an increasing number of communities are coming to rely on the employment generated by this sector. Some smaller industries also rely heavily upon the forest estate. These include the beekeeping industry, which produces several monofloral honeys based on tree species; the game hunting and trapping industry; and the sphagnum moss collection industry. These industries generate localised employment, which is important for supporting district and regional economies.

Quality of information: L **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the value of non-wood forest products. The collection, processing and use of non-wood forest products are important dimensions of the economic value of forests. In some countries, non-wood forest products are vital to the livelihoods and lifestyles of indigenous and other rural communities.

2008 COUNTRY REPORT

Timber production is just one of the economic benefits that New Zealand derives from its indigenous and plantation forests. The 8.3 million hectare estate is a key component of the New Zealand tourism industry, which employed 9.7 percent of the workforce in 2007 and contributed 9.2 percent of Gross Domestic Product[1]. New Zealand's forests also produce commercial quantities of game meat, hides, honey, possum fur and sphagnum moss. These products support a number of regional industries. A range of medicinal herbs and berries have traditionally been collected by Māori and the early European settlers. These resources have mainly been used for personal use, but are attracting increasingly commercial interest for health and skin-care products. Research is forecasting that the forest estate (particularly the 1.8 million hectares of plantation forest) can be grown in conjunction with secondary crops, such as mycorrhizal mushrooms. This development has the potential to significantly increase the net returns from the forest estate, and provide additional employment opportunities.

VALUE OF RECREATIONAL TOURISM

> *Natural attractions are widely regarded as New Zealand's key drawcard for international visitors… Nature-based tourism ranges from high impact adventure activities such as jet boating, skydiving and mountain climbing to more relaxing activities such as bush walking, wild life and scenic tours. (Ministry of Tourism, 2008)*

The Ministry of Tourism estimated that 71 percent of all international tourists to New Zealand participate in at least one nature-based tourist activity, while the *"propensity for domestic tourists was lower at around 21%, owing to a higher proportion of visitors being on business or visiting friends and relatives.. [… In 2006,] "tourists took part in 15.7 million nature-based activities (occasions), with 42% being enjoyed by international tourists and 58% by domestic tourists"* (Ministry of Tourism, 2008).

The tourism industry contributed $14.1 billion to New Zealand's Gross Domestic Product in the March 2007 year, through direct and indirect activity. This compares with $12 billion in 2003 and $8.7 billion

1 These figures include both direct and indirect (or downstream) employment.

in 1999. The 2007 figure represents 9.2 percent of New Zealand's GDP (Statistics New Zealand, 2007; Ministry of Tourism 2008). The significant growth in revenue over the past decade has been driven largely by overseas visitor numbers. Short-stay visitor numbers have climbed from 1.47 million in the 1998 to 2.48 million in 2008, as shown in Figure 6.1. The growth in visitor numbers between 1998 and 2003 was 40.1 percent, and in the subsequent five-year period (2003 to 2008), 20 percent. Over the ten-year period, the increase was 69.2 percent.

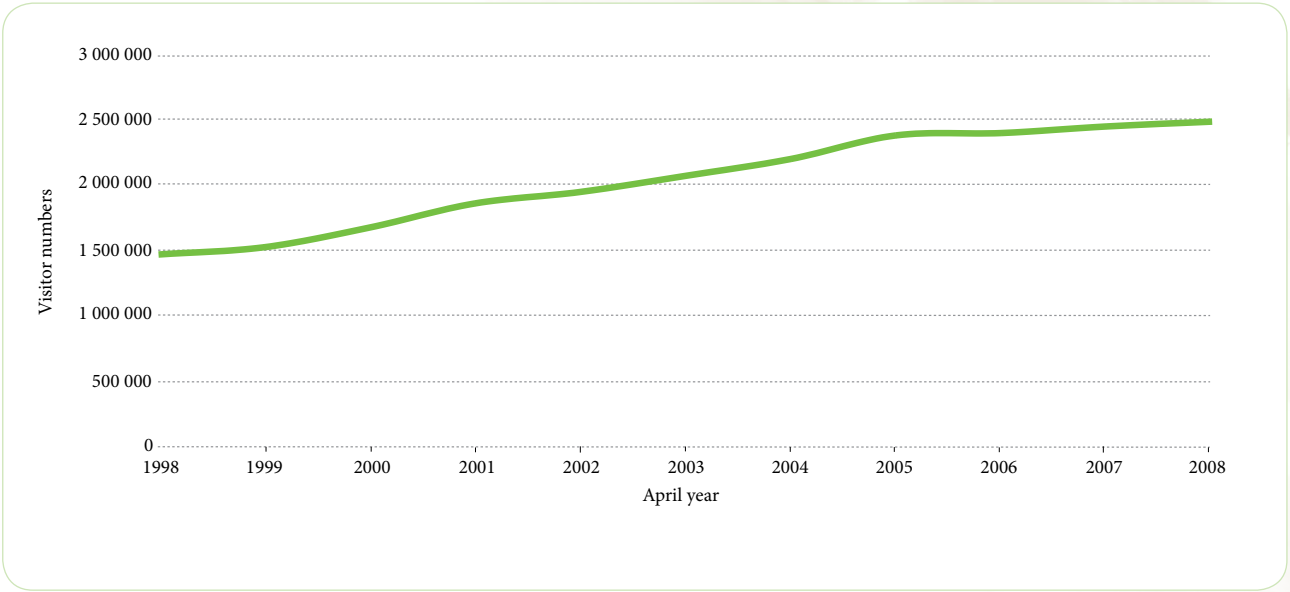
Direct employment in tourism was estimated to be 108 100 full-time equivalent positions in the March 2007 year. Another 73 100 FTEs were generated through indirect activities. The combined employment figure equated to 9.7 percent of the total workforce in the March 2007 year. Direct employment is estimated to have grown 2.6 percent between 2003 and 2007.

The importance of recreational tourism can be seen particularly in regions such as the West Coast of the South Island that continue to rely heavily on their natural resources. The region has extensive areas of indigenous forest, which have been incorporated into the Conservation estate. A recent study found that the economic activities associated with the public conservation estate contribute *"15 percent of the 12 341 full-time job equivalents in the region in 2003, 13 percent of total household income, and more than 10 percent of total gross output"* (Department of Conservation, 2006). The majority of these activities are tourist-related, followed by mining and farming. The activities are mainly conducted by third parties through a formal concession system. This system enables the Department of Conservation to monitor the use of the West Coast's natural resources, and ensure that they are being managed in a sustainable manner. In 2003, there were 682 third-party concessions on the West Coast for non-mining activities. The economic activity on conservation lands added value of $117.7 million in 2003 and had a total output of $221.6 million (Department of Conservation, 2006).

POSSUM FIBRE AND RELATED PRODUCTS

The past decade has seen renewed commercial interest in the trapping and processing of the Australian brushtail possum for fur production. Originally introduced with the objective of building a fur trade in New Zealand, the population has expanded to an estimated 70 million

FIGURE 6.1: OVERSEAS VISITORS ARRIVALS TO NEW ZEALAND



in the absence of natural predators. The species poses a significant threat to New Zealand's indigenous flora and fauna. The recent revival of the fur trade has been based on the development of a new fibre blend that incorporates possum fur and merino wool to produce a high-quality yarn. According to Warburton (2008), the possum-fibre-based industry has been developed over the last 15 years and has grown at about 10 percent per year over the last 7 years.

As outlined in Indicator 2.e, this new fibre blend has become an established part of the yarn industry and is estimated to be worth $50 to $70 million per annum. *"To service the current industry about 1 000 000 possums are harvested per annum with about 80% of the fibre being processed into yarn for manufacturing in New Zealand"* (Warburton, 2008).

Mānuka, flowers and seed capsules. Photo: Alan Reid.

There continues to be a small trade in fur skins and there is an emerging export market for possum meat, as a high-quality pet food.

COMMERCIAL GAME HUNTING

New Zealand is an internationally reputable destination for game hunting. The industry has experienced strong growth over the past 15 to 20 years, and now includes a number of game estates and reserves (large fenced areas of indigenous forest and open grasslands), where selected stock are introduced. Game estates can be well over 2000 hectares in size, and provide an experience comparable to open-range hunting. Hunters, mostly from the United States, are attracted by New Zealand's wilderness and the range of species that can be hunted. These include chamois, red deer, Sika, thar and wapiti. All of these species have been introduced over the past 150 years, and have established populations in New Zealand's forest and conservation lands.

> *"The costs of hunting on a game estate vary depending on the client's aspirations. It can range from $200 for a hind to $10,000 for a top trophy, with the average being $2,000 to $ 3,000." (Orman, 2006)*

The value of the game estate industry was estimated to be worth $15 million per annum at the beginning of the decade (Earl, 2001). A more recent estimate puts the earnings from the "safari industry [at] more than $20 million a year, plus an estimated 25% over and above that in added tourism-related spending" (McKinnon, 2006).

In addition to commercial game hunters, the country receives substantial numbers of visitors who hunt with New Zealand friends and family or who arrange their own hunting permits. While these visitors are not recorded in the game industry financial estimates, they do contribute to local economic activity through expenditure on accommodation and other services. The Ministry of Tourism estimates that 10 to 15 thousand

overseas visitors annually participate in some form of hunting or shooting activity (based on International Visitor Survey data for the 2003 to 2007 period).

GAME MEAT PRODUCTION

Commercial and private hunters have sourced game meat from New Zealand's forested areas for more than a century. As outlined in Indicator 2.e, commercial hunters were harvesting between 10 and 30 thousand feral deer per annum during the 1990s and the early part of this decade. Numbers fell away dramatically in 2002 and 2003, when venison prices fell and export controls were tightened. The recent recovery in venison prices is leading to some renewed interest in the commercial hunting of feral deer. Their handling has been approved for a limited number of venison processors; it may take several seasons of improved returns to see harvests reach the levels of the 1990s.

PRODUCTION OF HONEY AND RELATED PRODUCTS

New Zealand's beekeepers utilise a range of flowering indigenous and introduced tree species as sources of pollen and nectar. Three of the principal monofloral honeys are mānuka, southern rata and tāwari. Mānuka honey is particularly favoured as it contains natural compounds with recognised antibacterial properties, which enable it to be used in medical dressings and for treating burns. The University of Waikato's Honey Research Unit has been heavily involved in this work, and has developed a rating system using a Unique Mānuka Factor (UMF) "to show the level of activity in mānuka honey being sold as an antibacterial substance" (Waikato University, 2008). The Active Mānuka Honey Association estimates that the domestic and export market for UMF-rated honey (and products containing rated honey) is currently worth $100 million a year (Waikato University, 2008).

Beekeepers also extract honeydew nectar from two species of scale insects that inhabit the bark of beech trees (see Indicator 2.e).

Nationally, New Zealand produced 9660 tonnes of honey in the 2006/07 season, as described in Indicator 2.e. It is difficult to estimate the proportion of honey derived from forests and pasture species: apiarists frequently move their hives into forested areas or locate them on the bush line in early spring, so forest nutrients can be accessed (see Indicator 2.e).

Domestic honey consumption was about 5000 tonnes in the 2006/07 season, the remainder being exported (HortResearch, 2007). In addition to honey, New Zealand beekeepers produce a range of secondary products for the domestic and export market. These include: beeswax, live bees, queen bees, propolis (a resinous substance exuded by shrubs and trees) and honey powder.

SPHAGNUM MOSS COLLECTION

Another significant activity, in economic terms, has been the collection of sphagnum moss (see Indicator 2.e). Over 80 percent of the harvest is exported. Exports during the 1990s ranged between $13 million and $18 million per annum but have fallen back to $9 million in the June 2007 year (HortResearch, 2007).

FUTURE CROPS

Research efforts are also underway to extend the range of secondary crops that can be grown within the forest estate. Indicator 2.e provides details on the prospects for new crops such as edible mycorrhizal mushrooms, ginseng root, and medicinal herbs.

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Indicator 6.1.c Revenue from forest-based environmental services

The past decade has seen a growing recognition amongst New Zealanders of the role environmental services play in the sustainable development of their economy. A number of projects have been undertaken on valuing environmental services, and there is increasing political awareness of the need to incorporate non-market environmental services into decision-making. While there are limited examples of payments for environmental services, New Zealanders are recognising that these services will need to be considered in future negotiations on issues such as water and soil management.

Quality of information: L/M **Progress against indicator:** ▲

RATIONALE

This indicator provides information about forest-based environmental services for which markets and revenues are emerging or currently exist. Revenues from forest-based environmental services can be an important component of the economic value of forests.

2008 COUNTRY REPORT

New Zealand's plantation and indigenous forests provide a broad range of environmental services that benefit local communities and the national economy. These services include catchment protection, soil erosion mitigation, the provision of clean drinking water, the enhancement of biodiversity, and carbon sequestration and storage. While New Zealanders place a high priority on these services, they have generally treated them as a public, or free, resource (Department of Conservation and Ministry for the Environment, 2000). The exception to this has been catchment management. Community concerns in the early part of the twentieth century led to the passage of the Soil Conservation and Rivers Control Act in 1941. This Act authorised the establishment of local catchment boards, tasked with co-ordinating soil and water conservation. The boards provided financial assistance to landowners to carry out flood protection and soil conservation works. This normally involved tree planting programmes. A more recent and current example of this type of initiative is the East Coast Forestry Project that targets severely eroded properties with high sediment flows.

A DEVELOPING AREA OF PUBLIC DEBATE

The role of environmental services in the sustainable development of the New Zealand economy is emerging as a key policy and planning issue for the next decade. Government agencies, such as the Department of Conservation and the Ministry for the Environment, are taking on board the need to accurately assess New Zealand's natural capital, and to develop valuation methods that can measure non-market goods and services.

> *The first steps in preventing further decline in ecosystems (and the services they provide) are to recognise that they have economic values, and to attempt to measure at least some of them. Armed with this information, the Department [of Conservation] hopes to make better-informed conservation decisions, and increase public awareness of what is at stake…. (Department of Conservation, 2006)*

Demonstrating the growing awareness of this issue, local and central government agencies are developing base-line information on their environmental resources. They include assessments on the value, and future management, of environmental services. Public debate is now starting to examine how the providers of these services can be financially recognised by the downstream communities that benefit from these

services. This evolution in public attitudes is reflected in the Government's recently announced Afforestation Grant Scheme: assessment criteria for approving grants include soil conservation, water quality and improved biodiversity.

The need for this type of work is also being recognised by communities and commercial enterprises. Several project assessments in recent years have incorporated non-market environmental services as part of their analysis (Hughes et al, 2004). As New Zealanders become more familiar with this type of assessment, environmental values are likely to play a larger role in negotiations on land and water management issues.

RANGE AND VALUE OF ENVIRONMENTAL SERVICES PRODUCED BY THE FOREST ESTATE

The first systematic attempt to value the full range of benefits New Zealand derives from its natural resources was undertaken by Patterson and Cole in 1997. The results were published in 1999 and were used in the preparation of the New Zealand Biodiversity Strategy (2000).

> *Biodiversity is New Zealand's biological wealth. We base much of our economy on the use of biological resources, and benefit from the services provided by healthy ecosystems. These "ecosystem services" include producing raw materials … purifying water, decomposing wastes, cycling nutrients, creating and maintaining soils, providing pollution and pest control, and regulating local and global climates. (Department of Conservation and Ministry for the Environment, 2000)*

The valuation prepared by Patterson and Cole (1999) considered direct ecosystem services – the commercial and recreational activities that rely on natural resources – and indirect – environmental – services; New Zealand

TABLE 6.5: DIRECT AND INDIRECT VALUE DERIVED FROM NEW ZEALAND'S LAND-BASED BIODIVERSITY BY ECOSYSTEM TYPE (1994): TOTALS AND PER-HECTARE VALUES

ECOSYSTEM TYPE	DIRECT VALUE NZ_{1994}$ MILLION	INDIRECT VALUE NZ_{1994}$ MILLION	DIRECT AND INDIRECT VALUE NZ_{1994}$ MILLION
Forest[1]	2 427	3 458	5 885
Forest scrub[2]	84	695	779
Intermediate agriculture – forest[3]	109	398	507
Scrub[4]	3	601	604
All ecosystems (NZ total)	**13 728**	**25 608**	**39 336**
	DIRECT VALUE NZ_{1994}$ PER HA	**INDIRECT VALUE NZ_{1994}$ PER HA**	**DIRECT AND INDIRECT VALUE NZ_{1994}$ PER HA**
Forest	383	546	930
Forest scrub	66	544	610
Intermediate agriculture – forest	149	544	693
Scrub	3	544	547

Notes
1 Forest – mature indigenous forests and exotic commercial forests (6.33 million hectares).
2 Forest scrub – formations of trees in combination with scrub species. The trees are mainly indigenous podocarps, broadleaves or beech (1.28 million hectares).
3 Intermediate agriculture – forest – predominantly used for pastoral farming with some indigenous or exotic forestry (0.73 million hectares).
4 Scrub – mixed scrub species (1.1 million hectares).

Source
Patterson and Cole (1999).

depends on both to sustain healthy communities and a growing economy. Indirect services include the value derived from "erosion control, climate regulation, biological control, nutrient cycling, soil formation, disturbance regulation and so forth" (Patterson and Cole, 1999). The results from this valuation are shown in Table 6.5, and are based on 1994 values.

This analysis found that New Zealand's natural ecosystems contribute more in environmental services to national well-being than they do to the direct (market) economy. The principal environmental service was found to be erosion control, contributing about 40 percent of the indirect value generated by the four ecosystems listed in Table 6.5. In the case of forest ecosystems, this equated to $1 360 million (1994 value). Other significant contributors were waste treatment and climate regulation.

This work, and the broader debate around environmental services, has encouraged local and central government agencies to examine various methodologies for valuing the benefits of ecosystems. For example, a recent study of the water supply services of the 22 000 hectare Te Papanui Conservation Park, near Dunedin in the South Island states:

> *In approaching a valuation of Te Papanui's water supply, Butcher Partners Ltd asked this question: if the water supply were suddenly removed, how much would it cost the biggest users to get water from somewhere else?*
>
> *The resulting value of the water supply was $11 million a year (in 2005 dollars) to provide water for Dunedin residents, hydro-electricity generators in the region, and to irrigate the fields of Taieri farmers. This figure equates to a one-off payment in 2005 of $136 million. (Department of Conservation, 2006)*

Mixed beech forest, Baton River, Nelson. Photo: Alan Reid.

EMISSIONS TRADING

An *Emissions Trading Scheme* has been introduced in New Zealand, into which forestry entered from January 2008. The ETS is under review (in 2009), but the current provisions enable owners of post-1989 forest on eligible land to participate and take responsibility for carbon stock changes that occur from 2008 on. If carbon stocks increase, the owners will earn carbon credits, but the owners must meet a decline by surrendering the equivalent amount of emission units.

The first trade of forest-based carbon credits in New Zealand Units under the ETS occurred in February 2009, when 50 000 tonnes of NZUs were reported to have been sold at NZ$20 per tonne. This is the first instance of commercial trading in forest-based environmental services in New Zealand.

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Mixed hardwood forest, former water supply catchment and now, Karori Wildlife Sanctuary, Wellington City. Photo: Alan Reid.

Indicator 6.1.d Total and per capita consumption of wood and wood products in roundwood equivalents

Consumption of wood products is estimated using imports, exports and production data. Total apparent consumption, and apparent consumption per 1000 capita, show minor variations during the period from 2000 to 2007, and for the final year were 8.4 million and 2029 cubic metres respectively.

Quality of information: H/M

Progress against indicator: ▶

RATIONALE

This indicator provides information on consumption, including consumption per capita, of wood and wood products. Their quantity consumed illustrates one aspect of society's dependence on forests as a source of raw materials.

2008 COUNTRY REPORT

This indicator can be interpreted as apparent domestic consumption of various wood and wood products. For New Zealand the interpretation is:

Apparent domestic consumption = production + (imports – exports)

Note that allowance is made for stock changes.

Consumption per capita = apparent domestic consumption in the reference period ÷ estimated mean population in the reference period.

Apparent domestic consumption and per capita consumption data are available for a range of wood and wood products. They include roundwood removals, sawn timber, wood pulp, paper and paperboard, plywood, particleboard and fibreboard. An example (for sawn timber) of the time series that is available for this indicator is shown in Table 6.7.

SOURCE OF INFORMATION

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TABLE 6.6: ESTIMATED DOMESTIC CONSUMPTION OF ROUNDWOOD, 2000 TO 2007[1]

YEAR ENDED 31 MARCH	TOTAL APPARENT CONSUMPTION (000 M^3)	APPARENT CONSUMPTION PER 1000 CAPITA (M^3)
2000	7 189	1 871
2001	7 363	1 905
2002	6 974	1 790
2003	8 871	2 241
2004	9 428	2 342
2005	8 484	2 083
2006	8 202	1 996
2007	8 425	2 029

Note
1 See Indicator 6.1.h for data on roundwood removals, imports and exports.

Source
Ministry of Agriculture and Forestry (2008).

TABLE 6.7: ESTIMATED PRODUCTION, IMPORTS, EXPORTS AND CONSUMPTION OF SAWN TIMBER

YEAR ENDED 31 MARCH	MEAN NZ POPULATION[1] (000)	PRODUCTION (000 M^3)	IMPORTS (000 M^3)	EXPORTS (000 M^3)	TOTAL APPARENT CONSUMPTION (000 M^3)	APPARENT CONSUMPTION PER 1000 CAPITA (M^3)	CONSUMPTION PER 1000 CAPITA (M^3) – 5-YR M.A.[2]
2000	3 843	3 806	32	1 398	2 440	635	557
2001	3 868[R]	3 848	35	1 528	2 356[R]	609[R]	572[R]
2002	3 900[R]	3 864	32	1 644	2 253[R]	578[R]	578[R]
2003	3 970[R]	4 447[R]	38	1 866	2 619[R]	660[R]	602[R]
2004	4 045[R]	4 222[R]	42	1 624	2 640[R]	653[R]	627[R]
2005	4 101[R]	4 392[R]	50	1 847	2 595[R]	633[R]	626[R]
2006	4 148[R]	4 234[R]	58	1 818	2 474[R]	597[R]	624[R]
2007	4 198[R]	4 280[R]	51	1 938	2 393[R]	570[R]	622[R]

Notes
1 R = revised
2 5-yr m.a. = five-year moving average.

Indicator 6.1.e Total and per capita consumption of non-wood forest products

New Zealand's per-capita consumption of non-wood products from the forest estate is relatively low and concerns mainly game meat and honey. While the hunting of feral deer, goats and pigs is a popular pastime, the meat procured from this source represents only a small proportion of the protein intake of the New Zealand population. Households have some reliance on the forest estate for honey, of which an average New Zealander consumes about one kilogram per annum. New Zealand's forests were traditionally used by the Māori population as a source of berries, herbs and nuts. Some harvesting of berries and herbs continues. The harvest levels are considered to be small, although the interest in the use of traditional foods and medicines, for private and commercial use, is growing.

The harvest of sphagnum moss is destined primarily for overseas markets, rather than domestic consumption. Similarly, possum trapping is mainly for export. The pelts and fur are used in high-value fashion garments, strongly focused on export or selling locally to international visitors. The recently developed merino/possum yarn is generating increased domestic interest in possum fibre; it is becoming more common to see garments in local retail outlets.

Quality of information: L **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the consumption of non-wood forest products. The quantity of non-wood products consumed illustrates society's dependence on forests as a source of these products.

2008 COUNTRY REPORT

Limited statistical data exist on the consumption of non-wood forest products in New Zealand, particularly game meat and wild food, as these are normally harvested for personal use.

> *Whilst [the New Zealand Food Safety Authority] is reasonably confident that it knows the range of wild foods that are harvested, there is a lack of reliable and up-to-date information on harvesting activities. (NZFSA, 2007)*

Some secondary information is available through hunting organisations and the companies that process non-wood forest products. This data indicates that the collection of game meat and wild foods is a small component of most New Zealanders' diet. However, collecting wild foods (from the forest and marine environments) continues to be a high priority for a section of the Māori population.

> *Traditional foods, their sources, and methods of food gathering (mahinga kai) remain important for Māori and are an integral part of manaakitanga (providing for others). Many of these traditional foods still make up a significant part of the Māori diet today. (NZFSA, 2005)*

GAME MEAT CONSUMPTION

The principal game animals harvested in New Zealand are deer, goats (including chamois and thar), pigs and rabbits. All these introduced species are considered to be animal pests, as they pose a threat to the natural ecosystems in which they now roam.

CONSUMPTION OF FERAL DEER (VENISON)

Red deer are the most commonly hunted species, followed by Sika deer and fallow deer. A limited number of surveys have been conducted on the number of deer harvested by recreational hunters. *"Nugent (1992) estimated that 41 662 red deer were hunted from the ground annually. Estimates were also made for the annual ground-based hunting of Sika deer (6845), fallow deer (3921), and deer of other species (1833)"* (NZFSA, 2005).

Anecdotal evidence from the New Zealand Deerstalkers' Association indicates that "90% of what is hunted ends up on the table" (NZFSA, 2007). Only a small percentage of the carcasses brought out by recreational hunters are sold. Commercial harvesting of deer from conservation lands and the forest estate was discussed in Indicator 2.e.

CONSUMPTION OF FERAL GOATS

A significant proportion of the annual cull of feral goats is for pest control rather than human consumption. Past surveys indicate that several hundred thousand feral goats are thriving in scrub-covered hill country on both conservation and private farm land (NZFSA, 2005). *"One annual take was estimated at 68 486, of which 57 000 were taken by private hunters (the rest by government hunters) (Nugent, 1992)"* (NZFSA, 2005,). The harvest of chamois and thar combined is in the order of two to three thousand per annum; they are mainly hunted for trophy heads not food consumption (Fraser, 2000; NZFSA, 2005).

Kawakawa can be used internally and externally for medicinal purposes.

CONSUMPTION OF FERAL PIGS

Feral pigs "inhabit forest and scrublands, and are prevalent on rough hill-country farmland" (NZFSA, 2005); such land covers about 34 percent of New Zealand. The majority of the feral pigs are harvested from private farmland and plantation forests (Fraser, 2000). Nugent (1992) estimated the annual cull to be in the order of 100 000 per annum (NZFSA, 2005).

BERRY, HERB AND NUT CONSUMPTION

Berries, herbs and nuts *"were traditionally harvested by Māori as an important part of their diet, particularly by hapū [sub-tribes] living close to the forest where they are most abundant. The level of harvesting occurring nowadays is not certain. Seeds, in particular the flax seed, are receiving growing attention in the retail industry for inclusion in breads and other products"* (NZFSA, 2005).

CONSUMPTION OF HONEY

New Zealand's honey production has averaged 9267 tonnes per annum over the period 2001–2007. Domestic consumption is estimated to be about 5000 tonnes per annum; the remainder is exported, principally to the United Kingdom, Australia and Singapore (HortResearch, 2007). The 1997 National Nutrition Survey found that "the average consumption for all respondents was 2.9 g/person/day" (NZFSA, 2005), or about 1.06 kg per person, per year. As discussed previously, the statistics collected on honey production do not differentiate between the origins of pollen and nectar, such as white clover and pasture, or indigenous stands of mānuka. Providing data separately would be complicated, as hives can be located in a variety of pasture and bush situations during a single season.

POSSUM FIBRE AND ASSOCIATED PRODUCTS

The Australian brushtail possum was introduced to New Zealand in an effort to establish a commercial trapping industry. The first recorded shipment of possum pelts occurred in 1921. The market for pelts has been variable, driven by overseas trends in the fashion industry, the public attitude towards fur products, and

the preference of international buyers[1]. During periods of depressed pelt prices, the quantity of skins exported fell below 500 000. In peak years, when returns were sufficient to provide a reasonable living for trappers, it exceeded three million. The negative image of fur in the 1980s and 90s saw demand fall away. The domestic market for pelts and possum fur has until recently been limited.

The renewed interest in possum fur over the past 10 years has been driven by the development of a new fibre blend that incorporates possum and merino wool fibres. Local companies are also taking more control of processing and garment development. The blended fibre is not recorded as a separate wool or yarn category.

A description of the recent changes in the industry has been provided in Indicator 2.e. While the level of domestic processing has increased, the industry still depends upon the export market to sell much of the yarn, and final fashion garments. Blended possum and merino products are increasingly seen in New Zealand retail outlets, but it will take time to build consumer interest. The blended fibre is used in products such as gloves, scarves and hats, which emphasise the heat retention properties of the fibre.

There has been limited use of possums as a game meat: the animal can be a carrier of tuberculosis (Tb vector), and has been implicated in the spread of the disease to farm animals such as cattle and deer. Ongoing efforts by the Animal Health Board and the Department of Conservation have successfully reduced the infected population, enabling specific areas to be declared disease-free. Possum meat is being used in the production of pet food, an industry in the initial stages of development. The demand is coming more from the export market than local consumer interest.

1 The principal markets for possum fur and skins have been the United States, the United Kingdom and the European Union.

The sphagnum moss industry is export-focused, the majority of the harvest being supplied to overseas customers.

SPHAGNUM MOSS USAGE

The sphagnum moss industry is export-focused, the majority of the harvest being supplied to overseas customers (see Indicator 2.e).

WHITEBAIT HARVESTING

Whitebait is the generic term for the juvenile form of five fish species from the *Galaxiidae* family. The Māori population traditionally caught whitebait and it has become one of New Zealand's aquatic delicacies. Harvesting whitebait is controlled by the Department of Conservation and is limited to a short season in spring (about three months). Whitebait can be found in many of New Zealand's major rivers and streams, but its presence has generally declined in areas of extensive pasture land (with agricultural run-off). Intact forested catchments, with their higher water quality, continue to be a major source of whitebait. One of the best known areas for whitebait is South Westland (on the West Coast of the South Island), where the majority of the streams have their source within the public conservation estate.

SOURCES OF INFORMATION

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Indicator 6.1.f Value and volume in roundwood equivalents of exports and imports of wood products

Forestry is the third-largest export earner for New Zealand, valued at NZ$2.9 billion in 2008; about 70 percent of the harvested volume is exported as logs or processed products. The value decreased in 2008, reflecting difficult market conditions. New Zealand imports about NZ$1.5 billion of wood products per year.

Quality of information: H

Progress against indicator: ▶

RATIONALE

This indicator provides information about the value and volume of a country's exports and imports in wood products and their contribution to the domestic economy. International trade in wood products may be a significant factor in the management, commercial use and economic value of forests.

2008 COUNTRY REPORT

Roundwood removals (currently about 20 million cubic metres per year) far exceed New Zealand's domestic consumption of wood products (see Indicator 6.1.d). About 70 percent of the harvested volume is exported as logs or is processed into a range of products for export markets. New Zealand has good statistical datasets covering the trade of forest products. The annual values and volumes of these exports from 2003 to 2008 are provided in Figures 6.2A and 6.2B.

New Zealand also imports about $1.5 billion of wood products per year. The values and volumes of these imports are provided in Figures 6.2C and 6.2D. "Other products" include the manufacture of paper and paperboard, wooden furniture, mouldings and other miscellaneous products.

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2008) *Forestry production & trade statistics*. http://www.maf.govt.nz/statistics/forestry/

FIGURE 6.2: VALUE (IN NZ$ 000, TOP) AND VOLUME (IN ROUNDWOOD EQUIVALENT 000 M³, BOTTOM) OF NEW ZEALAND EXPORTS (LEFT) AND IMPORTS (RIGHT) OF WOOD PRODUCTS.

Data on all products for all years are not available in 2007 and 2008 due to confidentiality rules. Note differences in vertical scales.

FIGURE 6.2.A: VALUE (IN NZ$ 000) OF NEW ZEALAND EXPORTS OF WOOD PRODUCTS

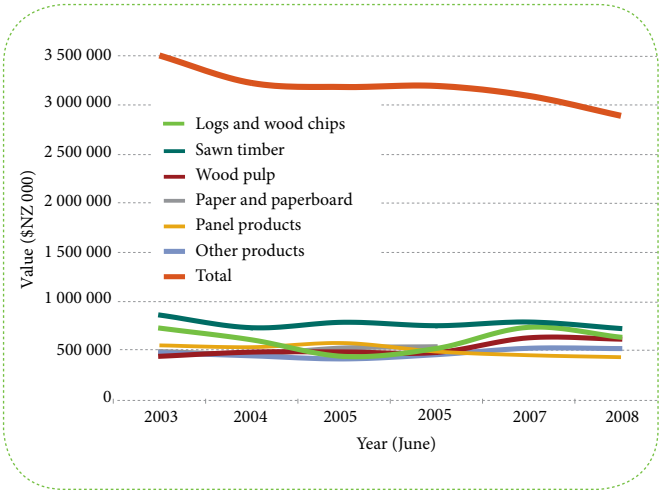


FIGURE 6.2.C: VALUE (IN NZ$ 000) OF NEW ZEALAND IMPORTS OF WOOD PRODUCTS

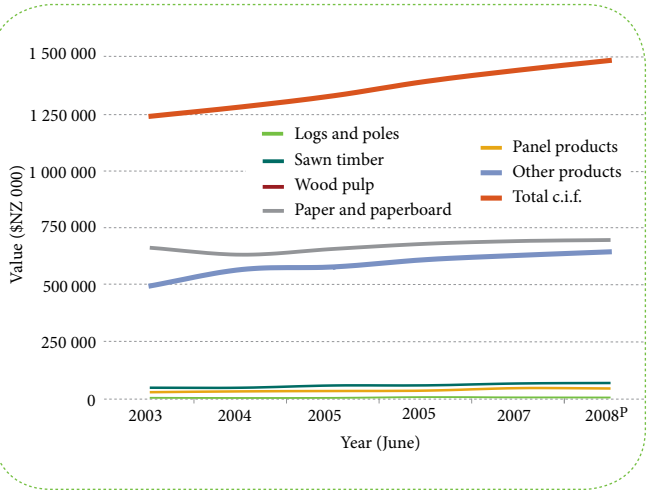


FIGURE 6.2.B: VOLUME (ROUNDWOOD EQUIVALENT 000 M³) OF NEW ZEALAND EXPORTS OF WOOD PRODUCTS

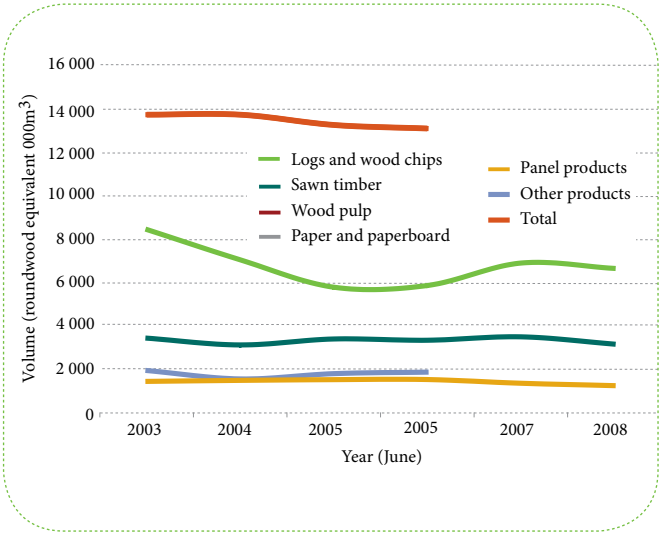
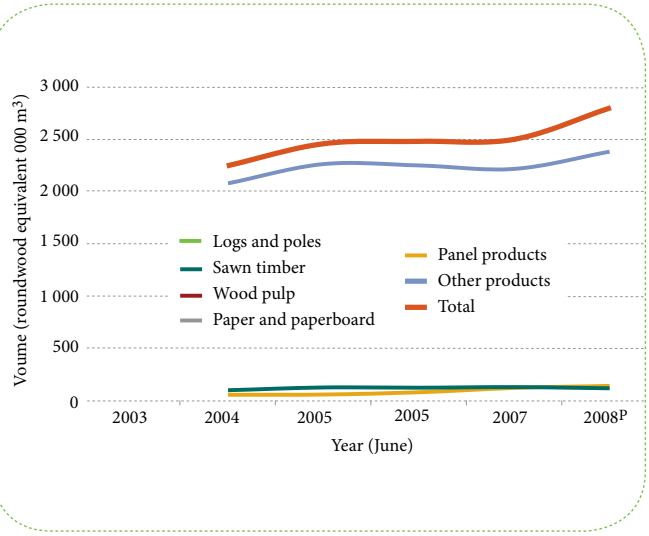


FIGURE 6.2.D: VOLUME (ROUNDWOOD EQUIVALENT 000 M³) OF NEW ZEALAND IMPORTS OF WOOD PRODUCTS



Notes
p = provisional, c.i.f. = cost, insurance, freight.

Source
Ministry of Agriculture and Forestry (2008).

Indicator 6.1.g Value of exports and imports of non-wood products

New Zealand currently exports a limited range of non-wood forest products. The principal categories of exports are honey ($55 million), sphagnum moss ($9 million), chamois leather ($2.5 million) and possum fur-skins ($2.3 million). Possum fibre is also exported as part of blended yarns and in fashion garments, while mānuka honey is used in several medical applications. An export industry is developing around the use of indigenous plant extracts in skin care and medical products. Imports of non-wood forest products are minimal. Only small quantities of natural resins, fur-skins, honey and chamois leather are imported each year.

Quality of information: L/M **Progress against indicator:** ▶

RATIONALE

This indicator provides information about the value of a country's exports and imports of non-wood products and their contribution to the domestic economy. International trade in non-wood products may be a significant factor in the management, commercial use and economic value of forests.

2008 COUNTRY REPORT

Non-wood forest products make up a small percentage of New Zealand's international trade. In the 2007 calendar year, the country imported or exported merchandise items amounting to $78.5 billion[1]. The principal non-wood forest products traded between New Zealand and the rest of the world are honey (and bee products), sphagnum moss, possum fibre, and limited quantities of plant foliage.

HONEY (AND BEE PRODUCT) EXPORTS AND IMPORTS

As discussed in Indicators 2.e and 6.1b, apiarists use the forest estate and forest margins as sources of pollen and nectar. A range of monofloral honeys are based around indigenous tree species, and a significant proportion of New Zealand's honey production (and exports) depend in part or in full on the forest estate.

The value of exports (in nominal terms) of honey and honey extracts has increased from $20.4 million in 2002 to $55.4 million in 2007 (Statistics New Zealand, INFOS), while imports over the same period have increased from $70 700 to $435 000. These figures do not include honey and honey extracts used in the production of value-added products, such as cooking ingredients, pharmaceuticals or medical applications.

VALUE OF SPHAGNUM MOSS EXPORTS AND IMPORTS

The sphagnum moss industry focuses on the export market, with more than 80 percent of production normally going overseas: mainly to Japan and South East Asia (see Indicators 2.e and 6.1.b). The major use of sphagnum moss is in orchid growing, as the moss can hold 20 times its own weight in water. A naturally sterile substance, sphagnum moss also has medicinal uses.

Export returns were in the range $13–18 million during the 1990s and the early part of this decade. Returns declined in 2004, and in 2007 were about $9 million per annum (HortResearch, 2007). Part of this decline results from the high value of the New Zealand dollar since 2003, and competition from other Pacific Rim producers.

Only small quantities of mosses and lichens are imported: normally less than $10 000 per annum according to trade data from Statistics New Zealand.

1 This figure includes all merchandise trade in 2007, which covers exports and imports of goods that alter the nation's stock of material resources.

VALUE OF FOLIAGE AND LIVE PLANT EXPORTS

New Zealand has a developing trade in the export of foliage, cut flowers and plants. Indigenous plants have a small role in these exports, for example several *Pittosporum* species are valued for their foliage, by flower arrangers. Between $0.4 million and $0.7 million of *Pittosporum* foliage is exported each year. Increasing numbers of live plants are also exported. Their value grew strongly in the first half of the decade, peaking in the June 2005 year at $15.7 million. Live plant exports have dropped in the June 2007 year to $11.6 million, which is still $6 million (or 107 percent) more than the comparable figure in 2000. (HortResearch, 2004; 2005; 2006; 2007).

THE TRADE IN POSSUM AND CHAMOIS

New Zealand's trade figures provide a detailed assessment of the trade in possum skins, but not the value-added products that have been developed over recent years. These value-added products include blended merino wool and possum yarn, fashion garments created from this yarn, and possum-based pet food. The trade in skins has seen a strong recovery from the position in the early part of the decade. In 2002, just $0.5 million of fur-skins were exported. In 2007, this had increased to $2.3 million. Imports of possum skins are negligible (Statistics New Zealand, INFOS).

The real growth in exports has been in downstream products, particularly the use of blended yarns that incorporate possum fur. As discussed in Indicator 2.e, the blended yarn industry is estimated to be worth "in the order of $50 to $70 million per annum" (Warburton, 2008).

This yarn is being used in a number of high-value

(branded) garment lines. A significant proportion of these garments is exported, or sold domestically to tourists. Possum-based pet food is another developing export area, gaining market acceptance in a number of Asian countries. Separate figures are not available for possum-based pet food.

New Zealand has a small trade in chamois leather. The value of exports (in nominal terms) has increased from $1.75 million to $2.5 million between 2002 and 2007, an increase of 41 percent. Imports have fallen over this period, from $0.33 million to $0.17 million (Statistics New Zealand, INFOS).

OTHER TRADED PRODUCTS

New Zealand has a small trade in natural gums and resins, a proportion of which are derived from forest lands. Exports have been in the $1–2 million range over the past five years, while imports have been in the $0.25–0.5 million dollar range.

Exports of commercially hunted game meat (principally venison) have declined sharply since the 2002/03 season, due to a tightening of the export regulations and an extended downturn in the price of venison.

There is growing interest in using indigenous plant extracts in skin care and medicinal products. There is on-going research in this area, and a small number of companies are working to develop overseas markets for these new product lines. Separate trade data are not available on these exports. Another potential export market is edible fungi (see Indicator 2.3).

SOURCES OF INFORMATION

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Statistics New Zealand (2008) *Overseas merchandise trade: December 2007*. Statistics New Zealand; Wellington; 13 p.

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National Beekeepers' Association of New Zealand, *Industry Profile*. http://www.nba.org.nz/Sections-article43-p1.htm

Mānuka flowers.
Photo: Alan Reid.

Indicator 6.1.h Exports as a share of wood and wood products production and imports as a share of wood and wood products consumption

About 70 percent of the annual volume of wood harvested in New Zealand is exported as logs or goes to the processing of exported wood products. The roundwood equivalent volume of imported wood products was about 14 percent of the domestically harvested volume in the year ended March 2008.

Quality of information: M **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the relative importance of international trade in wood and wood products to domestic production and consumption. Wood and wood product exports can be a significant source of revenue for domestic economies. Imports may supplement or substitute for production from domestic forest sources.

2008 COUNTRY REPORT

New Zealand has a well-managed sustainable plantation forest estate over an area of about 1.8 million hectares. The extent of the commercial forest resource and the size of New Zealand's population (4.27 million at 30 June 2008) mean domestic demand accounts only for a small proportion of the total production. The country is highly dependent on international trade and most of New Zealand's wood products are destined for overseas markets. Wood and wood products are the third-largest export industry in New Zealand. During 2000–2008, revenues from wood and wood product exports were more than NZ$3 billion a year, and more than 10 percent of the country's merchandise exports.

In 2008, the total harvest was about 20.4 million cubic metres, of which about 14 million cubic metres (roundwood equivalent) were exported as logs, poles, lumber, panel products, joinery, furniture and pulp and paper products.

New Zealand imports wood and wood products to meet its domestic requirements. In 2000 it imported 1.7 million cubic metres (roundwood equivalent), but that increased to 2.8 million cubic metres (roundwood equivalent) in 2008. Furniture, and paper and paper boards were the main imported items.

In 2000, New Zealand's estimated domestic consumption was 7.1 million cubic metres, which increased to 9.4 million cubic metres in 2004 and then declined to 8.4 million m^3 in 2007. The per-1000 capita consumption rose from 1871 cubic metres in 2000 to 2342 cubic metres in 2004, before dropping to 2029 cubic metres in 2007 (see Indicator 6.1.d).

The annual volumes of imports range between 20 to 30 percent of the volumes of total apparent consumption.

TABLE 6.8: ESTIMATED NEW ZEALAND PRODUCTION, IMPORTS, AND CONSUMPTION OF ROUNDWOOD[1], 2000 TO 2007

YEAR ENDED 31 MARCH	PRODUCTION (000 M^3)	IMPORTS[2, 3] (000 M^3)	TOTAL APPARENT CONSUMPTION (000 M^3)	APPARENT CONSUMPTION PER 1000 CAPITA (M^3)
2000	18 196	1 737	7 189	1 871
2001	19 287	1 608	7 363	1 905
2002	20 940	1 953	6 974	1 790
2003	22 451	2 134	8 871	2 241
2004	20 886	2 248	9 428	2 342
2005	19 260	2 458	8 484	2 083
2006	18 792	2 481	8 202	1 996
2007	20 038	2 494	8 425	2 029

Notes
1 No account is taken of changes in stock levels.
2 Imports are for years ended 30 June.
3 Imports do not take account of the use of sawmill residues in the country of origin.

Source
Adapted from Ministry of Agriculture and Forestry data.

An example of the type of information available for exports (and imports) is provided in Table 6.9.

Note that since 2007, the annually exported values and volumes of paper and paperboard have been suppressed to comply with Statistics New Zealand's confidentiality rules.

SOURCES OF INFORMATION

Ministry of Agriculture and Forestry (2008) *Forestry Production & Trade Statistics*. http://www.maf.govt.nz/statistics/forestry/

Statistics New Zealand (2008) *Overseas merchandise trade: December 2007*. Statistics New Zealand; Wellington; 13 p. http://www.stats.govt.nz/products-and-services/hot-off-the-press/overseas-merchandise-trade/overseas-merchandise-trade-dec08-hotp.htm?page=para004Master

TABLE 6.9: EXPORTS OF FORESTRY PRODUCTS FROM NEW ZEALAND, YEARS ENDED 30 JUNE 2000 TO 2008[1, 2]

FORESTRY PRODUCT, IN ROUNDWOOD EQUIVALENT[3] (000 M³(R))	2000		2001		2002		2003		2004		2005		2006		2007		2008[P]	
	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)	QTY (000 M³)	VALUE (NZ$ MILLION)
Logs and wood chips	6 965	706	7 136	771	8 614	830	9 361	779	7 024	601	5 764	432	5 840	513	6 875	729	6 630	627
Sawn timber	2 727	734	2 820	769	3 292	864	3 419	855	3 107	725	3 379	781	3 321	746	3 479	783	3 143	717
Wood pulp	2 208	610	2 225	620	2 355	518	2 023	433	2 258	477	2 417	478	2 387	473	2 363	622	2 405	609
Paper and paperboard[4]	1 425	510	1 267	577	2 086	557	1 929	481	1 541	457	1 784	518	1 853	531	..	..	..	..
Panel products	677	433	1 165	517	1 264	516	1 426	545	1 474	527	1 507	569	1 514	482	1 341	444	1 232	424
Other forestry products		353		353		410		413		438		407		450	..	515	..	512
All forestry products[5,6]	13 164		15 919		15 714		13 706		13 242		13 234		13 071			..		..
Total value		**3 346**		**3 606**		**3 695**		**3 506**		**3 224**		**3 184**		**3 194**		**3 093**		**2 889**
Total NZ merchandise trade[7]		**24 876**		**30 986**		**31 112**		**28 242**		**28 686**		**29 215**		**30 799**		**33 365**		**38 448**
Forestry products exports as a percentage of total merchandise exports		13.45		11.64		11.88		12.41		11.24		10.9		10.37		9.27		7.51

Notes
1 Values are NZ$ free on board (fob) and may include items such as some plywood items, for which no quantities are given.
2 Individual entries may not sum to stated totals, due to rounding.
3 Roundwood equivalent (m³(r)) has been estimated using conversion factors.
4 Paper and paperboard figures are suppressed in 2007 and 2008 to comply with Statistics New Zealand confidentiality rules.
5 All forestry products total value excludes Paper and Paperboard in 2007 and 2008.
6 This figure is not the sum of the sub-total roundwood equivalents as timber residue is used as input to other products.
7 Total New Zealand merchandise trade includes re-exports.
.. Not available

Source
Adapted from Statistics New Zealand and MAF data.

Indicator 6.1.i Recovery or recycling of forest products as a percent of total forest products consumption

With the exception of paper, New Zealand has made limited progress in the recycling of wood products. Significant volumes continue to go to landfills. The recycling (or safe disposal) of preservative treated timber is an issue New Zealand must address.

Quality of information: M **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the extent to which forest products are recycled or recovered. Recycled and recovered products are an important source of wood fibre for many industries and may compete with, or substitute for, harvested wood. Such products can help meet the demand for forest products without increasing harvest levels.

2008 COUNTRY REPORT

Paper is the major forest product that is recycled in New Zealand, and the only product for which recycling statistics are available. The annual tonnage of waste paper that is used in the manufacturing of paper and paperboard has been gradually increasing: see Table 6.10.

TABLE 6.10: WASTE PAPER USED FOR PAPER AND PAPERBOARD MANUFACTURING

YEAR ENDING MARCH	WASTE PAPER TONNES)
2000	189 666
2001	190 844
2002	199 774
2003	215 063
2004	218 259
2005	234 023
2006	234 023
2007	240 330
2008	260 064

Source
Ministry of Agriculture and Forestry (2008).

The total production of paper and paperboard for the year ended March 2008 was 871 000 tonnes, and total apparent domestic consumption was about 750 000 tonnes.

Little progress has been made in the recycling of waste timber and wood products (other than paper), with significant volumes going to landfills. In 2004, timber accounted for 14 percent of the estimated 3.2 million tonnes of solid waste that went to landfills. This does not include waste disposal to cleanfill, construction and demolition waste landfill sites, or dedicated industrial waste landfills (Ministry for the Environment, 2007). Coping with numerous types of wood products, and finding reliable recycling suppliers, have presented problems to establishing recycling operations (InWood, 2005). Preservative-treated timber presents a new recycling (or disposal) issue for New Zealand, as the first significant volumes are beginning to reach the end of their (theoretical) life-cycle.

A small market has developed for the use of recycled indigenous timbers. These timbers are mainly recovered from the demolition of older buildings and houses that were constructed when indigenous forests were the

principal source of timber. The recycled timber is used in furniture manufacturing and in the construction of new houses.

Scion's engineered wood products composite technologies research programme includes work on the recycling of wood product residues and wastes into composite materials.

SOURCES OF INFORMATION

FITEC (undated) *Forestry insights: recycling and re-use.* http://www.insights.co.nz/products_processes_rr.aspx

InWood (2005) *What a waste: compulsory wood recycling may be close*. Issue 64, August/September 2005.

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Ministry of Agriculture and Forestry (2008) *Statistics from annual pulp and paper mill survey* (unpublished). Ministry of Agriculture and Forestry; Wellington.

Scion (undated) *Engineered wood products.* http://www.ensisjv.com/ResearchCapabilitiesAchievements/WoodProductsProcessingandProtection/EngineeredWoodProducts/tabid/258/Default.aspx

Recycled rimu used in furniture. Photo: Alan Reid.

INDICATORS 6.2 INVESTMENT IN THE FOREST SECTOR

These indicators provide information on long-term and annual expenditures to enhance forest management, forest-based enterprises, and the knowledge and skills of people who are engaged in the forest sector. Maintaining and enhancing the long-term multiple socio-economic benefits derived from forests depends in part on investment in the forest sector, including both long-term capital investments and annual operating expenditures.

Indicator 6.2.a Value of capital investment and annual expenditure in forest management, wood and non-wood forest product industries, forest-based environmental services and recreation and tourism

Expenditure by the commercial forest industries is influenced by market conditions. These have been challenging at times in recent years and annual expenditure has varied accordingly. For non-wood forest products and the provision of environmental services, information on expenditure exists for some specific projects only. Expenditure by the government on all forestry-related activities is estimated to have increased by about 14 percent between 2000 and 2005.

Quality of information: L/M **Progress against indicator:** ▶

RATIONALE

This indicator quantifies investment and expenditure in developing, maintaining and obtaining goods and services from forests. Maintaining and enhancing forests and their benefits often depends on regular investments in restoration, protection and management, as well as in operations, forest industries and forest-based environmental services. When the capacity to protect, manage and use forests is eroded through lack of funding, the benefits that forests provide may decline or be lost.

2008 COUNTRY REPORT

Information is available on annual expenditure (and revenue) for the commercial forest industries, and for expenditure by the Crown. Information is not readily available on expenditure in the production of non-wood products and environmental services from New Zealand's forests.

COMMERCIAL FOREST MANAGEMENT AND WOOD-BASED PRODUCTS

Annual expenditure by commercial forestry enterprises is influenced by market conditions. Estimates of total expenditure for 2002 (data not available for 2003) and 2006 for major industry categories are provided in Table 6.11.

For wood product, and paper and paper product manufacturing, the expenditure is all from private enterprises. Central and local government (excluding state-owned enterprises) own about 5 percent of the plantation forest resource, so a small component of the expenditure under forestry and logging is from public sources.

For forestry and logging, the decrease in expenditure is partly accounted for by the levels of harvest; this decreased from 20.9 million cubic metres in 2002 to 18.8 million cubic metres in 2006 (years ending 31 March). This reduction reflected market conditions, exchange rates and shipping costs. Significant forest ownership changes have also resulted in changing objectives and expenditure patterns.

STATE FORESTRY

Forestry related operational expenditure and transfer payments by New Zealand's two principal government agencies with forestry responsibilities, the Department of Conservation and the Ministry of Agriculture and Forestry, increased from an estimated $184 million in 2000 to an estimated $221 million in 2005. This does not include the large majority of expenditure by research institutes or universities, nor does it include expenditure by a number of agencies involved in limited areas of forestry-related activities such as the Ministry of Foreign Affairs and Trade. Including all operational expenditure by state agencies brings the estimated totals to $235 million in 2000 and $276 million in 2005.

NON-WOOD FOREST PRODUCTS

The non-wood forest products industry is not well developed in New Zealand, and little information is available on investment or income. The main products are game meat, pelts, sphagnum moss and honey. In addition, small quantities of berries and fungi are harvested annually, along with plant extracts for medicinal remedies and healthcare products (see Indicators 2.e and 6.1.b).

Some examples of investment include the following research programmes:

- into mānuka honey, between the University of Waikato and healthcare products company Comvita worth $3.5 million over two years, milestone payments of up to $500 000, plus ongoing royalties (University of Waikato, undated);
- into nutrigenomics[1] and opportunities for new high-value foods worth $19.2 million (government-funded), with some foods based on forest plant species (Growing Futures, undated);
- between First Light Mushroom Co. Ltd and Crop & Food Research with investment of more than $10 million over six years, including government funding, to develop the commercial production of gourmet mushrooms under plantation forests (Crop and Food Research, 2008).

Rangiora in flower. Photo: Alan Reid.

ENVIRONMENTAL SERVICES

All forests provide environmental services of differing natures and to differing degrees. For New Zealand, the primary environmental services include maintenance

1 Nutrigenomics uses information about human genes to assess the effects of nutrients on health, performance and disease management.

TABLE 6.11: TOTAL EXPENDITURE IN 2002 AND 2006 FINANCIAL YEARS BY ANZSIC[1] ($ MILLION)

ANZSIC	2002	2006[P]
Forestry and logging	3 315	2 528
Wood product manufacturing	3 494	4 584
Paper and paper product manufacturing	2 680	2 683

Notes
1 ANZSIC = Australian and New Zealand Industrial Classification.
P = provisional.

Source
Statistics New Zealand (2008).

of biodiversity, soil conservation, maintenance of water quality, carbon sequestration and storage, and landscape values.

Environmental services are often components of, or secondary benefits from, broader forest management objectives. Consequently, little information on financial expenditure is available for specific environmental services on a national basis. Expenditure on some specific initiatives is addressed below.

The *New Zealand Biodiversity Strategy,* launched in 2000, has a 20-year vision of halting the decline in the country's indigenous biodiversity. To assist with its implementation, government allocated a five-year funding package of $187 million (covering land, freshwater and marine environments), commencing in 2000/01. At the conclusion of the five-year period, $28.7 million per annum was included in base-line funding to the Department of Conservation; this is intended for the continuation of biodiversity programmes and outputs that seek to achieve the outcomes of the *Biodiversity Strategy*.

The East Coast Forestry Project is a government-tendered grant scheme that has been in operation since 1993, to assist mitigating severe soil erosion in the East Cape region through forest establishment and regeneration. In 2000, expenditure on administration plus grants totalled $3.7 million, and in 2005 this was $4.0 million.

In 2007, $10 million was set aside to support over four years a Sustainable Land Management (Hill Country Erosion) Fund. This partly funds regional initiatives to work with hill country farmers, to treat soil erosion and work with climate change-related incentives to promote afforestation.

The Afforestation Grant Scheme is a new government initiative focused on climate change: a grant can be received for planting new forests on Kyoto-compliant land. Grant recipients will own the new forests while the government will retain carbon credits and take responsibility for deforestation liabilities. For the four years to 2011/12, the allocation to this scheme is $40.8 million.

Government's Permanent Forest Sink Initiative promotes the establishment of permanent forests on previously un-forested land. While no payments are made to land/forest owners, the initiative offers landowners the opportunity to earn Kyoto-compliant emission units.

Legislation introduced to establish an Emissions Trading Scheme is under review. If confirmed in its current form, this will enable owners of post-1989 forest on eligible land to choose to participate in the ETS, to take responsibility for carbon stock changes, and to earn carbon credits where the carbon stock increases.

RECREATION AND TOURISM

The management and review of recreational opportunities by the Department of Conservation in 2006/07 involved the total expenditure of $112 million. In 2001/02 the provision of recreational opportunities

and management of visitor and public information services by the Department accounted for $60.6 million.

Plantation forests are commonly available for restricted recreational activities, and a few have high levels of use. No data are available on expenditure on recreation in plantation forests.

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Plantation forest-stabilised watershed and adjacent cleared land, East Coast of the North Island. Photo: Alan Reid.

Indicator 6.2.b Annual investment and expenditure in forest-related research, extension and development, and education

The annual investment and expenditure in forest-related research, extension and development is hard to determine due to numerous research consortiums, research providers/industry arrangements, and the difficulty in isolating and defining investment and expenditure that is forestry-related.

Estimated investment in forestry-related research by the Foundation for Research, Science and Technology (FRST) has decreased slightly between 2002/03 and 2006/07. However, forestry has received government funding outside FRST for targeted strategic research and education initiatives.

Quality of information: M/L **Progress against indicator:** ▶

RATIONALE

This indicator provides information on annual investment and expenditure in forest-related research, extension and development, and education. Research underpins scientific understanding, including the ability to practise improved forest management and to develop and apply new technologies. Education, including extension activities, increases public awareness of the multiple benefits provided by forests.

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RESEARCH AND DEVELOPMENT FUNDING

In New Zealand, the principal source of Research and Development (R&D) funding is central government. Over the three years 2005/06 to 2007/08, the average vote to Research Science and Technology was $642 million compared, with $515 million in the previous three-year period. The Budget figure for 2008/09 is $726 million.

The Ministry of Research Science and Technology (MoRST) co-ordinates the allocation of research funding and monitors the effectiveness of the public sector investment. MoRST distributes its research budget through a number of agencies, the largest of which is the Foundation for Research, Science and Technology (FRST).

Around 22 percent of all New Zealand R&D is based in agriculture or forestry. A further 22 percent of the country's research effort is related to industry, 15 percent to development of infrastructure, and some 7 percent to care of the environment (Ministry of Research, Science and Technology, 2006a). While not all research in these areas is necessarily relevant to forestry, there is clearly potential for forestry to benefit.

The forestry sector contribution to R&D funding is difficult to calculate due to the numerous research consortiums and research provider/industry arrangements. In many instances, there are also significant in-kind contributions to research programmes.

Investments in forestry-related research by FRST between 2002 and 2006 are estimated at $24.1 million to $27.5 million per year. As shown in Table 6.12, forestry-related research accounts for 17 to 22 percent of FRST's estimated total research funding for the primary production sector during that period.

Estimated forestry-related research funding has decreased slightly between 2002/03 and 2006/07, even

though Vote Research Science and Technology (RS&T) increased 37 percent over the same period. To some extent, the increase in Vote RS&T has not necessarily occurred in the output expenses where forestry would be a major player. It is also important to recognise that forestry has received government funding outside FRST.

FOREST INDUSTRY DEVELOPMENT AGENDA

An example of other government funding has been the development a joint industry-government development process, called the Forest Industry Development Agenda (FIDA). Government's high-level objectives for the FIDA are to ensure forestry can make its optimal contribution to New Zealand's sustainable development; and plays a key role in the country's environmental goals.

The FIDA provides a means for government and industry to develop a strategic approach for the industry's future growth. It has been running since April 2005 and is an extension of the Wood Processing Strategy (WPS) that ran from 2000 to 2003. Cabinet allocated $18.2 million (GST-exclusive) to the FIDA process through to July 2009, shown in Table 6.13. Industry co-funding is required for some projects.

Projects range from promoting wood products, through new ideas for building houses with solid wooden walls, to reducing the use of pesticides in forests. The Market Access initiative is funding projects that address non-tariff barriers affecting wood exports. The Bioenergy initiative focuses on developing the use of woody residues as a bioenergy source, while Labour and Skills is funding the development of facilities in Rotorua for wood processing training.

Government announced in 2005 it would financially

TABLE 6.12: ESTIMATED BIENNIAL GOVERNMENT FORESTRY RESEARCH FUNDING

	2002/03	2004/05	2006/07
Government Vote Research Science and Technology[1,3]	445.4	555.0	630.7
Estimated primary sector research funding[2,3]	122.3	137.9	145.1
Estimated FRST forestry research funding[2,3,4]	27.5	24.1	25.9
Forestry percentage of estimated primary sector research (%)	22	17	18
Forestry percentage of Government Vote Research Science and Technology (%)	6	4	4

Sources
1 Treasury (2005).
2 Broom (2007, 2008).

Notes
3 Millions of dollars, excluding goods and services tax (GST).
4 The investment includes funds from FRST's Research for Industry, New Economy Research Fund, Environment and Research Consortia output expenses.

support the establishment of two wood design professorships, at the Schools of Engineering of Auckland and Canterbury Universities. This $2 million five-year initiative aims to increase awareness of sustainable building materials (principally timber) within the construction industry. These two positions will also be used to encourage high-class design approaches, using renewable materials.

The ongoing importance of government funding of forestry research is highlighted by a recent MAF estimate of support for forestry from 2000 to 2007: over $307 million of government spending over this period relating to forestry, of which about 45 percent was for research (Eyre, 2008).

TABLE 6.13: FIDA FUNDING ($ MILLION EXCLUDING GST)

INITIATIVE AREA	GOVERNMENT FUNDS	EXPECTED INDUSTRY FUNDS
Market development	8.0	2.7
Market access	1.2	0.4
Bioenergy	2.5	N/A[1]
Labour and skills	4.4	N/A[1]
Excellence in wood design	2.1	0.7

Note
1 Not applicable: these initiative areas are fully government-funded.

Source
Eyre (2008).

EDUCATION AND TRAINING

There is one Industry Training Organisation (ITO) covering forestry establishment, harvesting, solid-wood processing, wood panels, forest health, and pulp and paper production: this is the Forest Industries Training and Education Council (FITEC). At a university level, forestry education is through the School of Forestry at the University of Canterbury in Christchurch.

The numbers of people in forestry training give an indication of the funding levels. Since 2003, the total number of trainees in the forest industry has ranged from 11 000 to 12 700 (average 11 568). Modern apprentices have ranged from 375 to 429 (average 416) and the graduates from the University of Canterbury (forestry and forest engineering degrees) have ranged from 16 to 20 (average 18) (New Zealand Forest Owners' Association, 2004–2007).

Funding revenue for FITEC since 2003 has averaged $11.2 million dollars per annum, see Table 6.14. Government funded 73 percent of FITEC, and industry 17 percent. Funding for the University of Canterbury degree courses in Forestry Science and Forest Engineering totalled $2.2 million in 2007.

The National Centre of Excellence in Wood Manufacturing (NCEWM, formerly known as the Radi Centre) was established in 2002, in response to a recognised need for additional tertiary training in wood processing and timber design.

TABLE 6.14: REVENUE SOURCES FOR FITEC 2003–2006

REVENUE	2003 ($ 000)	2004 ($ 000)	2005 ($ 000)	2006 ($ 000)	AVERAGE (%)
Government revenue	7 357	8 928	8 509	7 923	73
Industry revenue	2 130	2 132	1 807	1 689	17
Other income	1 145	939	1 170	932	10
Total	**10 632**	**11 999**	**11 485**	**10 544**	**100**

Source
FITEC Annual Reports 2004–2007.

It is a partnership between the Waiariki Institute of Technology, the University of Auckland, and the Forest Industries Training and Education Council. Central government has provided major support. A grant of $2 million was provided to get the initiative off the ground; in April 2006, a further $5 million (over four years) was committed to develop new facilities and software to support training and innovation in timber design and production. The NCEWM draws on both New Zealand and overseas resources to support the training curriculum. In addition to training, the centre is developing partnerships with small to medium-sized businesses in the processing industry, to solve design and processing problems.

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INDICATORS 6.3 EMPLOYMENT AND COMMUNITY NEEDS

Forest-based and forest-related employment is a useful measure of the social and economic importance of forests at the national and local level. Wage and income rates and injury rates are indicators of employment quality. Communities whose economies are concentrated in forest industries, or who rely on forests for subsistence purposes, may be vulnerable to the short or long-term effects of economic or policy changes in the forest sector. These indicators provide information on levels and quality of forest employment, community resilience to change, use of forests for subsistence purposes, and the distribution of revenues from forests.

Indicator 6.3.a Employment in the forest sector

Forest management and timber processing are seen as drivers of regional economic activity in New Zealand. The sector is a significant employer in its own right; it also produces downstream activity in support services and further processing in areas such as transportation, furniture manufacturing and timber wholesaling. The wide geographical spread of the forest estate means there are employment opportunities in all districts but one. These opportunities include not only operational activities in the field or mill, but also positions in marketing, accounting and management. In the five years since the last country report, total forestry employment has declined due to market and foreign exchange conditions. Longer term, there are likely to be additional employment opportunities as the extensive plantings of the 1990s mature.

Quality of information: H **Progress against indicator:** ▼

RATIONALE

This indicator provides information on the level of direct and indirect employment in the forest sector. Employment is a widely understood measure of economic, social and community well-being.

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The forestry sector has been one of the drivers of the New Zealand economy, from the perspectives of employment and regional development. The sector was important for early development in the mid and late nineteenth century, and the current cohorts of plantings provide a sustainable resource base for domestic and export processing.

The modern picture of the forestry sector is of a range of diversified industries. Employment opportunities occur from logging and sawmilling through to cabinet making, pulp and paper manufacturing, energy production and research on bio-material applications. The sector has industries nationwide, with employment opportunities in all regions except the Chatham Islands.

The Central North Island currently has the largest number of workers employed in forestry and first-stage timber processing. The region had 38.7 percent of direct forestry employment in 2007, as shown in Table 6.15. This concentration of employment reflects the distribution of mature forests. The Central North Island was the focus of the first round of plantation plantings in the 1920s and 30s.

The former Forest Service sought to widen the distribution of plantings in the 1960s to 1980s, with new forests established in regions such as Northland, Nelson/Marlborough and Otago/Southland. Private investors also took on a larger role in forestry investment, and they tended to invest in a wider range of locations. The maturing of these plantings has enabled regional harvest

rates to be sustainably increased over the past 15 years. This has led to new investment in processing activity and employment. The combined Otago/Southland region experienced 3.6 percent annual growth in full-time employment between 1994 and 2003, which was "over three times the regional annual average growth rate in [full-time equivalent] employment of 1.1% [per annum]" (Business and Economic Research Ltd, 2005). The growth in regional harvest volumes generated additional employment across the country. There are now eight regions with over a thousand workers directly employed in forestry management, harvesting or first-stage processing.

The growth in new plantings during the 1990s (an estimated 554 000 hectares) provides a long-term base for expanding the industry and employment activity. These plantings are dispersed over a wide geographical area, and they combine both corporate and farm-scale plantings.

In looking at forestry employment numbers, it is important to examine not only direct employment, but also indirect and induced workforce activity. In the Otago/Southland situation, "the indirect and induced impacts of the sector generate[d] a further 3047 FTEs and $214 million in real GDP elsewhere in the region. In broad terms every one FTE employed in the sector generates a further 1.3 FTEs elsewhere in the region" (Business and Economic Research Ltd, 2005). A similar study in the Marlborough District found that "including indirect and induced effects, the forest industry generated $170 million in regional GDP and employed 1090 FTEs in the year ending March 2007" (Business and Economic Research Ltd, 2008).

RECENT TRENDS IN EMPLOYMENT ACTIVITY

Over the past five years, the forestry sector has seen a decline in employment activity: a combination of market and exchange rate conditions severely impacted upon industry profitability. To counter the downturn in market

TABLE 6.15: REGIONAL DISTRIBUTION OF EMPLOYMENT IN FORESTRY AND FIRST-STAGE PROCESSING

REGION	2002		2007	
	COUNT[1]	PERCENTAGE	COUNT[1]	PERCENTAGE
Northland	2 300	9.30	1 962	9.60
Auckland	1 847	7.40	1 500	7.30
Central North Island	10 500	42.25	7 891	38.70
East Coast	1 010	4.10	810	3.95
Hawkes Bay	1 112	4.50	1 083	5.30
Southern North Island	2 100	8.45	1 870	9.15
Nelson/Marlborough	1 913	7.70	1 857	9.10
West Coast	620	2.50	450	2.20
Canterbury	1 457	5.80	1 418	6.90
Otago/Southland	1 993	8.00	1 627	7.90
National total	**24 852**	**100.00**	**20 389**	**100.00**

Note
1 Figures are based upon "employee count", that is, a head count of all salary and wage earners for the February month. Employment figures are rounded and discrepancies may occur in compounded figures.

Source
Statistics New Zealand: New Zealand Business Demographic Statistics.

conditions, companies have restructured, and sought to improve productivity. As shown in Tables 6.15 and 6.16A, the number of forestry wage and salary earners has declined by about 18 percent between 2002 and 2007. Every region has seen a reduction in employment activity. The Central North Island has been most seriously affected, the 'Count' falling by 2609 employees.

The downturn in new planting since about the year 2000 has significantly impacted upon the number of workers employed in nursery operations, site preparation, planting and silviculture ("Services to Forestry"). This segment of the industry has declined by 1550 workers since 2002. The decline in forestry activity has flowed through to harvest volumes and employment. Harvest volumes in 2007 were about 5 percent lower than in 2002. Employment numbers have fallen by a larger percentage, as contractors have sought to reduce costs by adopting new technology and systems, to increase employee productivity.

Employment in log preparation and sawmilling has fallen by 9.3 percent. A proportion of this labour has been taken up in further processing activities. Employment activity in re-sawing and dressing (for example floorboards, mouldings and kiln-dried timber) has increased 25 percent over the past 5 years. Ongoing rationalisation in the pulp, paper and paperboard industry has seen employment numbers decline by 31 percent since 2002.

Looking to the wider forestry sector (Table 6.16B), the structural component industry experienced positive growth of 36 percent (1630 workers). This industry covers the manufacturing of wooden structural fittings; wooden components for pre-fabricated wooden buildings; wooden door frames, roof trusses and the like. Another important component of the industry is domestic and export furniture manufacturing, which has experienced a decline in employment of 11 percent. This is related in part to the high exchange rate (limiting exports), and stronger imports of furniture.

The New Zealand timber industry is currently at a cyclical low. The industry has taken steps to improve productivity, and to adapt to trading conditions that have become difficult, particularly as a result of the downturn in the North American construction industry. The sector is well positioned to take advantage of improvements in Pacific Rim trading conditions. Improved trading conditions will generate additional employment opportunities in the harvesting, processing and forest support industries.

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TABLE 6.16A: EMPLOYMENT COUNT[1] IN FORESTRY AND FIRST-STAGE PROCESSING (2002–2007)

ANZSIC CODE	DESCRIPTION OF ACTIVITY	2002	2005	2007	PERCENTAGE CHANGE (2002–2007)
A030100	Forestry	980	800	550	–43.90
A030200	Logging	4 590	3 760	3 610	–21.35
A030300	Services to forestry	3 860	3 100	2 310	–40.15
C231100	Log sawmilling	7 430	7 610	6 750	–9.15
C231200	Wood chipping	30	9	9	–70.00
C231300	Timber re-sawing and dressing	1 760	1 920	2 200	25.00
C232100	Plywood and veneer manufacturing	1 800	1 990	1 730	–3.90
C232200	Fabricated wood manufacture	1 340	1 300	1 140	–14.90
C233100	Pulp, paper and paperboard manufacturing	3 040	2 690	2 090	–31.25
Forestry and first-stage processing		24 852	23 179	20 389	–18.00
Total labour force as at March quarter[2]		**1 980 200**	**2 144 600**	**2 238 000**	**13.00**

TABLE 6.16B: EMPLOYMENT COUNT[1] IN INDUSTRIES ASSOCIATED WITH FORESTRY (2002–2007)[2]

ANZSIC CODE	DESCRIPTION OF ACTIVITY	2002	2005	2007	PERCENTAGE CHANGE (2002–2007)
C232300	Wooden structural component manufacturing	4 510	6 310	6 140	36.15
C232900	Wood product manufacturing (n.e.c.)[3]	2 130	2 060	2 130	0.00
C292100	Wooden furniture and upholstered seat manufacturing	6 370	6 450	5 630	–11.60
C233200	Solid paperboard container manufacturing	840	680	700	–16.70
C233300	Corrugated paperboard container manufacturing	1 150	1 230	1 180	2.60
C233400	Paper bag and sack manufacturing	230	200	190	–17.40
C233900	Paper product manufacturing (n.e.c.)[3]	1 530	1 180	1 130	–26.15
F453100	Timber wholesaling	5 320	4 070	4 140	–22.20

Notes
1 Figures based upon "Employee count", that is a head count of all salary and wage earners for the February month. Employment figures are rounded and discrepancies may occur in compounded figures.
2 The total labour force figures are derived from the Household Labour Force Survey, Statistics New Zealand.
3 n.e.c. = not elsewhere classified.

Source
Statistics New Zealand: New Zealand Business Demographic Statistics.

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Indicator 6.3.b Average wage rates, annual average income and annual injury rates in major forest employment categories

Nationally, New Zealand workers have seen their total hourly earnings rise by about 10 percent (in real terms) from 2001 to 2008. Within the forestry and timber processing industries the wage trends have been more variable. Total hourly earnings in sawmilling and wood product manufacturing have increased by 14.1 percent in real terms. This rise has been supported by strong domestic demand for skilled labour. In the case of forestry and logging workers, their total hourly earnings have seen a small decline in real terms, of 1.6 percent between 2001 and 2008. The wage trend in this industry has been adversely affected by the downturn in harvesting activity since 2003.

The forestry and timber processing industries have worked closely with the New Zealand Department of Labour and the Accident Compensation Corporation to identify risk areas in their operations, and to adopt injury prevention and monitoring initiatives. A strong emphasis is now being placed on benchmarking the health and safety performance of companies. The sector has made steady progress over recent decades in reducing the number of fatal accidents, through improved operational practices. The number of accident claims involving financial entitlements has shown a stable to declining trend since the previous country report.

Quality of information: M/H **Progress against indicator: Wages** ▶ **Injury Rates:** ▲

RATIONALE

This indicator provides information on average wage and income rates, and injury rates. These are important aspects of employment quality and the economic value of forests and forest related employment to communities.

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AVERAGE EARNINGS IN THE FORESTRY AND TIMBER PROCESSING INDUSTRIES

Wage rates in New Zealand have grown in both nominal and real terms over the past decade. This has been driven by a combination of low unemployment, tight labour conditions and improvements in productivity. In the period 2001–2008, total hourly earnings (including overtime) increased by more than 30 percent in nominal terms and by about 10 percent, when adjusted for inflation. Wage rates have increased particularly for skilled technical positions, where there is both a domestic and an international labour shortage.

Wage growth has not been consistent across the board, as every industry has its own set of drivers and constraints. Export industries, such as forestry, wool and meat production have been constrained by the relatively high New Zealand dollar and variability in commodity prices.

Average hourly earnings for workers in the forestry and timber processing industries can be tracked over time, using data from *New Zealand's Quarterly Employment Survey* (QES). Managed by Statistics New Zealand, the QES provides quarterly estimates of changes in average hourly earnings (pre-tax); average hours of paid work and the number of filled jobs. The survey covers about 18 000 business locations throughout New Zealand.

Table 6.17 provides total hourly earnings for workers in the "Forestry and logging" and "Saw-milling and other wood product manufacturing" industries. The wages data are provided in both nominal and inflation-adjusted terms. Earnings growth for the forestry and logging industry has lagged behind the New Zealand average. Total hourly earnings (which includes over-

TABLE 6.17A: AVERAGE HOURLY EARNINGS[1] FOR THE FORESTRY AND LOGGING INDUSTRY (A03)[2]

JUNE YEAR	AVERAGE TOTAL HOURLY EARNINGS (NOMINAL FIGURES)	AVERAGE TOTAL HOURLY EARNINGS (ADJUSTED TO JUNE 2008 PRICES)
2001	16.04	19.43
2002	17.19	20.27
2003	17.32	20.13
2004	17.61	19.98
2005	18.88	20.82
2006	19.39	20.57
2007	18.09	18.82
2008	19.12	19.12

TABLE 6.17B: AVERAGE HOURLY EARNINGS FOR THE TIMBER PROCESSING INDUSTRIES: LOG SAWMILLING AND TIMBER DRESSING (C231) AND OTHER WOOD PRODUCT MANUFACTURING (C232)[3]

JUNE YEAR	AVERAGE TOTAL HOURLY EARNINGS (NOMINAL FIGURES)	AVERAGE TOTAL HOURLY EARNINGS (ADJUSTED TO JUNE 2008 PRICES)
2001	15.41	18.66
2002	16.21	19.11
2003	16.56	19.24
2004	17.41	19.76
2005	17.60	19.41
2006	19.69	20.89
2007	19.38	20.16
2008	21.29	21.29

Notes
1 Average hourly earnings is equal to Total earnings (ordinary time plus overtime) divided by Total hours (ordinary time plus overtime).
2 Excludes "Support services".
3 Excludes "Log transportation".

Source
Statistics New Zealand (Quarterly Employment Survey).

time) increased by 19.2 percent between 2001 and 2008, in nominal terms. When adjusted for inflation, forestry workers experienced a small decline, of 1.6 percent in real earnings. This situation reflects the difficult economic conditions experienced in the forestry sector since 2003, and the downward pressure on employment (as discussed in Indicator 6.3.a).

This situation contrasts with the growth in earnings for workers in sawmilling and further processing. This industry has experienced earnings growth above the national average. In nominal terms, total hourly earnings increased by 38.2 percent over the period 2001–2008. In real terms, workers have seen their total hourly earnings increase by 14.1 percent over this period. While part of this increase stems from labour conditions within the industry, it also reflects broader national demand for the skills employed in sawmilling and timber processing. The industry has had to compete for labour against other manufacturing and construction industries.

AVERAGE HOURS OF WORK

The QES provides another important indicator of worker welfare – the average number of paid hours worked by employees. Nationally, the New Zealand labour force worked an average of 38.2 hours a week in the March 2008 quarter. This total included one hour of over-time. Over the entire period 2001–2008, the average working week has changed only marginally. In 2001, employees averaged 38.1 hours of paid work each week (March 2001

Planting. Photo: Pan Pac Forest Products Ltd (www.panpac.co.nz).

quarter). This increased to 38.9 hours in the March 2003 quarter, before gradually declining to the current level.

In the "Forestry and logging" industry, the average number of paid hours worked each week has declined over the past seven years. In the 2001 March quarter, employees worked an average of 40.4 hours (including over-time). This increased to 42.1 hours in the March 2003 quarter, and has since declined to 36.9 hours in the March 2008 quarter. The "Forestry and logging" workforce is now working a slightly shorter week than the national average. Again, this can be partially credited to the extended downturn in the industry.

The average working week for employees in the "Log saw-milling and other wood products manufacturing" industry has also come down over the past seven years. In the March 2003 quarter, employees worked an average of 43.6 hours. This included about three hours of over-time. In the subsequent seven years, the average working week has declined to 40.75 hours (March 2008 quarter), that is by three hours a week: split evenly between a reduction in ordinary working hours and over-time.

Photo: Pan Pac Forest Products Ltd (www.panpac.co.nz).

INJURY RATES AND ACCIDENT PREVENTION POLICIES

New Zealand operates a national accident and injury prevention scheme, which provides insurance for all residents and temporary visitors. The scheme covers workplace, sporting and household injuries. The scheme was introduced in 1974 and is administered by the Accident Compensation Corporation (ACC), a Crown agency. Those suffering injuries are entitled to free emergency care, subsidised or free on-going medical care, compensation for lost earnings and assistance with rehabilitation. As well as supporting the injured, ACC has a strong focus on injury prevention and mitigation. In the 2005/06 year, ACC spent close to $41 million on injury prevention schemes, in association with employers, sporting bodies and the like.

The New Zealand Department of Labour also works with the business community to improve workforce health and safety. Best practice guidelines for workplace safety are produced and regular inspections of business premises undertaken to check on arrangements, and that companies are complying with health and safety legislation. Workplace accidents are investigated by the Department of Labour, which also has responsibility for regulating the storage and use of hazardous goods and substances.

WORKPLACE SAFETY IN THE FORESTRY AND TIMBER PROCESSING SECTORS

> *Sustainability includes not only environmental and economic sustainability, but also social responsibility for all those working in the industry. (NZFOA, 2003, 5)*

The past 20 years has seen an increasing focus by employers on workplace and individual safety conditions. The industry, working with ACC and the Department of Labour, has identified the risk areas in silviculture, harvesting, cartage and processing; and has been introducing changes to progressively improve work place practices. Employers recognise that improving workplace

safety "will not only improve the welfare of those working in the industry, but will also improve productivity" (NZFOA, 2003), and help the industry meet its longer-term production and earnings goals.

A national database on logging injuries was established in 1984. Companies voluntarily reported the details of injuries sustained, days of work lost and near-miss events. The Accident Reporting Scheme was an important tool for undertaking research on injuries and monitoring the long-term success of prevention measures. Work undertaken by the "Centre for Human Factors and Ergonomics (COHFE) show[ed] the number of lost time injuries per million cubic metres of wood harvested decreased from 23.2 in 1990, to 5.8 in 2002" (NZFOA, 2003). These figures are particularly noteworthy, as the downward trend occurred during a time of increasing harvest volumes, and a general move into more difficult terrain.

In 2005, the New Zealand Forest Owners' Association, with the support of ACC, launched a web-based Incident Reporting Information System (IRIS). This is an interactive database, which enables companies (and the industry as a whole) to benchmark their health and safety performance. The database contains a substantial quantity of information on close calls, which can be used to reinforce (or refine) workplace practices.

The Accident Compensation Corporation, in association with the Forest Industries Training and Education Council, has developed a detailed hazard management guide that draws on best practice from New Zealand and overseas (ACC Work Safe – Forestry, 2002). Employers are encouraged to adopt these guidelines and to identify business-specific initiatives to improve safety. The industry is also working with ACC in a formal working group to develop reference tools for supervisors and foremen on safe working practices. Other initiatives include campaigns to encourage forest safety, and to raise public awareness of how the harvesting and processing

industries have moved over recent years to improve work place practices. As an industry, the forestry sector has a target of zero tolerance of unsafe work practices. A recent initiative in this area was the launch of a National Drug & Alcohol Code of Practice by the New Zealand Forest Owners' Association. The Code of Practice builds on a number of successful initiatives by individual forestry companies over the past decade. The Code of Practice sets a national standard for all employers and is an important step in eliminating drugs and alcohol from the workplace.

INJURY STATISTICS

> *In 2006, [New Zealand workers had] an average of 126 work-related injury claims per 1000 full-time equivalent workers (FTEs). The respective rates for females and males were 80 and 159 claims per 1000 FTEs. (Statistics New Zealand, 2007)*

The rates for the forestry and timber processing sectors are above the national average, reflecting the more physical nature of the work, and the use of potentially hazardous equipment. The injury data for forestry and logging are recorded as part of the larger "Agriculture, forestry and fishing" category, while timber-processing injuries are included in the "Manufacturing" category.

For the December 2006 year, the two sectors had 22 800 and 43 600 claims respectively. The "Agriculture, forestry and fishing" sector had a claim rate of 177 per 1000 FTEs and "Manufacturing" recorded a slightly lower rate of 165 per 1000 FTEs (provisional figures).

Some 87 percent of all work-related injury claims are for the payment of medical fees only, rather than rehabilitation costs or on-going compensation. This reflects the nature of the injuries being recorded. Nationally, 42 percent of all claims involved sprains and strains. A 2008 report by COHFE showed similar figures for the timber processing sector. *"Around 43% of all claims were musculoskeletal disorders, followed by lacerations/ puncture/sting, accounting for 22% of all claims"* (Ashby and Tappin, 2008).

Just 13 percent of claims "resulted in the payment of weekly compensation, the independence allowance, rehabilitation costs, or death benefits" (Statistics New Zealand, 2007). Table 6.18 records the number of new claims for financial entitlements involving workers from the "Forestry and logging" and "Wood and paper" industries. While there is variability in claim numbers between years, the figures show that injury rates are stable to falling. The positive work on injury prevention is coming through particularly in the "Forestry and logging" claim numbers. The number of paid entitlement claims has fallen each year since 2002.

The number of fatal accidents has declined over recent decades, in line with improvements in safety practices and equipment. Identifying measures to lessen the

TABLE 6.18: NEW CLAIMS FOR PAID ENTITLEMENTS (BY INDUSTRY)[1]

INDUSTRY CATEGORY	YEAR ENDED JUNE	ALL WORK-RELATED CLAIMS	COST OF CLAIMS ($000)	FATAL CLAIMS[2]	COST OF CLAIMS ($000)
	1996	573	2 066	7	104
	2001	496	2 044	5	136
	2002	555	2 486	≤ 3	44
A03 FORESTRY AND LOGGING	2003	546	2 845	7	132
	2004	506	3 150	4	91
	2005	434	2 163	≤ 3	38
	2006	408	2 322	≤ 3	19
	1996	1 308	4 093	≤ 3	15
	2001	899	3 227	≤ 3	30
	2002	1 055	3 878	≤ 3	58
C23 WOOD AND PAPER	2003	1 147	4 088	≤ 3	12
	2004	1 131	4 833	≤ 3	21
	2005	1 147	5 236	≤ 3	79
	2006	1 092	5 531	5	71

Notes
1 Ongoing claims are not recorded as part of this table.
2 The number of fatalities reported in the Work-related accounts may differ from the number of fatalities reported to Occupational Safety and Health (OSH – Department of Labour) and the Land Transport Safety Authority (LTSA).

Source
Accident Compensation Corporation.

potential of fatal accidents remains a priority for the industry. Every fatality is fully investigated by the Department of Labour, and the respective company, to determine the system failures that led to the incident. The reports from these accidents are used as the basis for new safety planning measures.

One area showing a significant improvement in safety practices over the past decade is the movement of logs. This improvement can be traced to the establishment of the Log Transport Safety Accord in 2001. The training, monitoring and design initiatives introduced under the accord have significantly reduced log truck crashes and rollovers, to the point where log trucks are now as safe as most other forms of heavy vehicle movement.

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Indicator 6.3.c Resilience of forest-dependent communities

The forestry and timber processing industries are important components of regional economic activity, but there are relatively few communities where the sector is the major employer. In most areas, forestry occurs in conjunction with pastoral production and other forms of rural activity, including tourism. Direct forestry employment (including wood product manufacturing) accounts for 1.4 percent of the national workforce. In New Zealand's major wood processing region (the Central North Island), the equivalent figure is 4.8 percent. Only 8 out of 129 area units in this region had more than 20 percent of their workers directly engaged in forestry.

New Zealand's forestry communities have faced serious challenges over recent decades, as a result of the phasing out of indigenous logging, the corporatisation and sale of the public estate, and the drive for improvements in productivity and competitiveness. These challenges have seen downward pressure on employment levels and the loss of key personnel. Communities have responded by identifying new employment opportunities (often associated with the natural environment, such as tourist tracks), or by putting in place infrastructure to attract new forms of industry. The adjustment process can be a difficult path for communities, with the loss of population and services. Successfully attracting new industry normally involves the community working closely with local and central government agencies.

Quality of information: L/M **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the extent to which communities are dependent on forests for their wellbeing, livelihoods, subsistence, quality of life or cultural identity; and are able to respond and adapt to social and economic change.

2008 COUNTRY REPORT

The forestry sector contributes at a number of levels to the economic and social wellbeing of towns and communities throughout New Zealand. The sector has been described as one of the drivers of regional economic activity, as the industry generates significant downstream employment in transportation, retailing and public administration (principally education and health). Recent modelling by Business and Economic Research Ltd (2005; 2008) indicates that this downstream[1] activity can equal or exceed the direct contribution of the industry.

One of the characteristics of the forestry sector is the dispersed nature of employment opportunities. Every district in New Zealand (except the Chatham Islands) has positions in forestry management or processing. This availability of employment is important for attracting and retaining families in rural areas (particularly younger families). These employment opportunities are critical for sustaining the viability of smaller communities. The most visible expression of this viability is well-supported social and sporting clubs. The forestry sector also brings to rural communities critical skills in management and administration. Such skills are important in smaller communities to guide decision-making and to foster local leadership.

Forestry and timber processing are normally one of a number of primary sector activities undertaken in rural communities. There are "few rural communities in New Zealand [that] are totally dependent on a single resource sector" (Taylor Baines and Associates, 1999). Forestry normally sits alongside pastoral production and other primary sector industries, including viticulture, cropping, fishing and mining. This diversity in economic activity provides communities with a more even (and secure) growth trajectory.

1 Downstream activity includes indirect and induced economic activity and employment.

Communities with a heavy reliance on forestry and timber processing generally fall into one of two categories. Those that:

- were involved in indigenous timber milling and have made the transition to plantation forestry;
- have developed around the maturing exotic plantations, established by the Forest Service and private investors since the 1920s.

MĀORI RELATIONSHIP WITH THE LANDS AND FORESTS OF NEW ZEALAND

New Zealand's indigenous forests historically provided Māori with a range of basic needs. Forests were a source of food, medicinal herbs and materials for handicrafts and weaving. Communities also harvested selected trees for settlement construction and canoes (waka). Customary practices evolved over the centuries to ensure that forest resources were maintained for future generations, and not over-utilised.

> *Traditionally, there was a specific custom for the taking or use of any material for basic living, such as food, shelter or clothing. For any of these, a formal ceremony took place. This is [still] valid today for many Māori. A recent occasion involved a ceremony to mark the removal of a tree for the construction of a waka (canoe) by the people of the Taitokerau. (FITEC,* http://www.insights.co.nz/people_industry_chv.aspx)

With European settlement, and the introduction of commercial farming and horticultural practices, Māori reliance on forests for their subsistence needs diminished. Small quantities of food and medicinal herbs continue to be collected by individuals and families. The hunting of feral deer, goats and pigs by individuals and families remains a social and recreational activity for a section of the Māori population. Hunting and commercial trapping provides a livelihood for a small proportion of the Māori and European population. In recent years there has been growing commercial interest in a number of the herbs and remedies that were traditionally sourced from

New Zealand's indigenous forests.

Māori continue to identify closely with their traditional lands and forests. Of the 1.4 million hectares of privately managed indigenous forests, Māori own more than 400 000 hectares – mainly through tribal incorporations and trusts (Miller et al, 2005)[2]. Several Māori incorporations have taken the lead in developing sustainable harvesting plans for their forest lands (under Part IIIA of the Forests Act). More than 29 percent of the indigenous forests in sustainable management are owned by Māori (Miller et al, 2005).

Māori participation in the commercial forestry sector is significant, through employment, training and land ownership. Māori comprise 29 percent of the forestry labour force (FITEC, 2005).

> *A survey carried out by the Ministry of Agriculture and Forestry in November 2000 (MAF, 2001)*

2 Almost 80 percent of New Zealand's indigenous forests are now managed by the Crown for conservation purposes.

estimated that 238 000 ha of Māori-owned land was in plantation forestry. This is around 14% of the total area of New Zealand's planted forests. (Miller et al, 2005)

The majority of these commercial forests were developed over the past 50 years, in conjunction with the Crown or private forestry companies. In 2000, just 10 percent of this estate was directly managed by Māori; but increasingly, Māori incorporations and trusts are assuming direct responsibility and management as leases expire. This situation reflects the growing aspirations of Māori owners to more directly manage their assets. Māori involvement in commercial forestry is expected to increase, with the settlement of historical Treaty claims.

"It is expected that the majority of these claims will be settled within 10–15 years and could result in Māori owning up to 41% of the land underlying New Zealand's planted forests" (Miller et al, 2005). The "Treelords" agreement in June 2009 between seven central North Island iwi and the Crown resulted in the ownership of 176 000 hectares of plantation forest land being transferred from the Crown to the iwi.

FORESTRY AS A PROPORTION OF TOTAL EMPLOYMENT

The number of communities with a moderate to high reliance on forest management and timber processing is relatively small. This can be seen by reviewing recent employment data. In the February 2007 year, 20 389 persons were engaged in forestry and first-stage timber processing. When wood product manufacturing and paperboard production are included, this figure rises to 31 859 persons. Set against a total labour force of 2 238 000 (March 2007) [3], the industry directly employs 1.4 percent of the workforce.

The Bay of Plenty region, in the central North Island, has the largest concentration of forestry and timber processing workers in New Zealand. The 2007 business survey figures show that 4.8 percent of the employee count was directly engaged in forestry, wood and paper manufacturing. A breakdown of the region, by area unit[4], reveals that 103 of the 129 area units (80 percent) had less than 5 percent of their engaged workforce in forestry and processing. Only eight of the area units had more than 20 percent in these employment categories and just three areas had over 50 percent. The workforce in these three areas ranged from 110 to 560 persons. The area units with the highest rates of forestry employment are those where service communities developed during the 1950s and 60s to meet the labour needs of the maturing exotic forests in the central North Island (along with their associated processing facilities).

The township of Kawerau (eastern Bay of Plenty) was constructed to house the workforce for an integrated sawmill and pulp and paper facility. Fifty years on, Kawerau still depends heavily upon the mill, and its associated industries. Other regions with communities that rely heavily on logging and sawmill employment are the West Coast of the South Island and western Southland.

STRUCTURAL PRESSURES ON FORESTRY COMMUNITIES

New Zealand's forestry communities have faced a number of economic challenges over the past generation, which have been weathered with varying degrees of success. The key developments in this period have been the:

- phasing out of indigenous logging on the Crown estate and the move to sustainable harvesting practices on private lands;
- centralisation of public and private services;
- adoption of new technology at all levels of the forestry and timber processing chain;
- restructuring of forestry and processing activity to remain internationally competitive.

3 The employment estimate for forestry and first-stage timber processing is derived from the Statistics New Zealand annual survey of economically active businesses, while the labour force estimate is calculated using the quarterly Household Labour Force survey.

4 Area units are aggregations of meshblocks with unique names. They are non-administrative areas intermediate between meshblocks and territorial authorities. Area units must either define or aggregate to define urban areas, rural centres, statistical areas, territorial authorities and regional councils. Each area unit must be a single geographic entity with a unique name.

The phasing out of indigenous logging from the Crown estate, and the requirement for private landowners to harvest on a sustainable basis[5], has seen the indigenous harvest fall markedly from 1 042 000 cubic metres of roundwood in 1970 to 20 000 in the December 2007 year (Ministry of Agriculture and Forestry, 2008) . The decline in indigenous log supplies has led to extensive restructuring within this industry sector, leading to job losses and a number of mill closures.

Some mills in close proximity to maturing exotic forests, have been able to be upgraded for processing new species. Investors have preferred such mill conversion over developing 'greenfield' plants, as the sites were already designated for industrial activity. This saved considerable time and expense in obtaining planning consents. The move to exotic timber processing has helped safeguard jobs, and in certain cases, been the springboard for expansion, particularly in the area of further processing.

Where mills have not been able to move into exotic processing or secure sufficient supplies of indigenous timber from sustainably managed blocks, there have been redundancies and mill closures. Communities have responded to plant closures, or to the downsizing of operations, in various ways but with a number of common themes.

Supported by their district councils[6], these communities have normally undertaken scoping projects to identify alternative employment opportunities for their communities. In the case of the Tuatapere community (in Western Southland), the Southland District Council assisted in developing a concept plan for the township, which built on its heritage sites (Houghton et al, 1996). As a consequence of this report, community funds were invested in developing a major walking track, which has encouraged investment in accommodation and craft facilities.

Bush track in mixed old plantation/indigenous hardwood regeneration, Karori Wildlife Sanctuary. Photo: Alan Reid.

These plans have generally focused on utilising the historical values of the community and developing tourism activities associated with the natural environment. Communities are also exploring the utilisation of their forested areas for non-timber products, such as honey production, game trophy hunting and wilderness tours. The adjustment that communities go through after the closure of a mill can be a difficult one for individuals and families. The skills of silviculture and processing workers are not necessarily compatible with the new initiatives being developed. Consequently younger workers have frequently migrated in search of new positions, while older employees have taken early retirement or accepted lower-skilled positions.

For the wider community, the loss of forestry revenue (through wages and service purchasing) has normally led to a period of economic uncertainty. This persists while

5 Sustainable harvesting of indigenous timber from private holdings was introduced through the 1993 amendment to the Forests Act (1949).

6 This support is frequently through a development board or community trust.

new ventures are explored and developed. In the case of tourism forest walks, the planning and development of a track and supporting facilities can take several years.

The forestry communities established during the 1950s and 60s to handle the growing volume of plantation forest timber have, in recent years, experienced substantial economic restructuring. This has been driven principally by the need for the forestry sector to remain competitive on the international stage, against producers with lower labour and infrastructure costs.

The drive for cost-efficiency can be seen in both processing and forest management. The Kinleith pulp mill has progressively reduced its labour force from over 2500 in the early 1980s to 613[7], through capital replacement and new technology adoption. At the harvesting level, improvements in haulage and delimbing systems are steadily improving the productivity of harvest workers, with a consequential reduction in the labour inputs required. The replacement of labour by capital equipment is ensuring the commercial viability of forestry production, but it has been at a cost to communities such as Kawerau, Tokoroa and Murupara, in the central North Island.

These developments have had significant economic ramifications for communities with a heavy reliance on forestry employment. Key services, including banking and postal outlets, were withdrawn from these centres, requiring residents to travel to regional centres[8]. The reduction in employment opportunities has impacted particularly on unskilled, older workers, who "do not have the technical skills to work the new technology …" (Taylor Baines and Associates, 1999).

The recent literature on community restructuring also noted that the loss of senior forestry staff meant that community organisations lost access to key skills (such as accounting and secretarial knowledge) and broader decision-making networks.

7 This figure includes maintenance employees and workers engaged by sub-contractors.

8 The withdrawal of services was not related simply to the downsizing of the forestry workforce. The past two decades have seen a national trend towards the centralisation of public and private services.

FUTURE ISSUES

This section has focused on New Zealand's established forestry communities, but it is important to appreciate that new centres of production will develop with the maturing of the exotic plantings in Northland, the East Coast of the North Island, Nelson/Marlborough and Otago/Southland. These plantings have the potential to generate significant regional employment and economic activity. In these regions, the forestry sector is likely to be a driver of new community formation.

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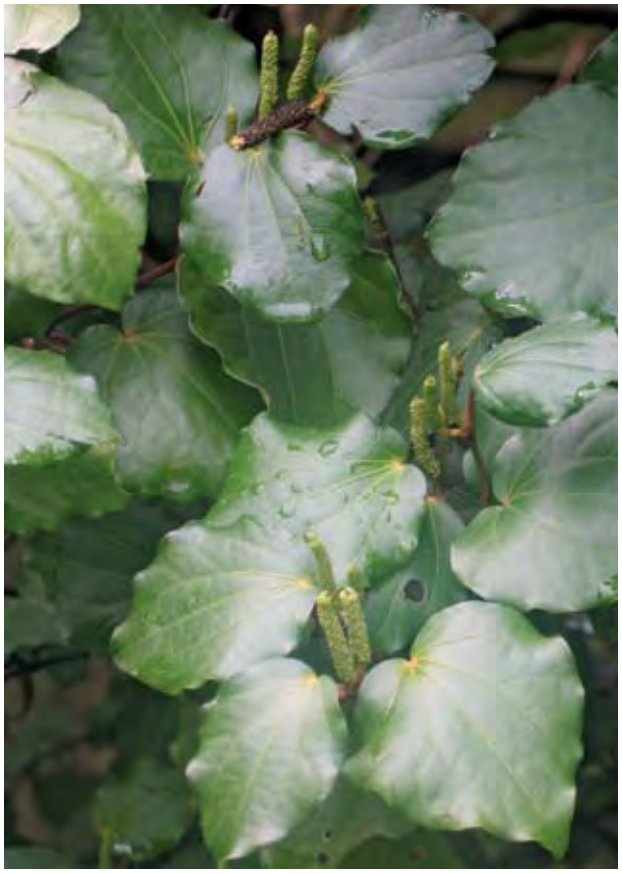

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Indicator 6.3.d Areas and percent of forests used for subsistence purposes

No communities rely on forests for subsistence purposes, but for some individuals and families the supply of fuel wood and opportunities to hunt deer and pigs for food are important. Traditional Māori medicine uses indigenous plant species.

Quality of information: L **Progress against indicator:** ▶

RATIONALE

This indicator provides information on the extent to which indigenous and other communities rely on forests as a source of basic commodities, such as food, fuel, shelter and medicinal plants. The practice of forest-based subsistence reflects the dependence of rural communities and individuals on forests for essential resources and may be closely linked to cultural identity and quality of life.

2008 COUNTRY REPORT

For centuries, Māori have made extensive use of the indigenous forest resource for the supply of food, fuel, shelter, clothing and medicinal products. The resource was respected and its use involved traditional processes of selection, access and removal – requiring the observance of rituals and ceremonies (see Indicator 6.3.c).

There are currently no communities that rely on forests for subsistence purposes. Nevertheless the supply of food (for example, meat from wild pigs and deer) and fuel (firewood) from both indigenous and plantation forests are important for some individuals and families, particularly in more remote locations.

Traditional Māori medicine (Rongoa Māori) involves spiritual healing and the use of herbs from indigenous plants, including tree species. Rongoa Māori is still practised and scientific studies have supported some of the information about the medicinal use of plants. The University of Waikato offers courses through its continuing education programme in Rongoa Māori.

The use of the indigenous forest resource by Māori is closely linked to their culture and values. Traditional Māori attitudes to the land, sky, rivers, lakes and seas and the creatures that live in them are based on their knowledge and beliefs about the beginnings of the world.

A renaissance of interest in community knowledge of the indigenous forest and its fauna and flora is taking place. Māori take wood for carving, vegetable materials for weaving, feathers of indigenous birds and other materials for traditional purposes.

No data are available to indicate the extent to which these uses of forests are undertaken, but in a national context they are very limited.

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Plantation forest, regenerating indigenous forest, Ruatoria. Photo: Alan Reid.

Indicator 6.3.e Distribution of revenues derived from forest management

Information is available on revenues generated by the commercial forest industries and received by government forest agencies. For forest industries in various forms of domestic and overseas private ownership, little information is available on how their revenues are distributed back to communities.

Quality of information: L **Progress against indicator:** ▶

RATIONALE

This indicator provides information about the flow and distribution of revenues from forest services, management and use back into forest-based communities, wider society and the forest sector. The distribution of those revenues provides information on the extent to which forest-based communities, the forest sector, and the wider society share in the economic benefits generated by forests.

2008 COUNTRY REPORT

As for indicator 6.2.a on investment and expenditure, information is available on annual revenue for the commercial forest industries and for revenue received by government. Information is not readily available on revenue from the production of non-wood products or for environmental services from New Zealand's forests.

COMMERCIAL FOREST MANAGEMENT AND WOOD-BASED PRODUCTS

Annual income received by commercial forestry enterprises is influenced by market conditions. Estimates of total income for 2002 and 2006 for major industry categories are provided in Table 6.19.

For "Wood product manufacturing" and "Paper and paper product manufacturing", the income received is all by private enterprises: this covers a range of listed and privately owned international and domestic companies. No information is available on the distribution of profits or dividends. In 2002, some $1039 million were paid in salaries and wages to employees and working proprietors; in 2006 this had increased to $1241 million. Purchases and other operating expenses (excluding purchases of goods bought for resale) increased from $4376 million in 2002 to $5129 million in 2006 (Statistics New Zealand, 2008).

For forestry and logging, ownership covers a broad range of overseas-owned timber investment management organisations (TIMOs), listed and privately owned international companies, privately owned domestic companies, partnerships, joint ventures, private investors and central and local government agencies. Again, no data are available on the distribution of profits and dividends, other than from central government-owned forests (see below). For salaries and wages to employees

TABLE 6.19: TOTAL INCOME IN 2002 AND 2006 FINANCIAL YEARS BY ANZSIC[1] CATEGORIES ($ MILLION)

ANZSIC CATEGORY	2002	2006[P]
Forestry and logging	3 275	2 810
Wood product manufacturing	3 663	4 627
Paper and paper product manufacturing	3 025	2 752

Notes
1 ANZSIC = Australian and New Zealand Industrial Classification.
P = provisional.

Source
Statistics New Zealand (2008).

and working proprietors, $341 million were paid in 2002 compared to $324 million in 2006. Purchases and other operating expenses (excluding purchases of goods bought for resale) decreased from $2257 million in 2002 to $1621 million in 2006.

For forestry and logging, the decrease in total annual income is partly accounted for by the levels of harvest, decreasing from 20.9 million cubic metres in 2002 to 18.8 million cubic metres in 2006 (years ending 31 March). This reduction reflected market conditions, the high NZD/USD exchange rates, and high shipping costs.

STATE FORESTRY

In 2005, forestry-related revenue received by the Department of Conservation and the Ministry of Agriculture and Forestry is estimated to total $109 million. Of this amount, $82 million was received through the management of central government's plantation forests on Māori lease land. This compares to an estimated total revenue of $74 million in 2000, of which $61 million came from the management of central government's plantation forests. All revenues are paid either to the departments involved, or to the Crown accounts (see Indicator 6.1.e).

Sub-alpine shrubland, Ruahine Mountains. Photo: Alan Reid.

NON-WOOD FOREST PRODUCTS

The non-wood forest products industry is not well developed in New Zealand, and little information is available on income or investment. The main products are game meat, pelts, sphagnum moss and honey. In addition, small quantities of berries and fungi are harvested annually, along with plant extracts for medicinal remedies and healthcare products.

Some examples of income include:

- the Active Mānuka Honey Association's members producing about 120 tonnes of bulk mānuka honey and added-value products worth around $12 million in 2005/06 (Country-Wide Publications Ltd, 2006);
- about 200 full-time possum hunters and trappers, each recovering about 100 to 150 kilograms of fur a month; in October 2007 this was worth around $100 per kilogram (Infonews.co.nz, 2007).
- Living Nature, which is New Zealand's largest skincare and makeup brand, using plant ingredients that include some indigenous forest species. It generates a turnover of about NZ$20 million per annum, and employs more than 80 staff (Growing Futures, undated).

ENVIRONMENTAL SERVICES

All forests provide environmental services of differing natures and to differing degrees. For New Zealand, the primary environmental services include maintenance of biodiversity, soil conservation, maintenance of water quality, carbon sequestration and storage, and landscape values.

Traditionally, the provision of environmental services has received limited recognition and has not generated income for forest owners in New Zealand. This situation is beginning to change, particularly through the introduction of government initiatives that address climate change issues.

Legislation that established an Emissions Trading Scheme is under review. As the legislation currently stands,

owners of post-1989 forest on eligible land can choose to participate in the ETS: if they take responsibility for carbon stock changes, they can earn carbon credits where the carbon stock increases, and trade these on the domestic or international markets.

The Government's Permanent Forest Sink Initiative promotes the establishment of permanent forests on previously un-forested land. This initiative also offers landowners the opportunity to earn and trade Kyoto-compliant emission units.

The East Coast Forestry Project and the Afforestation Grant Scheme (see indicator 6.2.a) do not provide "income" to landowners, but do provide a form of financial recognition for environmental services (soil conservation and carbon sequestration and storage) through grants for forest establishment.

RECREATION AND TOURISM

The provision of recreational opportunities for enjoyment by New Zealand citizens and overseas tourists is a major management outcome for the Department of Conservation. Income is generated through charges on concessions (private businesses operating on the publicly owned conservation estate) and hut and camp fees. Revenue from these sources increased from $10.9 million in 2000 to $16.1 million in 2005. This revenue is paid to DOC.

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Kidney ferns. Photo: Alan Reid.

INDICATORS 6.4 RECREATION AND TOURISM

Forests have long been used as a place for recreation and other leisure activities. The location and accessibility of forests and the availability of recreation facilities are important to forest-based recreation and tourism. Levels of use are an indication of the extent to which forests are valued by society for these uses.

Indicator 6.4.a Area and percent of forests available and/or managed for public recreation and tourism

Fostering the recreational use of New Zealand's conservation estate is one of the principal goals set by government for the Department of Conservation. The conservation estate includes about 78 percent (5.0 million hectares) of all indigenous forests in New Zealand. In the 2006/07 year, 41 percent of DOC's total expenditure was devoted to maintaining and developing recreational facilities within this estate. This included maintaining 12 860 kilometres of tracks. The nature of this investment has been changing over time, with DOC tailoring facilities to public needs, such as additional mountain-biking tracks and extreme sport facilities. A system of concessions enables private recreational interests to provide services within the conservation estate. These include ski fields, guiding and boating operations. New Zealand's larger plantation companies also provide opportunities for public access, to undertake activities ranging from hunting and horse trekking to scientific research. Access is normally via a permit system. This enables forestry operations to continue alongside recreational activities.

Quality of information: M **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the area and extent of forests available and/or managed for recreation and tourism activities. The availability and management of forests for these activities is a reflection of society's recognition of the value of forests for recreation and tourism.

2008 COUNTRY REPORT

New Zealand's forests, rivers and alpine areas are internationally regarded as offering high-quality adventure and wilderness experiences. The value of these areas (for recreation and conservation) has been recognised for more than a century, and progressive steps have been taken to ensure they are maintained for future generations. New Zealand's first national park, the 79 500-hectare Tongariro National Park, was established in 1887; just three years later the Milford Track in Fiordland was opened. The Milford Track has developed an international reputation amongst wilderness seekers, and the wider Fiordland region has been designated a World Heritage Area. Some 31 percent (8.3 million hectares) of New Zealand's land area is now formally protected for conservation and recreational purposes, and 78 percent (5.0 million hectares) of New Zealand's remaining indigenous forests are within the conservation estate.

The protection of New Zealand's natural resources for conservation and recreation is an on-going process. In 2002, New Zealand's fourteenth national park was established, the 157 000-hectare Rakiura National Park on Stewart Island. A priority for government in recent years has been the establishment of a network of high-country conservation parks in the South Island. These parks will provide greater public access to the high country and increased recreational opportunities. For example:

> *The Eyre Mountains/Taka Rā Haka Conservation Park provides unique opportunities for visitors to enjoy a back-country experience in a remote setting … Tramping and climbing options are plentiful within the park and trout fishing opportunities can*

be found in the rivers on the park boundaries. Hunting, four-wheel driving, mountain biking, horse riding, picnicking and camping are also popular options in this remote and scenic landscape. (Department of Conservation, 2007b)

A significant proportion of the New Zealand population regularly visits conservation areas, for camping, fishing, hunting or hiking. This ability to access the conservation estate is seen as a social entitlement (or right) which has been "enshrined in our statutes from the earliest days of European settlement, through devices such as the "Queen's Chain"[1] and the progressive reservation of special places warranting protection" (Department of Conservation, 1996). New Zealand has a strong recreational lobby, which campaigns to safeguard and enhance this right of public access to natural areas.

The principal pieces of legislation governing the management of New Zealand's protected lands (the National Parks Act 1980 and Conservation Act 1987) seek to balance the demands of conservation and recreation. Section 4 (2) (e) of the National Parks Act, and Section 6 (d) of the Conservation Act, seek to foster public access and recreation, where activities are not inconsistent with the protection of ecological values and preservation of natural features.

In addition to this legislative commitment, the New Zealand government has been committing increasing financial resources to the maintenance, and promotion, of recreation and educational facilities in the conservation estate.

In 2002, the Government [announced] a 10-year $349 million programme of work to replace, upgrade and maintain recreation facilities. In the first four years, the additional funds accelerated capital asset replacement, particularly of huts, structures, toilets and roadside facilities for day visitors. Highlights include 42 new backcountry huts since 2002. (Department of Conservation, 2007a)

In the 2006/07 year, $111 million was spent on managing recreational opportunities. This represented about 41 percent of DOC's total expenditure of $273 million (Department of Conservation, 2007a), used to maintain 13 628 structures, 12 860 kilometres of tracks and 950 huts.

The types of facilities developed by DOC have altered over time, as tourist preferences have changed. For example, DOC has been devoting additional resources to the development of mountain-biking tracks, and facilities for more extreme sports. In addition to these publicly funded facilities, there are opportunities for third-party (private) operators to establish and run tourism ventures within the conservation estate. These activities are operated through a concession system managed by DOC. The scale of these activities varies from low-intensity kayaking ventures through to ski-field operations. As at June 2008, there were 488 accommodation concessions, 473 guiding operations, 256 aircraft and boating

Pohutukawa flower. Photo: Alan Reid.

1 Queen's chain – is a 20-metre strip above mean high water springs that provides public access. The strip is either a surveyed strip of land owned by the Crown or territorial authorities, or it is memorialised on certificates of title as a marginal strip or esplanade strip.

operations, 25 ski field facilities and 18 education and instructional concessions.

In examining the area available for recreation and tourism, it is important to recognise that activities such as hunting, orienteering and mountain biking are not confined to public conservation lands. The majority of New Zealand's commercial forest owners operate permit systems that allow varying degrees of access to their properties. The permit will detail the type of activity that can be undertaken, the forestry blocks that can be accessed, and any restrictions on times and the routes to be used. The permit system enables forestry companies to continue their normal operations (silviculture, track development and harvesting) while safely allowing a degree of public access. Some of these recreational activities can have positive benefits for the forestry companies. Recreational hunting for wild deer, pigs and goats, along with the trapping of possums, assists the plantation forest companies in controlling pest numbers. The diversity of activities undertaken in the commercial estate can be seen in the permit data of companies such as Blakely Pacific Limited (2007). The recreational activities permitted in their South Island forests include: hunting, cycling, walking, horse trekking, vehicle club access and scientific research.

A number of New Zealand's commercial forests have developed into significant tourist attractions in their own right. These forests were generally established by the New Zealand Forest Service, a former state-owned agency. Walkways and supporting facilities were created in key locations, particularly tourist areas. The majority of these facilities have been maintained when these forests were sold to private interests. The 5700-hectare Whakarewarewa Forest, near Rotorua, is a good example of a commercial forest that has become a significant recreational resource for local and international visitors. The forest has a network of paths for walkers and joggers, mountain-bike and motorbike tracks, picnic areas and a visitor centre. The forest is managed by Kaingaroa Timberlands[2], and attracts an estimated 282 000 recreational visits per year (APR Consultants, 2007). Another example of this trend is Naseby Forest in Central Otago, which has gained a wide reputation for its mountain bike tracks. The forest is owned by Ernslaw One Limited, who supports the recreational use of the forest.

2 Kaingaroa Timberlands owns the forest estate but the land is held under a Crown Forest Licence.

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Indicator 6.4.b Number, type, and geographic distribution of visits attributed to recreation and tourism and related to facilities available

New Zealand's forests and wilderness areas have been progressively opened up to visitors over the past 150 years. These areas now play a central role in the country's domestic and international tourism industry. The increasing use of these areas for recreational activities can be seen in the visitor numbers to the conservation estate. An estimated 33 million visits were made to national parks and reserves in 2006, an 18 percent increase on the 2001 estimate. About 85 percent of these visits were for short stays or day trips, whereas 15 percent of visitors camped for one or more nights. These longer-term visitors have the ability to experience the more remote parts of the parks and reserves network. An increasing proportion of the visitor count is made up of international travellers, in search of wilderness experiences. Visitor data are showing that international travellers are experiencing not only the main conservation parks, but are exploring more remote areas, and are experiencing a wide range of activities, from camping and mountain biking to hunting and kayaking.

Quality of the information: M **Progress against indicator:** ▲

RATIONALE

This indicator provides a measure of the level and type of recreation and tourism use in forests. The number and geographic distribution of visits and the facilities available reflect the extent to which people participate in forest-based leisure activities and the importance of forests for recreation and tourism.

2008 COUNTRY REPORT

New Zealand's indigenous forests and conservation areas are generally seen as the cornerstone of the country's tourism industry. Domestic and international visitors are drawn by the opportunities to explore wilderness areas and to undertake a range of out-door, adventure pursuits. Providing access to these wilderness areas has required long-term investment by central and local government, in establishing high-quality walkways, tracks and supporting tourist facilities. In more recent decades, the private sector has taken a larger role in providing recreational facilities and in developing new forms of adventure activity.

> *Nature-based tourism ranges from high-impact adventure activities such as jet boating, skydiving and mountain climbing, to more relaxing activities such as bush walking, wildlife and scenic tours and boat cruises. (Market Economics Limited, 2008)*

The extensive network of tracks that visitors can now enjoy, have been developed over the past125 years. The internationally known Milford Track was one of the first to be opened, in 1890. The network of tracks was given a major boost in the 1950s and 60s, when the Forest Service established a system of back-country tracks and huts, both in conservation and production forests. These tracks opened up the back-country for recreational and commercial hunters. This was followed in the 1970s and 80s by a range of government initiatives to upgrade tracks and amenities, to encourage greater domestic and international use of the conservation resource. New Zealand's focus on wilderness and adventure experiences brings with it a higher level of risk than other forms of tourism. In recognition of this, significant resources are devoted to the provision of search and rescue, and emergency care services.

When considering the recreation and tourism opportunities associated with New Zealand's forests, it is important not to overlook the role of New Zealand's

1.8 million hectares of commercial plantations. The recreational facilities in these forests are not normally as developed as those in the conservation estate, but they can provide valuable opportunities for forest walks, climbing and hunting. As discussed in indicator 6.4.a, a number of the long-established commercial forests provide nationally important facilities, such as mountain-biking and orienteering tracks.

VISITOR NUMBERS

New Zealand's indigenous forests have been attracting visitors for more than 150 years. As early as the 1840s, British guidebooks were promoting the unique flora and fauna of the country, and the opportunities for wilderness experiences. Organised tours soon followed, along with the development of recreational facilities. The establishment of the Hermitage Hotel in 1884 (at the base of Mt Cook), was an early example of this development. The hotel provided a base for guided alpine walks and climbing experiences.

Developments in transportation over the past 50 years (particularly in long-distance air travel), have enabled New Zealand to become a mass tourism destination. In the mid 1950s, fewer than 100 000 overseas visitors arrived here annually. For the year ending December 2007, overseas visitor arrivals stood at 2.45 million (Statistics New Zealand, 2008). Domestically, the opportunity to visit New Zealand's indigenous forests and conservation areas has increased with improvements in roading conditions, greater vehicle numbers and the development of new tracks and facilities.

> *New Zealanders and international visitors make around 33 million visits to public conservation lands each year. This is an 18% increase over the 2001 estimate, and the growth continues, with overseas visitor numbers increasing even faster than visits by New Zealanders. (Department of Conservation, 2006)*

Visitor numbers are monitored by the Department of Conservation and the Ministry of Tourism, through visitor and site survey programmes. These programmes provide information on the major activities undertaken by domestic and international visitors; and on the number of visits to national parks, tracks and scenic reserves. This assists DOC and the wider tourism industry to plan for future demand and to identify where natural resources maybe under pressure (due to high visitor demand). In these situations, the data enable

Kahikatea-dominant grove on river flat, Orongorongo River, Wellington. Photo: Alan Reid.

DOC to put in place measures to relieve the pressure on conservation areas – for example, by providing additional funding to upgrade facilities or introduce measures to manage visitor numbers.

The visitor estimates produced by DOC (and the Ministry of Tourism) are for the entire conservation estate of 8.2 million hectares. A separate analysis is not available for the 5 million hectares of indigenous forest, as most parks and reserves combine areas of forest with open grassland, tussock and bush.

A breakdown of the 33 million visits to the conservation estate shows that the two main categories are short-stay and day visitors. Collectively, they make up about 85 percent of all visits to conservation areas. Short-stay visitors generally utilise the boundaries of conservation areas, for passive recreational activities such as sightseeing and picnics. The sites visited are normally adjacent to major transport routes. Day visitors have a far wider geographical range. The sites they visit range from reserves on the urban fringe to back-country tracks that can be walked in a day. Day visitors are generally seeking natural settings for walking, sightseeing, fishing or climbing. One of the more widely known day trips (both domestically and internationally) is the Tongariro Crossing in the central North Island. This seven-to-eight hour, high-terrain walk attracts about 70 000 visitors a year, and up to 1000 visitors a day in the peak season (2006 estimate).

Nearly 15 percent of visits to conservation areas involve overnight stays at campsites or huts. These visits range from single-night stays in easily accessible sites through to extended back-country hikes, on tracks that can take between three and six days (examples are the Routeburn Track: three days, Milford Track: four days and Heaphy Track: four to six days). Back-country fishing and hunting expeditions can be for significantly longer periods.

Of the visitors who stay overnight at campsites or in huts, just over 40 percent are classed as "back-country adventurers" by DOC. This group of visitors is seeking the traditional forest or high-country experience. They use the more remote tracks; this group includes hunters.

> *At a domestic level, about a third of New Zealanders are regular campers, 70 to 80 percent of New Zealanders report visiting a national park at least every two years, and about 40 percent have visited one in the past 6 months. (Carter, 2006)*

INTERNATIONAL VISITORS

Overseas visitor numbers to New Zealand increased by 65 percent between 1997 and 2007 (from 1.497 million arrivals to 2.465 million). This growth in visitor numbers has led to a substantial rise in the use of New Zealand's indigenous forests and conservation areas by overseas travellers, as shown in Table 6.20. The monitoring

TABLE 6.20: INTERNATIONAL VISITOR NUMBERS TO SELECTED NATIONAL PARKS

CALENDAR YEAR	FIORDLAND (SOUTHERN SOUTH ISLAND)	WESTLAND (WEST COAST SOUTH ISLAND)	AORAKI/MT COOK (CENTRAL SOUTH ISLAND)	ABEL TASMAN (UPPER SOUTH ISLAND)	TONGARIRO (CENTRAL NORTH ISLAND)	PAPAROA (WEST COAST SOUTH ISLAND)
1997	196 100	205 500	154 300	28 800	32 100	11 700
2002	273 000	280 900	158 100	57 900	55 100	44 400
2007	439 900	376 700	172 700	110 700	97 800	97 400
Percentage increase	124	83	12	284	204	732

Source
Ministry of Tourism, International Visitor Survey.

data from the Ministry of Tourism indicate that about 30 percent of all overseas travellers will visit at least one national park during their stay[1].

The National Park data show that overseas visitors are exploring a range of geographical locations, rather than concentrating on one or two particular areas. This is reflected in the fact that New Zealand's iconic alpine park (Aoraki/Mt Cook) has seen only a moderate rise in overseas visitor numbers since 1997 (12 percent). The more recently established Paparoa National Park, on the West Coast, experienced the greatest percentage gain, with visitor numbers rising 732 percent (from 11 700 to 97 400). Paparoa was designated as a National Park in 1987 and DOC has been progressively developing the facilities available to visitors. Parks with an international reputation, such as Fiordland and Westland National Parks, have experienced a steady rise in patronage, with an additional 240 000 visitors a year to Fiordland National Park and 170 000 to Westland National Park.

The international visitor survey also monitors the range of recreational activities tourists undertake while in the country. The principal activities associated with New Zealand's conservation lands and forests are shown in Table 6.21. The activities undertaken by international visitors span a wide spectrum, from strenuous wilderness treks through to more passive forms of recreation (such as scenic drives). In addition to this list, 184 000 international visitors undertook fishing, 130 000 river kayaking or canoeing, 96 000 rafting and 46 000 horse trekking. The survey results show that New Zealand's forests, rivers and alpine landscapes are seen internationally as important tourist destinations, and that visitors travel to the country to undertake a broad range of recreational activities.

1 This percentage has stayed relatively constant over the survey period.

TABLE 6.21: NATURE-BASED TOURISM ACTIVITIES UNDERTAKEN BY INTERNATIONAL TOURISTS IN 2006

ACTIVITY	OCCASIONS
Scenic drive	618 000
Forest walk (half day)	572 000
Trekking/tramp (1 day+)	405 000
Sightseeing tour	354 000
Glacier (walk/view)	344 000
Forest walk (half hour+)	231 000

Source
Market Economics Limited (2008).

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INDICATORS 6.5 CULTURAL, SOCIAL AND SPIRITUAL NEEDS AND VALUES

People and communities, in both rural and urban areas, have a variety of social, cultural, and spiritual connections to forests, based on traditions, experiences, beliefs, and other factors. Among them, the spiritual and cultural connections of indigenous people to forests often form part of their identity and livelihood. These values may be deeply held and influence people's attitudes and perspectives towards forests and how they are managed. These indicators provide information on the extent to which social, cultural, and spiritual needs and values exist and are recognized by society.

Indicator 6.5.a Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and values

The area of forest land managed by the Department of Conservation has increased from 4.9 million hectares in 2000 to 5.0 million hectares in 2008. Management of this forest land recognises its natural and cultural values. The Resource Management Act recognises and provides for the relationship of Māori and their culture and traditions, in resource management planning by all levels of government.

Quality of the information: M **Progress against indicator:** ▲

RATIONALE

This indicator measures the extent of forests managed primarily for their cultural, social and spiritual values to people and communities, including indigenous communities and others with strong ties to forests. The protection of forests to meet such needs and values is a reflection of the extent to which they are recognised by society.

2008 COUNTRY REPORT

The Department of Conservation manages land and forests under the Conservation Act 1987 and other Acts, and under a range of classifications such as national parks, conservation parks, stewardship areas, scenic and other reserves, and wildlife refuges. Under the Conservation Act, all land is managed for conservation purposes. Conservation is interpreted in section 2 of the Act as:

> *the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.*

The Department of Conservation consults with tāngata whenua[1] and the community about policy, management plans and operations (see Indicator 7.1.c) that relate to land managed under the Conservation Act. Customary use of traditional materials and indigenous species on conservation land may be authorised under various provisions of the Act.

Under the National Parks Act 1980, national parks are to be preserved as far as possible in their natural state.

The area of indigenous forest land managed by DOC has increased from about 4.881 million hectares in 2000, to 5.003 million hectares in 2008. While this is about 78 percent of New Zealand's indigenous forest estate, lowland forest ecosystems are poorly represented.

Many private organisations are actively involved in conservation and environmental issues in New Zealand.

1 Tāngata whenua includes iwi, hapū and whānau.

These vary from local clubs concerned with the protection or restoration of the local environment, to national and international groups concerned with preserving the environment for its ecological, scientific, recreational or scenic values.

As an example, the Royal Forest and Bird Protection Society owns nearly 40 reserves around New Zealand, totalling more than a thousand hectares (Royal Forest and Bird Protection Society of New Zealand, undated).

The protection of important cultural sites, particularly wāhi tapu sites[2], in the management of plantation forests is provided for through statutory planning processes under the Resource Management Act 1991 (see Indicator 7.1.e). Social values are not generally accorded primary recognition in plantation forest management. Management of Māori-owned plantation forests, and of plantation forest on Māori leased land, commonly gives recognition to Māori customary values.

2 Traditional Māori heritage sites of cultural significance.

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Mixed conifer farm woodlots, Bay of Plenty. Photo: Alan Reid.

Indicator 6.5.b The importance of forests to people

Forests are well recognised for a range of natural, cultural, social and economic values. The importance of particular values and mixes of values varies with the nature and location of the forests. While legislation and policy have largely ended the debate over the protection of natural values of indigenous forests, New Zealand society remains divided on the ability to interact with indigenous ecosystems in sustainable ways.

Quality of the information: M **Progress against indicator:** ▲

RATIONALE

This indicator provides information on the range of values that communities and individuals hold for forests. These values shape the way people view forests, including their behaviours and attitudes to all aspects of forest management.

2008 COUNTRY REPORT

New Zealanders recognise a wide range of values associated with both indigenous and plantation forests. Most prominent are:

- biodiversity at the species and ecosystem levels, and the ability of ecosystems to function in a healthy state;
- the productive capacity of forests for timber, employment and economic contributions – largely, but not entirely, related to plantation forests;
- access to non-polluted drinking water catchments and waterways;
- the contributions forests make to soil conservation and carbon sinks;
- freedom of access to a wide range of passive and active recreational pursuits;
- intrinsic values and their contributions to people's health and well-being;
- wild animal recovery and the cultural harvest of plant species;
- landscape features and their contributions to the identity of areas.

These values are based on a review by Barnard et al (2006) who concluded that forest management practices across public and private tenures account for the values inconsistently.

Many are "public" values, such as biodiversity, landscape and water quality. Consequently, forest management on publicly and privately owned land attracts considerable public interest.

The purpose of management of publicly owned indigenous forests under the Conservation Act 1987 is to maintain their intrinsic values (see Indicator 6.5.a). Sustainable forest management of privately owned indigenous forests under Part IIIA of the Forests Act 1949 requires the management of indigenous forest land in a way that maintains the ability of the forest to continue to provide a full range of products and amenities in

Tree fern. Photo: Alan Reid.

perpetuity, while retaining the forest's natural values. The passing of this legislation in 1993, and the decision by government to halt harvesting from publicly-owned indigenous forest from 2003, ended much of the debate over the protection of the natural values of indigenous forests.

Plantation forests are recognised for their commercial value in the production of wood and processed wood products and for employment. They also contribute to sustainable economic development, to carbon sequestration and storage, and enable the setting aside of indigenous forests from commercial wood production.

New Zealand's forests are highly valued for recreational purposes including tramping (trekking), bushwalking, camping, wildlife appreciation, photography, mountain-biking and hunting (see Indicator 6.4.b). They are also widely used for community activities and school educational visits.

Māori have strong cultural, spiritual and commercial connections to forests and forestry. They are connected spiritually and culturally with indigenous forests as a resource for food, medicines, building materials, shelter, clothing, implements and handicrafts. Plantation forestry provides an option for the protection of Māori lands, employment and economic benefits.

In the management of plantation forests, Māori have historically adhered to basic customary principles and beliefs that form Māori customary law. In managing the Māori lease plantation forests of Lake Taupō and Lake Rotoaira , the first three objectives of each lease require the:

› maintenance of soil stability and the prevention of erosion to protect the streams, rivers and lakes;
› protection of wildlife and fish habitat;
› protection of wāhi tapu (prohibited and sacred sites) on the land lands.

The Parliamentary Commissioner for the Environment's 2002 report *Weaving Resilience into our Working Lands* identifies the clash of values over what New Zealand should do with indigenous plants growing, or planted, on privately owned land. The report states:

> *At the core of the debate regarding the future roles of native plants on private land is a fundamental difference of view concerning the ability of New Zealanders to interact with indigenous ecosystems in ecologically sustainable ways. There is an inherent tension in human efforts to manage natural resources. This tension is most immediately evident in the conflicts between values of utilisation and protection, between monetary returns and ecological constraints. The inability of New Zealanders to reconcile these conflicts has created a significant split in the purposes for which we manage land …*
>
> *As illustrated, land management in New Zealand can be characterised by a dichotomy [sic] between:*
> – *nature and culture (society);*
> – *public and private;*
> – *indigenous and exotic;*
> – *conservation and production;*
> – *protection and exploitation.*

This indicates that New Zealander society is divided on how well the values of indigenous vegetation are appreciated; and questions whether the nation has yet developed the ability to manage indigenous resources for productive purposes, while protecting their natural values.

SOURCES OF INFORMATION

Asher, G (2003) *Māori plantation forests – a challenge for sustainable forest management.* Paper to the UNFF Intersessional Experts Meeting, 25–27 March 2003; Wellington.

Barnard, T; Spence, H; Crawford, K (2006) *New Zealand Montreal Process review: forest values in New Zealand.* Report to the Ministry of Agriculture and Forestry. Ensis Environment; Scion; Rotorua.

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Forests Act (1949) published under the authority of the New Zealand Government, Wellington.

Miller, R R; Dickinson, Y; Reid, A (2005) *Māori connections to forestry in New Zealand.* A paper presented to the IUFRO Conference; Brisbane.

Parliamentary Commissioner for the Environment (2002) *Weaving resilience into our working lands; recommendations for the future roles of native plants.* Parliamentary Commissioner for the Environment; Wellington; 149 p.

FURTHER READING

FITEC (undated) *Forestry insights: forests and people.* http://www.insights.co.nz/story_behind_uv.aspx

Forest values project. http://www.ngaitahu.iwi.nz/Ngai-Tahu-Whanui/Natural-Environment/Customary-Natural-Resources/Forest-Values-Project/

Volunteers of a community-based conservation project working to recreate coastal forest, Kapiti District. Photo: Nga Uruora.

CRITERION 7

Legal, institutional and economic frameworks

Criterion 7 and associated indicators relate to the overall policy framework of a country that can facilitate the conservation and sustainable management of forests. Included are the broader societal conditions and processes often external to the forest itself but which may support efforts to conserve, maintain or enhance one or more of the conditions, attributes, functions and benefits captured in Criteria 1–6. No priority or order is implied in the listing of the indicators.

TABLE 7.1: INDICATORS FOR CRITERION 7, QUALITY OF INFORMATION AND TRENDS

	CRITERION 7: LEGAL, INSTITUTIONAL AND ECONOMIC FRAMEWORKS	QUALITY OF INFORMATION	TREND
	LEGAL FRAMEWORK		
7.1.a	Property rights	H	▶
7.1.b	Planning, assessment, and policy reviews	M/H	▶
7.1.c	Public participation	H	▲
7.1.d	Best practice codes	H	▲
7.1.e	Conservation of special values	M	▲
	INSTITUTIONAL FRAMEWORK		
7.2.a	Public involvement activities	H/M	▲
7.2.b	Forest-related planning	M	▶
7.2.c	Human resource skills	M	▶
7.2.d	Infrastructure	M	▲
7.2.e	Enforce laws	M	▶
	ECONOMIC FRAMEWORK		
7.3.a	Investment and taxation	M	▶
7.3.b	Trade policies	H	▲
	MEASURING AND MONITORING		
7.4.a	Availability of data	M/H	▲
7.4.b	Statistical reliability	M/H	▲
7.4.c	Compatibility with other countries	M	▲

CRITERION 7: LEGAL, INSTITUTIONAL AND ECONOMIC FRAMEWORKS		QUALITY OF INFORMATION	TREND
	RESEARCH AND DEVELOPMENT		
7.5.a	Scientific understanding	H	▲
7.5.b	Costs and benefits	M	▲
7.5.c	Socio-economic consequences	M/H	▲
7.5.d	Impacts of human intervention	H	▲
7.5.e	Climate change	H	▲



KEY

L = low
M = medium
H = high

Neutral ▶
Positive ▲
Negative ▼
Insufficient data ?

NEW ZEALAND OVERVIEW

LEGAL FRAMEWORK

New Zealand has a well established and robust legal framework for the identification and protection of property rights, particularly through the Property Law Act 1952 and the Resource Management Act 1991. Dispute resolution mechanisms include arbitration, mediation, the Small Claims Tribunal and the Courts. The foundation legal document recognising the rights of Māori people is the Treaty of Waitangi, and addressing claims from Māori under the Treaty is a government focus.

The RMA is the primary legislation for the statutory management planning of land, air and water resources. The purpose of the RMA is to promote the sustainable management of natural and physical resources while (amongst other things) avoiding, remedying or mitigating adverse effects of activities on the environment. Much of the responsibility for implementation of the RMA has been devolved to local government (regional and district/city councils), principally through the development of a range of policy statements and plans.

Biosecurity is a key issue for New Zealand, as the country is free of many overseas forest (and other) pests and diseases. With increasing trade and travel elevating the risks of incursions, a strong biosecurity system is crucial. This is delivered under the Biosecurity Act 1993, with the system focused on risk reduction, readiness, response and recovery.

With a few exceptions, all legislative Bills are progressed through a Parliamentary select committee process that provides for public participation. The development of local authority policy statement and plans under the RMA also allows for public input.

For the public to be able to have effective input to legislative and planning processes, access to good information is essential. A wide range of forestry information is available (see below under Institutional Framework). The Official Information Act 1982 operates on the principle that government information shall be made available unless there is good reason for withholding it.

The Parliamentary Commissioner for the Environment is an independent Officer of Parliament under the Environment Act 1986 with wide powers to investigate, report and make recommendations to Parliament on any environmental matter. The Parliamentary Commissioner can also investigate and advise public authorities on the effectiveness of environmental management.

At the forest level, the Conservation Act 1987 requires the Department of Conservation to develop conservation management strategies for the integrated management of natural and historic resources, including the Crown-owned indigenous forests. Sustainable forest management plans and permits are required under the Forests Act 1949 where timber is harvested from privately owned indigenous forests.

The commercial plantation forest industry has been to the forefront in the development and use of best practice codes. It released the *New Zealand Environmental Code of Practice for Plantation Forestry* in 2007, replacing an earlier code that originated in 1990. A range of other codes of practice, industry standards, accords and guidelines are also in use. The *New Zealand Forest Accord* is a voluntary agreement between environmental groups and the New Zealand Forest Owners' Association that provides for the exclusion of indigenous vegetation from land clearing and disturbance.

The conservation of special (forest) values is recognised under the RMA, the Historic Places Act 1993, the Conservation Act 1987, the National Parks Act 1980 and the Forests Act 1949.

INSTITUTIONAL FRAMEWORK

The Department of Conservation relies on partnerships with the community to achieve its mission of conserving New Zealand's indigenous biodiversity. DOC also provides a range of levels of engagement for the public through visitor centres, volunteer programmes, conservation projects, annual events, educational resources, discussion documents and access to website-based resources.

The Ministry of Agriculture and Forestry focuses on the collection and dissemination of information and statistics concerning commercial plantation forests. Much of this is available on MAF's website. The MAF does not provide a forestry extension service.

Other key government agencies that have forestry-related information available to the public are Statistics New Zealand and the Ministry for the Environment. The forest industries, forestry organisations, research institutes and environmental groups also provide public access to a range of forestry information.

No national forest policy exists in New Zealand, as governments over the last two decades have taken a cross-sectoral approach to resource management. They sought to manage adverse effects on the environment and establish legislative and economic frameworks within which investment is largely market-driven. The RMA delivers resource management planning at central, regional and district government levels (see above under Legal framework) that directly affects many forestry activities. Conservation management strategies cover the Crown-owned indigenous forest conservation estate, and more detailed conservation management plans may be prepared. About 114 000 hectares of privately owned indigenous forest are under sustainable forest management plans or permits. Large-scale plantation forest owners also undertake estate, forest and/or operational levels of planning.

Forestry, resource management and biosecurity legislation and regulations are enforced by specialist staff from central and local government, as well as by honorary rangers for the conservation forest estate. The Acts include penalties for offences that provide for fines and imprisonment, while the RMA also provides for enforcement orders and abatement notices.

A well-developed road, rail and port infrastructure generally serves the needs of the forest industries. Central and local government operate the public road network, and central government purchased the national rail assets in 2008. Overseas trade relies heavily on sea transport and New Zealand is served by 12 commercial ports with significant volumes of forestry exports and/or imports.

New Zealand has well-developed systems of forestry training and education, delivered through the Forest Industries Training and Education Council, polytechnics and universities.

ECONOMIC FRAMEWORK

Investment and taxation regimes applying to commercial forestry have generally been stable since 1991, when significant changes were made to the income tax legislation applying to forestry. The taxation rate for businesses in New Zealand decreased from 33 to 30 cents in the dollar in 2008.

Investment in commercial forestry is influenced by a range of business and market-related factors. Investment in new forest planting has dwindled over the last 10 years and deforestation (disinvestment from forestry) of harvested plantations has been significant since 2005. Investments in wood processing and overseas investments in New Zealand forestry are variable on a year-by-year basis.

The New Zealand economy is highly dependent on international trade of primary products, with forestry the third-highest export earner. New Zealand operates a

relatively open trade policy and actively engages in trade liberalisation. Over recent years it has become a party to a number of regional lateral and plurilateral agreements, and signed a free trade agreement with China.

MEASURING AND MONITORING

Comprehensive statistical databases are available that describe the plantation forest estate, the production of, and trade in, wood and wood products. Forecasts of plantation forest wood availability are prepared about every five years. The reliability of this information is supported by the generally strong commitment of forest owners and processors of wood products to provide detailed statistical information.

Information on the extent and physical attributes of indigenous forests is being strengthened as a result of international climate change reporting requirements and the use of satellite imagery. These requirements, and the application of revised survey methods, are raising the reliability of data available for the indigenous forest estate.

SCIENTIFIC UNDERSTANDING

New Zealand has a number of Crown Research Institutes (CRIs), universities, companies and individuals providing forestry or forestry-related research. A range of research consortiums has been established to facilitate and oversee commercial forestry research programmes.

Traditional "non-market" goods and services provided by forests are increasingly being recognised as having monetary value. The introduction of a New Zealand Emissions Trading Scheme (currently under review) is the first major step towards actual financial recognition of such a service (sequestration and storage of carbon). The first sale of forest-based carbon credits occurred in 2009.

Forestry's contributions to the development of social capital and to community resilience through direct and indirect employment are significant in many areas of New Zealand. The socio-economic consequences of resource management are matters that are assessed within the planning framework of the RMA. Independent third-party certification of commercial plantation forests also requires evaluation of socio-economic impacts of forest management.

The ability to predict the impacts of human intervention in commercial plantation forest management is well-developed through sophisticated growth and yield modelling systems and research programmes. Logging research has received a renewed focus under the recently formed research consortium Future Forest Research.

Climate change-related research has been a focus for the government in recent years. Expert reports and peer-reviewed scientific studies on the impacts of climate change on New Zealand's forests are being published both domestically and internationally. Impacts on forest/tree growth rates and changes in risk levels from wind, fire, pests and diseases are likely to be significant, but variable across the country.

Mixed conifer farm woodlots, Bay of Plenty. Photo: Alan Reid.

INDICATORS 7.1 LEGAL FRAMEWORK

Extent to which the legal framework (laws, regulations, guidelines) supports the conservation and sustainable management of forests.

Indicator 7.1.a Property rights

New Zealand has a well established and robust legal framework for the identification and protection of property rights and the resolution of disputes. Addressing claims from Māori under the Treaty of Waitangi is a focus of Government.

Quality of information: H **Progress against indicator:** ▶

DESCRIPTION

INDICATOR 7.1.a: Clarifies property rights, provides for appropriate land tenure arrangements, recognises customary and traditional rights of indigenous people, and provides means of resolving property disputes by due process.

RATIONALE

All countries possess a framework including the body of enacted and/or customary rules permitting activities and providing remedies for perceived wrongs. When applied to forests, this framework – complemented by the natural laws of forest ecosystems – can promote the sustainability of forests. The frameworks have developed in response to the diverse societies in all countries, and so reflect many customs and values.

The frameworks establish the basis for the ownership of and responsibility for forests, and for the participation of individuals and groups in the management of forests. The management of forests thus takes place within the frameworks. The frameworks reflect the values and needs of the various communities and can encourage the acceptance of long-term values necessary for sustainability. The level of stability and acceptance of these frameworks can enhance the degree to which sustainability is attained.

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TREATY OF WAITANGI

The foundation legal document recognising the rights of the Māori people in New Zealand is the Treaty of Waitangi, signed in 1840. Its principles (see http://www.waitangi-tribunal.govt.nz/treaty/principles.asp) are provided for in many pieces of domestic legislation, including the Resource Management Act 1991[1] and the Conservation Act 1987.

The Waitangi Tribunal is the judicial body that considers claims from Māori who believe they are prejudiced by government action inconsistent with the Treaty of Waitangi. The Tribunal was established in 1975 by the Treaty of Waitangi Act 1975. It is a permanent commission of inquiry, charged with making recommendations on claims brought by Māori relating to actions or omissions of the Crown that breach the promises made in the Treaty of Waitangi (see http://www.waitangi-tribunal.govt.nz/about/about.asp). Many claims relate to the return of land held by the Crown. Land subject to a claim has its title annotated accordingly so that the claim is not affected should the land be sold.

1 Under section 6(e) of the Resource Management Act, the relationship of Māori with their ancestral lands, water, sites and treasured resources is a matter of national importance, to be recognised and provided for by all who exercise functions under that Act. The principles of the Treaty of Waitangi must also be taken into account in managing the use, development and protection of natural and physical resources (s8).

PROPERTY RIGHTS

The Property Law Act 1952 sets out a general basis for property rights in New Zealand. Land tenure in New Zealand is based on a system of land survey and registration of title under the Land Transfer Act 1952[2]. Legislation enabling the creation of "forestry-specific" property rights includes the Forestry Rights Registration Act 1983 and Part IIIA of the Forests Act 1949 (see below).

Property disputes, as with other disagreements, are resolved through a variety of formal and informal means. Contractual disputes may follow a formal process through the Small Claims Tribunal or through District or High Courts, depending on the financial value of the dispute. However, arbitration and mediation are also well-established processes.

RESOURCE MANAGEMENT ACT 1991

The Resource Management Act 1991 is the principal statute for the management of land, subdivision, water, soil resources, the coast, air, and pollution control. The legislation is primarily implemented by local government authorities through regional and district plans that contain policies, rules and performance objectives associated with resource use (see http://www.mfe.govt.nz/publications/rma/rma-guide-aug06/html/page2.html).

The Environment Court determines disputes under the RMA that are not settled through consultation, negotiation or mediation procedures set out in the Act (see http://www.mfe.govt.nz/publications/rma/everyday/court-guide/html/index.html). Appeals against Environment Court decisions on questions of law can be taken on to the High Court and Court of Appeal.

FORESTRY RIGHTS REGISTRATION ACT 1983

The Forestry Rights Registration Act provides for the creation of forestry rights by the proprietor of land to establish, maintain and harvest a crop of trees on the land. Forestry rights are commonly used in joint-venture situations where a forestry investor establishes a forest on land owned by another party.

FORESTS ACT 1949

The purpose of Part IIIA of the Forests Act 1949 is to promote the sustainable management of indigenous forest land. It applies to most privately owned land. Part IIIA requires the registration of sawmills milling indigenous timber, and that logs to be milled are sourced from government approved sustainable forest management plans or permits that are recorded against the certificate of title (see http://www.maf.govt.nz/forestry/indigenous-forestry/indigenous-foresty-for-web.htm).

TE TURE WHENUA MĀORI ACT 1993

A small amount of land is held in Māori tenure and is known as Māori customary land. Both Māori customary land and Māori freehold land are subject to the Te Ture Whenua Māori Act 1993, which recognises the special significance of land to Māori and restricts its alienation (see http://www.governance.tpk.govt.nz/why/teturewhenua.aspx). Such land is still open to the full range of forestry uses, if the owners so wish.

SOURCES OF INFORMATION

Arbitration Act (1996) published under the authority of the New Zealand Government, Wellington.

Forestry Rights Registration Act (1983) published under the authority of the New Zealand Government, Wellington.

Forests Act (1949) published under the authority of the New Zealand Government, Wellington.

Land Transfer Act (1952) published under the authority of the New Zealand Government, Wellington.

2 The State grants title to land through registration and guarantees the accuracy of that title. The register is a public "document" that records the status of any land, restrictions that might be placed on it and other facts including mortgages and leases.

Ministry of Agriculture and Forestry. http://www.maf.govt.nz

Ministry for the Environment. http://www.mfe.govt.nz

Property Law Act (1952) published under the authority of the New Zealand Government, Wellington.

Resource Management Act (1991) published under the authority of the New Zealand Government, Wellington.

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McSoriley, J; Herrington, G (1994) *Forestry*. In *New Zealand forms and precedents,* Butterworth, Wellington; and the Ministry of Forestry; Wellington.

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Ministry for the Environment (undated) *Resource Management Act*. http://www.mfe.govt.nz/rma/index.php

Waitangi Tribunal. http://www.waitangi-tribunal.govt.nz/

Williams, DAR (ed) (1997) *Environmental and resource management law* (2nd edition). Butterworth; Wellington.

Indicator 7.1.b Planning, assessment, and policy reviews

Legislation requires resource management policy development and the preparation of plans by local government at the regional and district levels. Management strategies are required for the Crown-owned indigenous forests and plans or permits for privately owned indigenous forests where timber is harvested. Larger plantation forest owners prepare estate/forest management plans.

Quality of information: M/H **Progress against indicator:** ▶

DESCRIPTION

INDICATOR 7.1.b: Provides for periodic forest-related planning, assessment, and policy review that recognises the range of forest values, including co-ordination with relevant sectors.

RATIONALE

See Criterion 7 and Indicator 7.1.a.

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RESOURCE MANAGEMENT ACT 1991

The Resource Management Act 1991 is the primary legislation for statutory resource management planning, having brought together laws governing land, air and water resources. The RMA is currently under review to simplify and streamline planning processes.

The purpose of the RMA (section 5) is "...to promote the sustainable management of natural and physical resources". Sustainable management is described as:

... managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well being and for their health and safety while –

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) Avoiding, remedying, or mitigating any adverse effects of activities on the environment.

Matters of national importance are also identified in the RMA (section 6) and these must be recognised and provided for by those parties implementing the legislation. They include the:

- protection of outstanding natural features and landscapes from inappropriate subdivision, use and development;
- protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;
- relationship of Māori and their culture and traditions with their ancestral lands, water, sites, wāhi tapu, and other taonga;
- protection of historic heritage from inappropriate subdivision, use and development;
- protection of recognised customary activities.

Other matters that those implementing the legislation must have regard to (section 7) include:

- kaitiakitanga[1];
- the ethic of stewardship;

1 Kaitiakitanga means the exercise of guardianship by New Zealand's indigenous people in relation to natural and physical resources.

- the maintenance and enhancement of amenity values;
- intrinsic values of ecosystems;
- maintenance and enhancement of the quality of the environment.

Central government has devolved much of the responsibility for resource management planning and policy making to local government through the RMA. Every regional council must have a regional policy statement with which regional and district plans must be consistent. Such statements achieve the purpose of the RMA by providing an overview of the resource management issues of the region, as well as policies and methods to achieve integrated management of the natural and physical resources of the whole region. Regional and district plans assist councils with carrying out their functions in order to achieve the purpose of the RMA. All policy statements, and regional and district plans, must be reviewed every 10 years.

The effects of forestry on the environment and the non-trade values of forest resources must be managed within this RMA framework.

Over the last five years several wood processing proposals have not received the consents necessary under the relevant RMA plans to proceed.

LOCAL GOVERNMENT ACT 2002

The Local Government Act 2002 requires regional, district/city councils to develop community outcomes and translate these into Long Term Community Plans. These are 10-year strategic planning documents covering all functions of local government. They do not override the provisions of RMA plans, but are expected to inform the preparation of such plans.

CONSERVATION ACT 1987

The Conservation Act 1987 requires the Department of Conservation to develop conservation management strategies in accordance with the legislation under which DOC operates. The purpose of these strategies is to implement general policies and establish objectives for the integrated management of natural and historic resources managed by DOC, and for recreation, tourism and other conservation purposes. For areas where there are high levels of activity or complexity that cannot be satisfactorily dealt with by a conservation management strategy, a more detailed conservation management plan may be prepared. A conservation management plan must be prepared for each national park and be reviewed at least every 10 years.

FORESTS ACT 1949

An amendment in 1993 introduced Part IIIA (Provisions Relating to Indigenous Forests) to the Forests Act 1949. Part IIIA requires sustainable forest management plans or permits approved by the Ministry of Agriculture and Forestry for the harvesting of timber from most privately owned indigenous forest, and the registration of all sawmills processing indigenous timber.

The purpose of Part IIIA is to promote the sustainable management of indigenous forest land. Sustainable forest management is defined (section 7) as:

> *…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 forest's natural values.*

BIOSECURITY ACT 1993

New Zealand's isolation has meant that indigenous flora and fauna and the plantation forest estate are free from many of the pests and diseases that affect other countries. Increasing trade and travel, and climate change, are elevating the risks of pests and diseases entering the country and becoming established. A good biosecurity system is crucial to protect the environment, the economy and human health. New Zealand's biosecurity system is based on the Biosecurity Act 1993, and on four basic steps that reduce the potential or actual impacts of a

new and unwanted organism:

- Risk reduction involves identifying, analysing and eliminating or mitigating risks (pre-border and border biosecurity measures).
- Readiness is about preparedness for future events.
- Response involves actions taken after an incursion event.
- Recovery comprises the co-ordinated mid- and long-term efforts to restore the social, economic, natural and built environments.

MAF Biosecurity New Zealand leads the country's biosecurity efforts. Forest biosecurity is strengthened though collaboration with the sector and other stakeholders. Particularly relevant are the Forest Biosecurity Consultative Committee, the Surveillance Incursion Response Working Group and the Forest Research Biosecurity Council.

INDEPENDENT OFFICERS OF PARLIAMENT

The Parliamentary Commissioner for the Environment (PCE) is an independent Officer of Parliament set up under the Environment Act 1986. The PCE aims to maintain and improve the quality of New Zealand's environment, with a focus on sustainability. The PCE has wide powers to investigate, to report findings and to make recommendations to Parliament on any matter where the environment may be, or has been, adversely affected; and to investigate and advise public authorities on the effectiveness of environmental planning and management.

Under the Ombudsmen Act 1975, an Ombudsman can investigate any decision, recommendation or action affecting any person or body of people undertaken by public service departments. An Ombudsman may report and make recommendations on complaints.

COMMERCIAL FOREST MANAGERS

The larger commercial forest managers prepare their own forest management plans. In 2007 the *New Zealand environmental code of practice for plantation forestry* was released, replacing an earlier code. This is an important reference tool for forest managers in developing plans and undertaking management operations. The code is based around18 "Best Environmental Management Practices" which are structured as practical decision-making and audit tools, and is supported by extensive background material.

The majority of the larger plantation forest owners have gained, or are in the process of gaining, environmental certification. This is principally Forest Stewardship Council accreditation which covers 55 percent (by area) of the national plantation forest estate. Initial assessments and annual audits are carried out by accreditors, who assess compliance with the environmental, economic and social principles and criteria set down by the certifying bodies.

Redwood plantation, Holt Forest, Hawkes Bay. Photo: Alan Reid.

SOURCES OF INFORMATION

Biosecurity Act (1993) published under the authority of the New Zealand Government, Wellington.

Conservation Act (1987) published under the authority of the New Zealand Government, Wellington.

Department of Conservation. http://www.doc.govt.nz

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Forests Act (1949) published under the authority of the New Zealand Government, Wellington.

Local Government Act (2002) published under the authority of the New Zealand Government, Wellington.

MAF Biosecurity New Zealand. http://www.biosecurity.govt.nz/

Ministry of Agriculture and Forestry. http://www.maf.govt.nz

Ministry for the Environment. http://www.mfe.govt.nz

New Zealand Forest Owners' Association. http://www.nzfoa.org.nz

Office of the Ombudsmen. http://www.ombudsmen.parliament.nz/internal.asp?cat=100003

Office of the Parliamentary Commissioner for the Environment. http://www.pce.govt.nz

Ombudsmen Act (1975) published under the authority of the New Zealand Government, Wellington.

Resource Management Act (1991) published under the authority of the New Zealand Government, Wellington.

FURTHER READING

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New Zealand Forest Owners' Association (2007) *New Zealand environmental code of practice for plantation forestry: parts one to five.* NZFOA; Wellington.

Ministry for the Environment (undated) *Quality planning: the RMA planning resource*. http://www.qualityplanning.org.nz/

Indicator 7.1.c Public participation

Democratic processes of governance generally ensure opportunities for public participation in policy development. The rapid advances in information availability through the internet are offset to some degree in the commercial forest industries, by reducing opportunities for contact between forest managers and the public.

Quality of information: H **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.1.c: Provides opportunities for public participation in public policy and decision-making related to forests and public access to information.

RATIONALE

See Criterion 7 and Indicator 7.1.a.

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POLICY AND LEGISLATION

National policy influencing forestry is developed by central government. For Ministers to receive sound, comprehensive and co-ordinated policy advice, departments preparing papers are charged with ensuring they consider the interests of other departments and government agencies: these must be consulted at the earliest possible stage. Where appropriate, consultation with outside interest groups is encouraged when developing policy.

Examples of groups consulted in forestry policy development are: industry organisations such as the New Zealand Forest Owners' Association; environmental non-government organisations; and professional and landowners' organisations such as the New Zealand Institute of Forestry and New Zealand Farm Forestry Association. Public consultation may be undertaken on some issues.

The New Zealand Parliamentary system has one legislative chamber, an elected House of Representatives. All legislative Bills[1] are referred to select committees (small groups of Members of Parliament) for consideration. Select committee consideration allows the members of the House, interest groups and the general public to examine and have input, through written and oral submissions, into draft legislation before it passes into law. Select committees also consider petitions, carry out inquiries, consider the Estimates and conduct the annual financial reviews of departments and other public organisations.

REGIONAL AND DISTRICT PLANNING

At regional and district levels, the Resource Management Act 1991 provides for Māori and members of the wider community to take part in planning the management of resources of their area. Examples are public consultation and input in the initial stages of preparing policy statements and plans; and submissions to local governments after the public has been notified about policy statements, plans or plan changes. Certain applications for resource consents for proposed activities with potentially adverse environmental effects must be publicly notified and must allow for submissions.

Long-term council community plans are prepared under the Local Government Act 2002. Part of their purpose is to provide an opportunity for participation by the public

1 Except those considered under urgency, and Appropriation and Imprest Supply Bills.

in decision-making processes on activities that are to be undertaken by regional and district/city councils.

INFORMATION

The Official Information Act 1982 makes official information more freely available to the people of New Zealand. This assists their effective participation in the making and administration of laws and policies, and promotes accountability of Ministers of the Crown and officials. The main principle governing release of official information is that "…information shall be made available unless there is good reason for withholding it" (section 5). Section 6 of the Act identifies the reasons for which official information can be withheld.

A wide range of general information and data related to the New Zealand forestry sector is freely available through government departments, particularly the Ministry of Agriculture and Forestry, the Department of Conservation, the Ministry for the Environment, and Statistics New Zealand (see Indicator 7.4.a).

SOURCES OF INFORMATION

Cabinet Manual (2008). http://www.cabinetmanual.cabinetoffice.govt.nz/

Local Government Act (2002) published under the authority of the New Zealand Government, Wellington.

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FURTHER READING

Ministry for the Environment (undated). *Quality planning: the RMA planning resource.* http://www.qualityplanning.org.nz/

Indicator 7.1.d Best practice codes

The commercial forest industry has been to the forefront in the development and use of codes of practice and standards and accords with environmental organisations. These and supporting codes from other authorities have assisted in elevating the standard of forest management and the wellbeing of the workforce.

Quality of information: H **Progress against indicator:** ▲

DESCRIPTION
INDICATOR 7.1.d: Encourages best practice codes for forest management.

RATIONALE
See Criterion 7 and Indicator 7.1.a.

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CODES OF PRACTICE

The *New Zealand Forest Code of Practice* was first published in 1990. It has recently been re-drafted as the *New Zealand Environmental Code of Practice for Plantation Forestry* which was officially launched in August 2007.

The code was developed by the New Zealand Forest Owners' Association and endorsed by other major forest industry organisations. It is based around 18 "Best environmental management practices" that are structured as practical decision-making and audit tools, supported by extensive background material.

The code incorporates "Best environmental management practices" for use by forestry contractors, replacing the 1996 *Environmental Management System* (EMS) for forestry contractors.

Safety is part of sustainability; in 1999 the Occupational Safety and Health group of the Department of Labour issued an *Approved Code of Practice for Safety and Health in Forest Operations.* This is a statement of statutory requirements, rules and provisions, based on preferred work practices and arrangements, to ensure the health and safety of forestry workers. The code is supported by best practice guidelines containing safety, health, training and operational information, and outlining preferred work practices or arrangements on the major components related to each part. This provides practical information for those carrying out, or directly associated with, the work.

In 2008 the New Zealand Forest Owners' Association also published the *NZ Forestry Drug & Alcohol Code of Practice*.

These codes are useful tools for local government when developing plans and considering resource consents. Self-monitoring through codes of practice is encouraged by many regional councils as it promotes "ownership" of potential adverse effects of activities and of resource consents. Codes also provide councils with a consistent and cost-effective base for gathering information to monitor effects on the environment of forestry activities.

Most forestry companies also have in-house environmental management systems and codes of practice for environmental management and worker safety.

STANDARDS

A *National Industry Standard for Sustainable Forest Management* was also developed by the New Zealand Forest Owners' Association in 2005. Compliance with the standard is voluntary. It provides forest managers with a framework for gaining community and market recognition that forest management practices exceed legal requirements, and may form the basis for independently audited assurance that wood products are from a well-managed designated area of forest.

Standards and Guidelines for Sustainable Management of Indigenous Forests have been developed by the Ministry of Agriculture and Forestry. They reflect the statutory requirements under Part IIIA of the Forests Act 1949; and specify structured indigenous forestry standards, for approval and administration of sustainable forest management plans and permits. Each criterion and subset of goals, indicators, benchmarks and verifiers provide guidance on how MAF will apply provisions of the Act. The objective of the MAF's *Standards and Guidelines* is to present detailed procedures and practice standards for sustainable forest management.

A standard for the *Management of Agrichemicals* was approved by Standards New Zealand in 2004. This sets out the requirements for the safe, responsible and effective management of agrichemicals. It describes a risk-management approach for major activities by suppliers and users, and planning for and dealing with emergencies. The standard replaces earlier codes of practice relating to the use of agrichemicals.

ACCORDS

The *New Zealand Forest Accord* was signed in 1991 by the New Zealand Forest Owners' Association and the main conservation groups. It was reaffirmed in 2007, with the accord partners extending it to include climate change and the mitigating roles of indigenous and plantation forests.

The objectives of the accord form the basis for the *Principles for Commercial Plantation Forest Management in New Zealand,* signed by the same parties in 1995. These principles commit the members of the Forest Owners' Association to meeting standards of environmental practice and social behaviour in excess of those required by law or international treaties.

GUIDELINES

New Zealand contributed to the development of FAO's voluntary guidelines on *Responsible Management of Planted Forests*, completed in 2006.

The Ministry for the Environment is developing guidance material for their quality planning website on rural land use. This material will focus on forestry and agriculture.

SOURCES OF INFORMATION

Department of Labour, Occupational Safety & Health Service (1999) *Approved code of practice for safety and health in forest operations*. http://www.osh.dol.govt.nz/order/catalogue/301.shtml

Ministry of Agriculture and Forestry (2007) *Standards and guidelines for sustainable management of indigenous forests*. http://www.maf.govt.nz/forestry/indigenous-forestry/intro-page-for-standards.htm

New Zealand Forest Owners' Association (2007) *New Zealand environmental code of practice for plantation forestry.* http://www.nzfoa.org.nz/index.php?/File_libraries_resources/Standards_guidelines/Environmental_Code_of_Practice

New Zealand Forest Owners' Association (2008) *NZ forestry drug & alcohol code of practice*. New Zealand Forest Owners' Association; Wellington.

New Zealand Forest Owners' Association (2005) *A national industry standard for sustainable forest management.* http://www.nzfoa.org.nz/index.php?/File_libraries_resources/Standards_guidelines/A_National_Industry_Standard_for_Sustainable_Plantation_Forest_Management

Standards New Zealand (2004) *New Zealand standard: management of agrichemicals*. http://shop.standards.co.nz/scope/NZS8409-2004.scope.scope.pdf

FURTHER READING

FITEC. *Vision, knowledge, performance*. http://www.fitec.org.nz/business_centre/best_practice_guidelines/default_flash.aspx

Forest Industry Contractors' Association. *Publications*. http://www.fica.org.nz/index.cfm?id=3

Ministry for the Environment (undated) *Quality planning: the RMA planning resource.* http://www.qualityplanning.org.nz/

Photo: Pan Pac Forest Products Ltd (www.panpac.co.nz).

Indicator 7.1.e Conservation of special values

Legislation recognises special environmental values associated with forests and provides mechanisms for their protection. The Department of Conservation is an advocate for the conservation of natural and historic resources, while the New Zealand Forest Owners' Association has an accord with environmental groups to avoid disturbing indigenous vegetation.

Quality of information: M **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.1.e: Provides for the management of forest to conserve special environmental, cultural, social and/or scientific values.

RATIONALE

See Criterion 7 and Indicator 7.1.a.

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RESOURCE MANAGEMENT ACT 1991

Section 6 of the Resource Management Act 1991 (RMA) requires all persons exercising powers under it to recognise and provide for matters of national importance. These include the protection of areas of:

- significant indigenous vegetation and significant habitats of indigenous fauna;
- outstanding natural features and landscapes from inappropriate subdivision, use and development.

There are no nationally agreed assessment criteria for significant indigenous vegetation and significant habitats of indigenous fauna, or for outstanding landscapes and natural features. The implementation of these matters of national importance has sometimes been controversial with rural land owners.

The same section of the RMA requires recognition and provision for the relationship of Māori and their culture and traditions with their ancestral land, water, sites, wāhi tapu[1], and other taonga[2], and the protection of recognised customary activities.

Cultural and social values in particular are provided for by "heritage orders" under sections 187–198 of the RMA. These orders provide protection for places of special interest, character, intrinsic or amenity value or visual appeal, including places of spiritual value to Māori. Once a heritage order is in place, no-one can do anything to that land or property that would nullify the effect of the order, unless they have written consent from the applicable heritage protection authority. A heritage order takes precedence over the provisions of a district plan or a resource consent.

HISTORIC PLACES ACT 1993

Heritage sites can also be protected under the Historic Places Act 1993. The purpose of this Act (section 4) is "…to promote the identification, protection, preservation and conservation of the historical and cultural heritage of New Zealand." In addition to heritage orders, heritage covenants (voluntary agreements) may be negotiated by the Historic Places Trust with the owner of an historic place. It is unlawful under section 10 of the Historic Places Act to destroy, damage or modify any archaeological sites.

1 Wāhi tapu are scared places.

2 Taonga are treasured possessions.

INDIGENOUS FORESTS ON CROWN-OWNED LAND

The majority of indigenous forest in New Zealand is held in public ownership under the Conservation Act 1987 or National Parks Act 1980. Conservation Act land is managed "…for conservation purposes" and the Department of Conservation is an "advocate for the conservation of natural and historic resources" (section 6). The National Parks Act (section 4) requires such parks to be "…preserved as far as possible in their natural state." There is no harvesting of timber from land managed under these Acts.

As from 31 March 2002, all but 12 000 hectares of indigenous forest on Crown-owned land managed under other legislation were withdrawn from management involving timber production. These 12 000 hectares, over which a forestry right exists in favour of the local owners (the Waitutu Incorporation), are managed in accordance with the Part IIIA provisions of the Forests Act 1949.

INDIGENOUS FORESTS ON PRIVATELY-OWNED LAND

Part IIIA of the Forests Act 1949 provides for the sustainable management of indigenous forests on private land through restrictions on the harvesting, milling and export of indigenous timber and forest products. Forest owners who wish to harvest trees must obtain a sustainable forest management plan or permit. Sustainable forest management requires forest land to be managed 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 forest's natural values" (section 2).

Implementation of the Act recognises many values of indigenous forests including flora and fauna, soil and water quality protection, amenity and commercial values.

COMMERCIAL PLANTATION FORESTS

The *New Zealand Forest Accord* is a voluntary agreement between members of the New Zealand Forest Owners' Association and environmental groups. Under the accord, the association's members will exclude areas of naturally occurring indigenous vegetation from land clearing and disturbance.

SOURCES OF INFORMATION

Conservation Act (1987) published under the authority of the New Zealand Government, Wellington.

Department of Conservation. http://www.doc.govt.nz

Environmental Defence Society (undated) *Resource Management Act: for the community – heritage order.* http://www.rmaguide.org.nz/rma/otherprocesses/heritageorders.cfm

Forests Act (1949) published under the authority of the New Zealand Government, Wellington.

Historic Places Act (1993) published under the authority of the New Zealand Government, Wellington.

Ministry for the Environment. http://www.mfe.govt.nz

Ministry for the Environment (undated) *Quality planning: the RMA planning resource*. http://www.qualityplanning.org.nz/plan-topics/index.php

National Parks Act (1980) published under the authority of the New Zealand Government, Wellington.

New Zealand Forest Owners' Association (1991) *New Zealand Forest Accord*. http://www.nzfoa.org.nz/index.php?/File_libraries_resources/Agreements_Accords/New_Zealand_Forest_Accord

Resource Management Act (1991) published under the authority of the New Zealand Government, Wellington.

FURTHER READING

Rainbow, S; Derby, D (2000) Heritage and planning. In Memon, AP; Perkins, HC (eds), *Environmental Planning and Management in New Zealand*, Dunmore Press.

INDICATORS 7.2 INSTITUTIONAL FRAMEWORK

These indicators provide information on the extent to which the institutional framework (including capacity) supports the conservation and sustainable management of forests.

Indicator 7.2.a Public involvement activities

There is a range of public involvement and collaborative management opportunities associated with the indigenous conservation estate. While good information is available for the plantation forests, the commercial management focus results in fewer opportunities for public involvement and education.

Quality of information: H/M **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.2.a: Provide for public involvement activities and public education, awareness and extension programmes, and make available forest-related information.

RATIONALE

Within the overall legal framework, countries possess institutions and organisations that can promote sustainability. The framework can integrate public needs and aspirations into the process of planning and can maintain this infrastructure on an ongoing basis. The structures needed to develop the requisite skills must be in place, along with the means to ensure that plans are implemented. A wide variety in the needs from forests by societies means, that a similarly wide variety of skills must be continuously developed. The planning, implementation, and enforcement activities should be open and transparent to provide evidence of a country's commitment to sustainability. The frameworks accommodate a variety of societal values ensuring sustainability and are designed to engender broad public support for implementation and enforcement. The degree to which these institutions are in place and are functioning on a continuous basis is a measure of sustainability.

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Opportunities for public involvement in the development of national policy, and in regional and district level planning, have been addressed in Indicator 7.1.c. Central and local government and private agencies involved in forestry and forest management offer varying opportunities for additional public involvement activities.

THE DEPARTMENT OF CONSERVATION

Conservation in New Zealand is increasingly becoming a collaborative effort among the public, non-government organisations, businesses, and all levels of government. DOC focuses on biodiversity and ecosystem protection, rather than on forests as an ecosystem type.

The Department of Conservation relies on partnerships with the community to achieve its mission to conserve New Zealand's unique indigenous biodiversity. These partnerships include:

- a Treaty partnership with iwi Māori (New Zealand's indigenous people);
- working with regional and district councils to implement their responsibilities for biodiversity conservation in regional and district plans and coastal plans under the Resource Management Act 1991;
- working with environmental non-government organisations (NGOs), trusts and other community interest groups;
- working with private land owners for the protection

of natural areas through covenants and other conservation measures such as Ngā Whenua Rāhui[1];
- working with universities and research institutions to improve knowledge and techniques of conservation;
- providing opportunities for corporate sponsorship of conservation programmes;
- working with education providers to enable them to deliver conservation education programmes;
- providing and promoting opportunities for community involvement in practical conservation projects and policy development;
- joint programmes for protection of biodiversity, such as Project Crimson and organisations such as the Nature Heritage Fund.

Involving the community in caring for its heritage through education, sponsorships, awards, community involvement programmes, partnerships and events such as Conservation Week is a key part of DOC's work. Public involvement activities range from national-level initiatives to locally run community programmes.

The Department of Conservation provides a range of levels of engagement for the public. Its visitor information centres provide interpretation of New Zealand's indigenous ecosystems. There are volunteer programmes and annual events such as Arbor Day. Information about New Zealand's biodiversity is also made available through a number of different mechanisms such as educational resources for schools, fact sheets, scientific papers, public discussion documents, maps, and media articles. DOC's website (http://www.doc.govt.nz) provides access to these resources. In addition, DOC supports community-initiated conservation projects, either on conservation land administered by DOC or on other land with significant conservation value.

1 A contestable fund with which to negotiate the voluntary protection of indigenous forest on Māori-owned land.

THE MINISTRY OF AGRICULTURE AND FORESTRY

The Ministry of Agriculture and Forestry has a specific focus on the collection and dissemination of information and statistical data concerning commercial plantation forests, the primary processing of wood products, and international and domestic trade of wood products. These cover quarterly and annual releases of statistics on logs and roundwood removals and on the production of sawn timber, panel products, pulp, paper and paperboard, and wood chips. The exports and imports of forest products are covered by annual releases of statistics. The information is usually available in both printed and electronic form, with much of it available (sometimes in summarised versions) on MAF's website.

Of particular note is the *National Exotic Forest Description*, New Zealand's official source of statistics on plantation forestry. The NEFD operates a partnership with the New Zealand Forest Owners' Association.

Reports on *Regional Forest Industries and Wood Availability Forecasts* were completed and published between 2007 and 2009 (see Indicator 7.4.a).

MAF does not provide an "extension service" to forest and/or land owners, but does provide advice and printed or website-based information on:

- Part IIIA of the Forests Act 1949 (indigenous forestry provisions);
- Part IIIB of the Forests Act (a mechanism allowing landowners to access value created by the Kyoto Protocol of carbon sequestration on land, through the establishment of forest sink covenants);
- other forestry related government initiatives to mitigate climate change, principally the forestry component of the Emissions Trading Scheme and the Afforestation Grant Scheme.

Private forest consultants are considered more appropriate to provide general forestry extension activities. Similarly, MAF does not convene forestry field days and seminars, but may participate in such events organised by others and provide information and displays on its role and on sustainable forest management.

COMMERCIAL FOREST INDUSTRIES

The commercial forest industries comprise corporate and private forest owners, wood processors and service providers (collectively represented in a range of industry associations). The different groupings provide forestry and forestry-related information through a variety of mechanisms such as websites, publications, conferences, seminars, field days, working demonstrations, tuition, and training courses.

Forestry Insights was a major educational initiative between the former Ministry of Forestry and the forest industries in the mid 1990s, providing free educational resources to all schools at all levels. The project is now co-ordinated by the Forest Industries Training and Education Council and the original material has been revised. It focuses on students, teachers, industry trainees and the general public. All material is on the internet at http://www.insights.co.nz/

Forestry Insights has six themes: forests and people; the forest habitat; natural forests and plantations; processes and markets; creatures; and wood and climate change.

The forest industries have recently developed *NZWood,* a new website (http://www.nzwood.co.nz/) which is a promotional and development programme for New Zealand's forests and wood resources.

The corporate owners of plantation forests often provide for various forms of public recreation in their forests. This commonly includes walking, mountain biking, picnicking, and hunting where this is not in conflict with other uses.

RESEARCH INSTITUTES

Scion (formerly Forest Research) and Landcare Research provide forestry and forest-related information to the wider public through their websites, various bulletins, and directly through dissemination to interest groups and other stakeholders. Scion's *Forests of Life* (http://www.scionresearch.com/forests+of+life.aspx) is an inquiry-based science and education programme.

OTHER ORGANISATIONS

The New Zealand Institute of Forestry has a *National Policy on Forestry* and an *Indigenous Forest Policy* based on a forest ecosystem approach to sustainable management. Both the Institute of Forestry and the New Zealand Farm Forestry Association convene annual conferences and hold regular seminars and field days.

Regional and city/district councils administer parks and reserves, some of which may be forested. These are available to local citizens and visitors for a range of recreational activities, community events, education and research, and sometimes for commercial activities.

New Zealand has several environmental organisations that are active in sustainable forest management issues (for example, the Royal Forest and Bird Protection

Society, and Greenpeace Aotearoa New Zealand). There are also several forestry interest groups, particularly with respect to indigenous forests (for example, Tāne's Tree Trust and Kauri 2000). These organisations provide written information to their members, convene workshops and field days, and participate in statutory planning and political processes for the sustainable management of forests and forest land.

SOURCES OF INFORMATION

Department of Conservation. http://www.doc.govt.nz

FITEC. *Forestry insights*. http://www.insights.co.nz/

Ministry of Agriculture and Forestry. *Forest industry and wood availability forecasts*. http://www.maf.govt.nz/mafnet/publications/wood-availability/

Ministry of Agriculture and Forestry. *Forestry production and trade statistics*. http://www.maf.govt.nz/statistics/forestry/

Ministry of Agriculture and Forestry. MAF Forestry. http://www.maf.govt.nz/forestry/

New Zealand Farm Forestry Association. http://www.nzffa.org.nz

New Zealand Institute of Forestry. *NZ Institute of Forestry policies, codes and standards*. http://www.nzif.org.nz/policies/index.htm

WoodCo (undated) *NZWood*. http://www.nzwood.co.nz/

FURTHER READING

Forest Industries Training. http://www.fitec.org.nz

Greater Wellington. *What you can do in parks and reserves*. http://www.gw.govt.nz/section406.cfm?

Greenpeace Aotearoa New Zealand. http://www.greenpeace.org/new-zealand/

Kauri 2000 Trust. http://www.kauri2000.co.nz/

Landcare Research. http://www.landcareresearch.co.nz

Royal Forest and Bird Protection Society of New Zealand. http://www.forestandbird.org.nz/

Scion. http://www.scionresearch.co.nz

Tāne's Tree Trust. http://www.tanestrees.org.nz/

Mountain beech forest, Southern Alps, Canterbury. Photo: Ian Platt.

Indicator 7.2.b Forest-related planning

New Zealand has no national forest policy or national forestry programme. The Department of Conservation prepares management strategies for Crown-owned indigenous forest areas, and may prepare more detailed management plans. Government approved plans or permits are required for privately-owned indigenous forests where timber is harvested. Larger scale plantation forest owners undertake estate, forest and operational planning, influenced by codes or practice and certification requirements (for many).

Quality of information: M **Progress against indicator:** ▶

DESCRIPTION

INDICATOR 7.2.b: Undertake and implement periodic forest-related planning, assessment, and policy review including cross-sectoral planning and co-ordination.

RATIONALE

See Criterion 7 and Indicator 7.2.a.

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NATIONAL POLICY

No national forest policy or national forest programme exists in New Zealand, and there is no target plantation forest estate area or annual forest establishment target. Government announced a national indigenous forest policy, in 1990, with some refinements subsequently. The most notable amendment was the cessation of all harvesting from indigenous forest on Crown-owned land from 31 March 2002, with the exception of 12 000 hectares.

Government policy approach to resource management is cross-sectoral. It seeks to manage adverse effects on the environment, and establish legislative and economic frameworks within which investment decisions can be largely market-driven.

RESOURCE MANAGEMENT ACT 1991

The Ministry for the Environment administers the Resource Management Act 1991. This is the primary legislation for statutory resource management planning, having brought together laws governing land, air and water resources. Central government has devolved much of the responsibility for implementing resource management planning and policy making to local government through the RMA.

All regional councils must have regional policy statements and plans, and district councils must have a district plan. These documents help councils achieve the purpose of the RMA. All policy statements, and regional and district plans, must be reviewed every 10 years.

The needs of resource managers and users are considered during the development and review of regional policy statements, and of regional and district plans, through formal (as set out in the legislation) and informal consultation processes. Public submissions must be called for during the drafting of policy statements and plans. Consultation with affected parties may also be required before resource consents[1] are granted or declined. Any submitter who is not satisfied with a council's decision may appeal to the Environment Court, and then to the High Court (on points of law only).

1 A resource consent (where required) gives a person or organisation permission for a stated period, and usually subject to conditions, to carry out an activity that is not allowed as of right in a regional or district plan.

The RMA requires the Minister for the Environment to monitor the effect and implementation of the legislation. The Act also requires every regional and district council to monitor the state of the whole or any part of the environment of its region or district. It does so to the extent that is appropriate to enable the local authority to carry out its functions effectively under the Act. Regional and district councils are also required to respond to complaints and, where necessary, take enforcement action. Such action may include infringement and abatement notices, enforcement orders and prosecutions (see indicator 7.2.e).

LOCAL GOVERNMENT ACT 2002

The Local Government Act 2002 requires regional and district/city councils to consult with local communities and Crown agencies in the development of community outcomes. These are then translated into plans of action known as the Long Term Council Community Plans. While they do not override the provisions of RMA plans, they are expected to inform the preparation of such plans.

CONSERVATION ACT 1987

The Department of Conservation manages about 78 percent of New Zealand's indigenous forest resource under the Conservation Act and other legislation such as the National Parks Act. The Conservation Act promotes the conservation of New Zealand's natural and historic resources. Conservation is defined as:

> *…the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.*

The Act does not provide for the taking or harvesting of wood from indigenous species. Exceptions are, if a current lease or licence providing for this was granted before the commencement of the Act, or if authorised for traditional Māori purposes.

Conservation management strategies are required under the Conservation Act and are prepared by DOC. These

strategies have 10-year terms, provide an overview of conservation issues, and give direction for the management of conservation areas. Other non-statutory plans and strategies prepared by DOC must have regard to the relevant conservation management strategy.

Conservation management plans are 10-year statutory plans prepared by DOC to implement conservation management strategies in areas where there is a high level of activity or a complexity of issues. The plans establish detailed objectives for the integrated management of natural and historic resources within a particular area.

The process for preparing the strategies and plans is set out in the Conservation Act. It may include the preparation of information leaflets and resource discussion documents, the circulation of draft material, and the facilitation of hui, public meetings and workshops.

FORESTS ACT 1949

The Ministry of Agriculture and Forestry administers the Forests Act 1949. Under Part IIIA of the Act, any harvesting from most of the privately owned indigenous forest resource is subject to approved sustainable forest management plans or permits. MAF is required to consult with DOC, and where the land concerned is Māori land, with the Ministry of Māori Development (Te Puni Kōkiri) before approving a sustainable forest management plan or permit.

Of the 1.4 million hectares of privately owned indigenous forest, 300 000 to 400 000 hectares may have potential for sustainable forest management involving the harvesting of wood. As at June 2008, some 114 000 hectares of indigenous forest were covered by approved sustainable forest management plans and permits.

Only sawmills registered under the Act may process indigenous timber. Regulations require sawmills to keep records of logs milled and provide quarterly returns to MAF. This a key mechanism for monitoring sustainable harvesting.

PRIVATE FOREST PLANNING

Larger-scale plantation forest owners undertake their own estate, forest and/or operational levels of planning. Standards, codes of practice, principles of forest management and accords that may be followed in planning processes by these forest owners have been discussed in sections under Indicators 7.1. Planning is also influenced third-party certification requirements. While there is no legal requirement to involve local communities in the planning processes, this is becoming more common as a result of certification and its requirements for social impact assessments and monitoring.

SOURCES OF INFORMATION

Conservation Act 1987, published under the authority of the New Zealand Government, Wellington.

Department of Conservation. http://www.doc.govt.nz

Forests Act 1949, published under the authority of the New Zealand Government, Wellington.

Ministry for the Environment. http://www.mfe.govt.nz

Ministry of Agriculture and Forestry. http://www.maf.govt.nz

Resource Management Act 1991, published under the authority of the New Zealand Government, Wellington.

FURTHER READING

Ministry for the Environment (undated) *Quality planning: the RMA planning resource.* http://www.qualityplanning.org.nz/plan-topics/index.php

Indicator 7.2.c Human resource skills

The New Zealand Qualifications Authority administers well-developed systems of formal forestry sector (and other) training and education programmes. Larger forestry organisations also provide in-house training. The commercial industries face the challenge of contractor retention during periods of low demand for wood products.

Quality of information: M **Progress against indicator:** ▶

DESCRIPTION

INDICATOR 7.2.c: Develop and maintain human resource skills across relevant disciplines.

RATIONALE

See Criterion 7 and Indicator 7.2.a.

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Most forestry sector organisations recognise the importance of developing and maintaining a high level of education and skill in their workforces. Commercial forest industries face the challenge of balancing the retention of skilled staff and contractors, with maintaining viability and reducing employment levels during periods of depressed demand for wood products.

Training includes formally structured, nationally recognised qualifications, in-house training programmes, and training for community-based organisations.

NEW ZEALAND QUALIFICATIONS AUTHORITY

The New Zealand Qualifications Authority (NZQA) co-ordinates the administration and quality assurance of national qualifications in New Zealand. It aims to ensure the qualifications are accepted, nationally and internationally, as credible and robust. The NZQA works closely with other education agencies such as the Ministry of Education. It receives about half its funding from central government and the rest from fees and levies.

The New Zealand Qualifications Framework involves 10 qualification levels that depend on the complexity of learning. The levels cover certificates, diplomas, Bachelor's degrees, postgraduate diplomas/certificates, Master's degrees, and Doctorates.

Certificate courses cover a wide range of topics relevant to the management of both the commercial plantation forest and the indigenous conservation forest estates.

FITEC

The Forest Industries Training and Education Council is the Industry Training Organisation for the forest industries. ITOs are recognised by Skill New Zealand under the Industry Training Act 1992, and are established by industries to meet their needs for skill standards and national qualifications.

FITEC's responsibilities include:

- setting national standards and qualifications and developing learning resources;
- developing training programmes for employers and employees;
- developing arrangements for training delivery;
- maintaining a database of trainees and their learning records;
- arranging quality assurance of training producers, industry trainers and assessors;

› providing leadership in the industry on skills and learning issues.

FITEC is owned by the industries and works on all aspects of education and training for:

› forest establishment, silviculture and harvesting;
› solid wood processing;
› pulp and paper production;
› wood panel manufacturing;
› forest health and biosecurity;
› credit and finance.

POLYTECHNICS AND OTHER ACCREDITED PROVIDERS

Several polytechnics and other accredited institutions provide forestry training at the certificate and diploma levels located throughout New Zealand.

UNIVERSITIES

The School of Forestry at the University of Canterbury (Christchurch) offers the only professional forestry degree programmes in New Zealand. These are:

› Bachelor of Forestry Science;
› Bachelor of Forest Engineering;
› Postgraduate Diploma in Forestry;
› Master of Forestry Science;
› PhD in Forestry.

Other universities offer a range of undergraduate and postgraduate programmes associated with environmental sciences, sustainability and the environment, and recreation, leisure and tourism.

SOURCES OF INFORMATION

Forest Industries Training. http://www.fitec.org.nz

Ministry of Education . http://www.minedu.govt.nz/

New Zealand School of Forestry, University of Canterbury. http://www.fore.canterbury.ac.nz

TABLE 7.2: GRADUATION OF STUDENTS IN FORESTRY-RELATED EDUCATION IN 2005

CATEGORY	NUMBER GRADUATING
Certificates/Diplomas	2 150
Bachelor's degree or equivalent	42
Master's degree or equivalent	9
Doctorates	2

Sources
FITEC (2008).
Ministry of Education (2008).
New Zealand School of Forestry (2008).

FURTHER READING

Lincoln University. http://www.lincoln.ac.nz/

Ministry of Education. http://www.minedu.govt.nz/

New Zealand Qualifications Authority. http://www.nzqa.govt.nz

Skill New Zealand. http://www.skillnz.org.nz

The University of Auckland. http://www.auckland.ac.nz/

Indicator 7.2.d Infrastructure

New Zealand has a physical road, rail and port infrastructure that enables the movement of forest products to domestic and international markets.

In 2006/07, forestry had the largest freight movement of any primary production sector, with 30.3 million tonnes of logs, chips and manufactured timber products transported within New Zealand. Port infrastructure has continued to develop over the last five years and caters for the export of about 70 percent (roundwood equivalent) of the annual harvest.

Quality of information: M **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.2.d: Develop and maintain efficient physical infrastructure to facilitate the supply of forest products and services and support forest management.

RATIONALE

This indicator enables the monitoring of physical infrastructure development to enable the domestic and international supply of forest products and the management of the forest resources. The degree to which infrastructure developments are in place and functioning on a continuous basis, is a measure of sustainability.

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New Zealand has in place physical infrastructure to support a broad range of activities, including the forest industry. Central and local government fund and operate the public road network, which is the largest capital investment in New Zealand's transport system.

Forestry and its related industries play a major role in the New Zealand economy; they represent a significant proportion of the freight volume transported domestically and exported through New Zealand's network of ports.

It is estimated that, in 2006/07, the movement of forestry goods within New Zealand totalled 30.3 million tonnes of logs, chips and manufactured timber products. When average transport distances are taken into account, the movement of logs and wood products in New Zealand accounted for 3.8 billion tonne-kilometres[1]. This is well ahead of other primary production sectors, the next largest being milk and dairy products at 1.9 billion tonne-kilometres (Richard Paling Consulting, 2008).

A priority for the New Zealand government has been to develop a more integrated transport network, as a means of increasing efficiency within the system as well as reducing emissions on a per-tonne basis. In 2004, the government re-purchased the national rail network from Toll Holdings; this was followed in June 2008 with the rail and ferry assets of Toll being purchased for $665 million. The company has been re-branded as Kiwirail. At the time of the purchase, government stated that "Rail will be a central part of building a truly sustainable and highly efficient transport system in New Zealand." (Hon Dr M Cullen, 2008)

There is a heavy reliance on sea transport for overseas trade: over 99 percent of imports and exports (by volume) is moved by sea. International shipping lines handle virtually all of the overseas trade. New Zealand has 12 main export ports, which can handle containerised and bulk freight.

1 Tonne-kilometre represents the movement of one tonne over a distance of one kilometre.

TABLE 7.3: FOREST COMMODITIES – MODE OF TRAVEL IN 2006/07

COMMODITY	TOTAL VOLUME (000 TONNES)	SHARE OF MODE (%)	
		ROAD	RAIL
Logs and chips	21 600	94	6
Manufactured timber products	8 750	97	3
Total	**30 350**	**95**	**5**

Source
Richard Paling Consulting (2008).

TABLE 7.4: ROAD INFRASTRUCTURE IN NEW ZEALAND

	KILOMETRES OF ROAD	
	2002/03	2006/07
State Highway	10 791	10 893
Local Authority	81 703	82 683
Total	**92 494**	**93 576**

Source
Ministry of Transport (2008).

TABLE 7.5: ROAD USER CHARGES PURCHASED FOR LOG HAULAGE VEHICLES

YEAR	DISTANCE PURCHASED (000 KM PER YEAR)
2003	145 825
2007	152 838

Source
Wehi (2008).

ROAD INFRASTRUCTURE

New Zealand has an extensive roading network with a total length of 93 600 kilometres of formed road. Major roads (known as State Highways) total 10 900 kilometres and carry 46 percent of all New Zealand traffic. Some 82 700 kilometres of local authority roads provide the secondary network.

An indicator of the use of State Highways and local authority roads for log transport can be obtained from the level of Road User Charges (RUCs)[2] purchased for log haulage (where the vehicle is either diesel powered and/or over 3.5 tonnes in weight). Table 7.5 shows that the level of purchase has increased by about 5 percent since 2003.

Central government invests more than $1.6 billion in land transport each year, and regional and territorial authorities invest a further $400 million (mainly from rates). Funding of the National Land Transport Programme increased 25 percent between 2003/04 and 2006/07. Included in this programme was specific regional development expenditure ($15 million to 22 million per annum) for Northland and Tairawhiti, to provide improved roading infrastructure for forest products.

Government is currently evaluating the potential to increase weights and dimensions of heavy vehicles on specified routes. This could reduce freight costs, fuel consumption and carbon emissions.

RAIL

Railway infrastructure in New Zealand includes about 4000 kilometres of narrow-gauge track, 2187 railway bridges and viaducts, and 147 tunnels.

Raw and processed forestry products, such as logs, pulp, sawn timber and panel products are carried by rail to

2 Road User Charges (RUCs) are the charges that recover road costs from diesel vehicles through an average weight-distance paper licence system.

domestic destinations and export ports. The majority of pulp and paper is hauled by rail, but trucks dominate the market for hauling logs, lumber and wood chips.

Rail currently represents 18 percent of all freight tonne-kilometres and has been so fairly consistently from 2003 onwards. Government's target in the *New Zealand Transport Strategy 2008* is to increase rail's share of freight to 25 percent of tonne-kilometres by 2040. The *National Freight Demands Study* (2008) estimates that growth in rail freight between 2006/07 and 2031 will increase by 151 percent for logs and woodchips, and by 24 percent for timber, wood products and pulp and paper.

PORTS

New Zealand has 12 commercial ports with significant volumes of forestry exports or imports. They are predominantly owned by local government, although six are partly privatised. Most forest product-exporting ports are focusing on improving log storage and covered storage facilities for processed forest products.

In the year ended March 2007, 30 percent of the logs harvested were exported. Reductions in exports over the previous four years are due largely to forest owners wanting to mature their forests, and to high exchange rates and shipping costs. There has however, been an expansion in lumber (sawn timber) and wood panel products.

SOURCES OF INFORMATION

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Wehi, N (2008) Personal communication. NZ Transport Agency.

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Indicator 7.2.e Enforce laws

Forestry, resource management and biosecurity legislation and regulations are enforced by specialist staff from central and local government agencies, as well as by honorary rangers for the conservation forest estate. Legislation includes penalties for offences that provide for fines and imprisonment.

Quality of information: M **Progress against indicator:** ▶

DESCRIPTION
INDICATOR 7.2.e: Enforce laws, regulations and guidelines.

RATIONALE
See Criterion 7 and Indicator 7.2.a.

2008 COUNTRY REPORT

Laws and regulations are enforced both by central and local government agencies.

DEPARTMENT OF CONSERVATION

Compliance and law enforcement by DOC apply to all the legislation it administers. It is a system based on complete integration, and the powers exercised across the various Acts are similar.

The estate administered by DOC's compliance and law enforcement-warranted officers relevant to Indicator 7.2.e consists of:

- reserves (including wildlife protected areas) in a marine or terrestrial setting;
- national parks (some such as Fiordland and Abel Tasman are both in a marine and a terrestrial context);
- conservation areas.

For the following reasons, DOC generally undertakes its own enforcement work:

- the operations frequently occur in remote locations where it is not practical to call in the police;
- specialist knowledge and skills are often needed for conservation enforcement work, in terms of understanding both the legislation, and the assets and values it manages;
- staff often need to act quickly in order to apprehend an offender, or to prevent the offence causing major environmental effects.

Currently DOC uses the powers:

- to intervene to stop offending (and prevent further damage);
- to require personal particulars to be provided;
- to stop persons and other things (can only currently stop boats under the Reserves Act);
- of entry and search;
- of seizure or arrest for offences committed using boats in national parks and reserves.

Warranted compliance and law enforcement staff with powers can deal with an offence they see occurring; or they can investigate and collect evidence about an offence that they believe, on reasonable grounds, has been committed. Law reform will allow DOC to be more effective in enforcement than it has been in the past.

The Department of Conservation has divided law enforcement into three facets. High-level officers are available to operate in a national context to deliver the chain of evidence required for serious offending, such as the taking of plants (indigenous forest) or biosecurity threats. These officers carry out planned operations in

areas of high risk for DOC, or where information is received that illegal activity is taking place.

The second level is a specific role for field staff dealing with incidents in their own locations, and submitting prosecution files. The last level involves all staff employed by DOC: they have a role to be the eyes and ears for any offending, and pass on information to the second level for investigation. A National Compliance and Law Enforcement Co-ordinator provides the national strategic direction for complete integration for training, and delivery of all the powers across all the legislation, for which DOC is responsible.

HONORARY RANGER SYSTEM

The Department of Conservation has functions New Zealand-wide. It is impossible to carry out its statutory role without the involvement of the community, given the scale involved. For example, in the whitebait fisheries surrounded by forests in the remote parts of New Zealand (Wild Places to Big Bay, and Martins Bay, on the West Coast) the honorary officer carries out DOC's role. Expense and time-wise, it would be impossible for fulltime DOC staff with compliance roles to spend the entire season in the location. The honorary system also assists DOC with capacity to carry out its statutory function. A regular reporting obligation forms part of holding the honorary warrant.

Honorary officers work in three ways:

- in teams with DOC staff in surveillance roles on planned operations;
- through advocacy and education, including publicising and promoting material relating to conservation;
- in surveillance outside normal work hours.

All honorary officers undertake the same five-day compliance and law enforcement course as DOC staff. Regular refresher courses are made available, as are opportunities to be part of the yearly whole-of-government cross-agency training.

MINISTRY OF AGRICULTURE AND FORESTRY

The Ministry of Agriculture and Forestry enforces the Forests Act 1949, and parts of the Biosecurity Act 1993. Enforcement includes bringing prosecutions against those who contravene the Acts and their regulations.

Part IIIA of the Forests Act applies to the large majority of the privately owned indigenous forests. The number of prosecutions under this Act (generally brought for illegal harvesting of indigenous timber) has been very low in recent years. This reflects an efficient control system of sawmill registration, improved understanding by forest owners of the provisions of the Act, and ongoing monitoring by MAF. In isolated areas, however, smaller-scale offences can be difficult to detect.

BIOSECURITY ACT 1993

Central and regional government agencies administer functions under the Biosecurity Act 1993. The Act provides a framework to manage pests and unwanted organisms in New Zealand. The work is led and co-ordinated by MAF, which has a specialist enforcement team with powers of prosecution for breaches of the biosecurity law. Penalties for offences against the provisions of the Act vary according to the nature of the offence. For an individual person, penalties range up to imprisonment for a term not exceeding five years, a fine not exceeding $100 000, or both. In the case of a corporation, the penalties involve fines of up to $200 000.

New Zealand is relatively free of major pests and diseases owing to its geographic isolation and strong border controls. Incoming passengers and freight are physically checked for items that could be carrying dangerous pests and diseases. The maximum penalty for making a false declaration is a fine of up to $100,000, or imprisonment for up to five years. An instant fine of $200 is levied on anyone who completes a declaration card incorrectly or forgets to declare items.

Regional pest management strategies exist yet a land

occupier may fail to comply with any rule in that strategy. In that situation, the relevant regional council may require the landowner to undertake specified actions to address the situation. Failure to comply with a legal direction can result in the regional council entering onto the land to carry out the work itself, and subsequently recovering actual and reasonable costs from the landowner.

LOCAL GOVERNMENT

Local government (regional and district/city councils) primarily implements the Resource Management Act 1991 (see Indicator 7.1.b).

Enforcement orders under the RMA can be sought by a council or any person from the Environment Court that (summarised from section 314 of the RMA):

> *require a person to cease, or prohibit a person from commencing, anything done or to be done by, or on behalf of, that person that:*
> - *contravenes or is likely to contravene the Act, any regulations, a rule in a plan, a resource consent, or certain other provisions;*
> - *is, or is likely to be, noxious, dangerous, offensive, or objectionable to an extent that it has or is likely to have an adverse effect on the environment.*
>
> *Enforcement orders can also require a person to do something that is considered necessary to ensure compliance with the Act, any regulations, a rule in a plan, a resource consent, and certain other provisions, and to avoid, remedy or mitigate adverse effects on the environment caused by, or on behalf of, that person.*

An authorised enforcement officer can serve an abatement notice under the RMA on any person for a similar range of circumstances as outlined above. An abatement notice is a warning to the recipient that (s)he is contravening the provisions of the RMA.

Penalties for offences vary depending on their nature. They extend to imprisonment for up to two years or a fine not exceeding $200 000; where the offence is a continuing one, a fine not exceeding $10 000 for every day that the offence continues.

SOURCES OF INFORMATION

Biosecurity Act (1993) published under the authority of the New Zealand Government, Wellington.

Department of Conservation. http://www.doc.govt.nz

Forests Act (1949) published under the authority of the New Zealand Government, Wellington.

MAF Biosecurity New Zealand. http://www.biosecurity.govt.nz

Ministry of Agriculture and Forestry. http://www.maf.govt.nz

Ministry for the Environment. http://www.mfe.govt.nz

Resource Management Act (1991) published under the authority of the New Zealand Government, Wellington.

FURTHER READING

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Ministry for the Environment (undated). *Quality planning: the RMA planning resource.* http://www.qualityplanning.org.nz/

INDICATORS 7.3 ECONOMIC FRAMEWORK

Extent to which the economic framework (economic policies and measures) supports the conservation and sustainable management of forests.

Indicator 7.3.a Investment and taxation

The investment and taxation regimes that apply to forestry have generally been stable since the early 1990s. Annual investment in new forest planting has decreased for the last 14 years, while announced investment in wood processing fluctuates from year to year. The income tax rate for businesses decreased from 33 to 30 percent in 2008.

Quality of information: M **Progress against indicator:** ▶

DESCRIPTION

INDICATOR 7.3.a: Investment and taxation policies and a regulatory environment which recognise the long-term nature of investments and permit the flow of capital in and out of the forest sector in response to market signals, non-market economic valuations, and public policy decisions in order to meet long-term demands for forest products and services.

RATIONALE

Forests are the source of a range of products that are traded in the marketplace. These products thus have an economic value. Documenting and monitoring the economic frameworks, which will vary in their details among countries, will provide opportunities to demonstrate whether the economic products are being sustained, over-exploited or under-utilised. The linkages between market sustainability and ecological sustainability are not well understood; nor is there sufficient knowledge to say whether economic factors are sensitive enough to identify the need for changes in forest management before there is impact on forest ecosystems. Indicators in the subsections of Criterion 7 may allow sufficient tracking of the economic framework, to permit a strengthening of the linkages between the market and management of forests.

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INVESTMENT

Investment in New Zealand's commercial forest industries can be split into the investment needed to maintain and/or expand the existing level of resource, and the capital necessary to process that resource. The New Zealand government is supportive of foreign investment. Historically secure property rights; an independent, transparent and efficient legal system; and lack of corruption, all favour long-term investment in the New Zealand forest industries.

General factors that influence investment decisions in forest growing and wood processing include:

- operating costs, capital costs, size of margins and the return on capital;
- availability of labour with required skills;
- taxation regimes;
- environmental performance requirements and legislation;
- infrastructure;
- availability of government and sector support.

INVESTMENT MECHANISMS

Investment in the forest-growing and wood processing industries can be made in a number of ways, giving flexibility for investors. Mechanisms include:

TABLE 7.6: NEW PLANTING AND REPLANTING OF PLANTATION FORESTS (HECTARES)

YEAR (ENDED MARCH)	NEW PLANTING	REPLANTING
2000	40 000	29 000
2001	34 000	36 000
2002	30 000	35 000
2003	22 000	40 000
2004	20 000	38 000
2005	11 000	43 000
2006	6 000	32 000
2007	3 000	36 000
2008	2 000	36 000
2009[P]	1 000	37 000

Note
P = provisional.

Source
Ministry of Agriculture and Forestry (1999–2008).

TABLE 7.7: WOOD PROCESSING INVESTMENT (PUBLICLY ANNOUNCED, AS AT JANUARY 2006, $ MILLION)[1]

YEAR	NEW PLANT	PLANT UPGRADES	TOTAL
2000	4.0	59.0	63.0
2001	2.0	18.4	20.4
2002	236.5	91.2	327.7
2003	12.0	23.5	35.5
2004	30.0	64.5	94.5
2005	0.0	67.0	67.0
2006–09	380.0	233.0	613.0

Note
1 This is not a comprehensive summary, but covers publicly announced, one-off investment intentions greater than NZ$1 million. Actual investment will depend on various factors.

Source
New Zealand Forest Owners' Association et al (2008).

- direct investment, such as through the purchase of land, forestry cutting rights or processing facilities;
- joint ventures facilitated through the Forestry Rights Registration Act 1983;
- shares in forestry companies;
- investment companies;
- partnerships.

INVESTMENT IN PLANTATION FORESTS

Investment in new plantation forests has gradually decreased since reaching a peak in 1994, when 98 000 hectares were planted. Little new planting has occurred in the last few years (see Table 7.6) as a result of decreasing real log prices, increasing land values, dramatic increases in shipping costs (particularly for logs), and a generally high exchange rate (NZD/USD). These factors have made the economics of plantation forestry investment less attractive. In 2009, shipping costs and the exchanged rate have dropped considerably, but the global financial crisis depresses demand and investment.

While the majority of the plantation forest harvested each year is replanted, significant deforestation (disinvestment) has occurred since 2005, with an estimated 13 600 hectares deforested in 2007 and 15 600 hectares in 2008 (years ended March). Coupled with the low levels of new planting, this has resulted in small net decreases in the plantation forest estate for the years between 2005 and 2008.

Deforestation has been driven by the factors influencing new planting, plus competition for land from a buoyant dairy industry (up to late 2008). Forest land owners have sought to change land use before incurring potential deforestation liabilities during the first Commitment Period (from 2008) under the Kyoto Protocol.

Since 2003 there have been significant changes in plantation forest ownership in New Zealand. United States-based Timber Investment Management

Organisations (TIMOs) have made large investments in plantation forests as publicly listed forest companies have divested their forest assets.

INVESTMENT IN WOOD PROCESSING

A key challenge for the forest industries is to create value through profitable wood processing, rather than depending on commodity log exports. While exported volumes of processed wood products are increasing, about 30 percent of the volume harvested in the year ended March 2008 was exported as logs. Several significant wood processing proposals over the last five years have failed to gain the necessary resource consents under the Resource Management Act 1991.

Much of the investment to process the forecast increase in available wood from the plantation forest estate may have to be financed from offshore sources. This is because of the magnitude of investment required, although the recent advent of new government retirement schemes may provide a medium to long-term source of domestic-based investment funds.

FOREIGN DIRECT INVESTMENT

The Overseas Investment Office administers the New Zealand government's foreign investment policies, the Overseas Investment Act 2005, and the Overseas Investment Regulations 2005. The Act requires consents for overseas investments in sensitive New Zealand land and significant business assets. Sensitive New Zealand land includes:

- non-urban land greater than 5 hectares;
- land on identified offshore islands greater than 0.4 of a hectare;
- land greater than 0.4 of a hectare that is held for conservation purposes under the Conservation Act 1987;
- land greater than 0.4 of a hectare subject to a heritage order;
- land greater than 0.4 of a hectare that is registered (or there is an application to register) as a historic place, historic area, wāhi tapu, or wāhi tapu area.

Significant business assets arise where the overseas investor would acquire a 25 percent or more ownership or controlling interest, and the value of the assets or

TABLE 7.8: OVERSEAS INVESTMENT IN NEW ZEALAND AND IN NEW ZEALAND FORESTRY[1] ($ MILLION)

YEAR (ENDED DECEMBER)	NEW ZEALAND NET INVESTMENT	FORESTRY NET INVESTMENT	FORESTRY AS % OF TOTAL INVESTMENT
2000	5 514.2	1 159.1	21
2001	741.5	29.9	4
2002	372.5	[2] –411.9	–
2003	1 642.9	384.2	23
2004	2 842.7	351.3	12
2005	2 962.2	113.3	4
2006	3 263.1	741.4	23
2007	4 725.4	12.3	< 1

Notes
1 Data are for land and non-land consents.
2 The negative figure represents net divestment of forest assets by overseas owners to New Zealand owners.

Sources
Overseas Investment Commission (2000–2004).
Overseas Investment Office (2008).

consideration exceeds $100 million.

The Act identifies criteria for consents for overseas investments in land and in significant business assets.

TAXATION

The main forms of taxation that affect forestry are income tax, and goods and services tax (GST).

The current taxation regime for forestry has applied since 1991. For taxation purposes, expenditure by a forestry business falls within three categories:

- costs of a capital nature where the value added is reflected in the asset, for example land purchase; these costs are neither deductible nor depreciable;
- costs of a capital nature expended on an asset with a limited life, for example construction of fences, roads and firebreaks; these can be depreciated against income from any source;
- costs directly related to the tree crop or incurred in the maintenance of the forestry business, for example for planting, tending, pest control and overheads; these are deductible in the year incurred from income from any source.

Young kauri plantation, Holt Forest, Hawkes Bay. Photo: Alan Reid.

The income tax rate for all companies and other businesses in New Zealand was reduced from 33 percent to 30 percent from 1 April 2008, and applies to net income after allowable deductions.

GST is a value added tax of 12.5 percent that applies to goods and services supplied by GST-registered persons.

THE CONSERVATION ESTATE

Expenditure by the Department of Conservation has increased from $257.3 million in 2002/03 to $291 million in 2007/08. This is for all output classes and across the conservation estate, that is, not just operational and forest-related expenditure (which is difficult to assess). Expenditure by selected key output classes is identified in Table 7.9.

Forest-related operational expenditure has been estimated to have increased from $75.9 million in 2000 to $120.7 million in 2005.

TABLE 7.9: DEPARTMENTAL EXPENDITURE BY KEY OUTPUT CLASSES FOR 2002/03 AND 2007/08

OUTPUT CLASS	2002/03 ($000)	2007/08 ($000)
Management of natural heritage	110 215	143 695
Management of historic heritage	4 858	6 005
Management of recreational opportunities	104 673	119 200
Conservation with the community	28 082	13 748

Sources
Department of Conservation (2003, 2008).

SOURCES OF INFORMATION

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Income Tax Act (2007) published under the authority of the New Zealand Government, Wellington.

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Simpson Grierson (2006) *Doing business in New Zealand: 5 taxation.* http://www.simpsongrierson.com/pdf_display.cfm?pathto=/assets/doing_business/Taxation.pdf

Indicator 7.3.b Trade policies

New Zealand operates a relatively open trade policy and actively engages in trade liberalisation forums. Over recent years it has become a party to a number of regional bilateral and plurilateral agreements, and signed a free trade agreement with China in 2008.

Quality of information: H **Progress against indicator:** ▲

DESCRIPTION
INDICATOR 7.3.b: Non-discriminatory trade policies for forest products.

RATIONALE
See Criterion 7 and Indicator 7.3.a.

2008 COUNTRY REPORT

Trade liberalisation is consistent with, and a necessary complement to, New Zealand's market-led domestic economic reforms that were initiated in the mid-1980s. The free-market philosophy is based around the following concept: when firms and people are completely free to buy and sell goods and services, those goods and services will, all other things being equal, be allocated to those who value them most highly. Similarly, a non-discriminatory trade policy will assist achievement of sustainable forest management by helping to ensure forest resources are appropriately valued. New Zealand operates a relatively open trade policy.

During the Uruguay Round of the General Agreement on Tariffs and Trade (GATT), New Zealand supported a zero-for-zero sectoral initiative that advocated across-the-board elimination of tariffs on wood and paper products. As the wood products initiative failed, New Zealand retained some relatively low tariffs (maximum 5 percent) on solid wood and some panel products. For pulp and paper items, however, New Zealand signed a zero-for-zero undertaking; for pulp this has already been achieved.

New Zealand is party to a number of regional bilateral and plurilateral agreements. In general, these promote trade liberalisation and economic development, and provide for free trade in forest products. These agreements include the following:

- The Asia Pacific Economic Cooperation (APEC), of which New Zealand is a foundation member, is a cooperative which promotes trade liberalisation, facilitation and economic development. New Zealand subscribes to APEC's Declaration of Resolve agreed in Bogor in 1994 that proposes a timetable liberalisation throughout the region. According to the Bogor timetable, free and open trade and investment will be achieved by the developed economies by 2010 and the developing economies by 2020.
- The Australia–New Zealand Closer Economic Relations Trade Agreement (ANZCERTA). Under this agreement, all forestry trade between the two countries is free of tariffs.
- Closer Economic Partnership Agreement with Singapore from 1 January 2001, which similarly ensures that all forest products-related trade between the two countries is tariff-free.
- Subsequent to the Singapore Agreement, the Trans-Pacific Strategic Economic Partnership Agreement (the Trans-Pacific Agreement, formerly known as P4 or TPA) was signed by New Zealand, Chile and Singapore on 18 July 2005 and by Brunei on 2 August 2005. A binding Environment Cooperation Agreement and a binding Labour Cooperation Memorandum of Understanding, which had been negotiated as part of

the Trans-Pacific package, were signed concurrently. All forest products-related trade under the TPA is tariff-free.

› The *Free Trade Agreement between New Zealand and China* (NZ-China FTA), signed on the 7 April 2008 in Beijing, includes some remaining low tariffs (maximum 5 percent) on certain forest products which will reduce to zero by 2012.

New Zealand has also ratified the *Pacific Agreement on Closer Economic Relations* (PACER), which entered into force in 2002. PACER sets out principles and objectives to guide future trade relations in the Pacific region, and provides for the free trade agreement in goods among Pacific Island countries (PICTA – the *Pacific Island Countries Trade Agreement*), now being implemented and later likely to be extended to services. PACER also provides for the development of a free trade agreement among the *Forum Island Countries*[1] (FIC) and Australia and New Zealand, commonly referred to as PACER Plus. PACER Plus will supersede the *South Pacific Regional Trade and Economic Co-operation Agreement* (SPARTECA), under which Australia and New Zealand currently provide non-reciprocal duty-free access for FICs to their markets. For most products, including all forest products, SPARTECA entails duty-free access. The access provided under SPARTECA will be carried over into the new PACER Plus agreement.

New Zealand is committed to the World Trade Organisation (WTO), by ensuring its border protection operations and technical standards and regulations are consistent with the *WTO Agreement on Sanitary and Phytosanitary Measures* and the *WTO Agreement on Technical Barriers to Trade.*

New Zealand does not restrict export of wood products (including logs) sourced from plantation forests. However, the principles of sustainable forest management apply under the Forests Act 1949 to remaining indigenous forests that are available for timber production: this means export prohibitions on logs and woodchips (and in the case of some species, sawn timber). Government can thus meet its goal of ensuring that the limited supply of slow-growing and valuable indigenous timber species is directed to high-value local finished products. There are no restrictions on the export of finished products manufactured from indigenous timbers.

SOURCES OF INFORMATION

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Ministry of Foreign Affairs and Trade. http://www.mfat.govt.nz

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New Zealand – China Free Trade Agreement. http://www.chinafta.govt.nz/

1 Pacific Forum Island Countries are: Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Republic of the Marshall Islands, Nauru, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

INDICATORS 7.4 MEASURING AND MONITORING

Capacity to measure and monitor changes in the conservation and sustainable management of forests.

Indicator 7.4.a Availability of data

Comprehensive statistical databases and wood availability forecasts continue to be a feature of commercial (plantation) forestry in New Zealand. Information on the physical attributes and extent of indigenous forests is being strengthened as a result of requirements for international climate change reporting, and by the use of satellite imagery.

Quality of information: M/H **Progress against indicator: ▲**

DESCRIPTION

INDICATOR 7.4.a: Availability and extent of up-to-date data, statistics and other information important to measuring/describing indicators associated with Criteria 1–7.

RATIONALE

The ongoing evaluation of sustainability of forests depends on the ability to measure biological, social and economic parameters in a continuous, reliable and agreed fashion. The structures may be part of duly constituted governments and/or other organisations and/or individuals with interests in forests. An agreed-upon understanding of sustainability will be based on measures that are clearly understood and accepted by societies. An open and transparent measurement system will enable support to be generated for policies promoting sustainability. The degree to which sustainability is being achieved will then be enhanced by the ability of countries to develop methods of assessment and common reporting. The acceptability of the use of indicators is strengthened if the system in place to monitor and measure is itself demonstrated to be sufficient to the task.

2008 COUNTRY REPORT

Historically, New Zealand's national forestry statistics, monitoring and inventory systems have focused on the economic production aspects of forestry. Since the late 1960s, dependence on timber production from indigenous forests has greatly reduced; now almost all of New Zealand's timber production comes from plantation forests.

During the major government sector restructuring that occurred in New Zealand in the 1980s and early 1990s, many monitoring systems were downsized and some ceased altogether. However, since the United Nations Conference on Environment and Development in 1992, there has been increasing awareness of environmental issues. This has been enhanced by a range of international environmental agreements and their requirements for monitoring and reporting.

INDIGENOUS FORESTS

Three national-scale forest inventories have been undertaken in New Zealand, the most recent being through the Land Use and Carbon Analysis System (LUCAS) between 2001 and 2007 (see below). The original national forest inventory was undertaken between 1921 and 1923, and another major national forest survey was conducted between 1946 and 1955.

NATIONAL VEGETATION SURVEY

Ecologically based vegetation monitoring has been undertaken over the last 50 years or so. The resulting information has been brought together in the National

Vegetation Survey (NVS) database, the largest vegetation database in New Zealand. It is funded in part by the Foundation for Research, Science and Technology, and managed by Landcare Research.

The NVS database is a physical archive and computer databank containing records from about 77 000 vegetation survey plots – including data from over 19 000 permanent plots. NVS provides a unique record, spanning more than 50 years, of indigenous and exotic plants in New Zealand's terrestrial ecosystems. Broad ranges of habitats are covered, with emphasis on indigenous forests and grasslands.

The physical archive includes plot sheets, maps and photographs from many years of vegetation surveys. Software that was specifically prepared for summarising data and statistical analysis is available.

The New Zealand Forest Service, the Department of Lands and Survey and the Botany Division of the Department of Scientific and Industrial Research (DSIR) conducted the original surveys. These government departments no longer exist, but ongoing surveys and research by the Department of Conservation, regional councils, universities and Landcare Research are constantly providing new data to NVS.

Most of the data are available electronically; they can be provided under license agreements and on a single-use basis, unless otherwise negotiated. Costs of data handling must be met by the user.

Data within NVS can support international reporting requirements for the Convention on Biological Diversity, the Framework Convention on Climate Change, and the Montreal Process. Nationally, they support the Resource Management Act, state of environment reporting, and also assist resource management and ecological restoration. Historical information in NVS has significance in enabling New Zealand to address issues of current concern, that were unforeseen at the time of data collection. Examples are: assessing the impacts of climate change on indigenous ecosystems, the storage of carbon in indigenous ecosystems, and setting restoration goals in areas since degraded.

NATURAL HERITAGE MANAGEMENT SYSTEMS (NHMS)

The Department of Conservation is a significant contributor to biodiversity monitoring. DOC uses standard measurement techniques to provide information on changes in stand structure and vegetation composition in the presence of herbivorous pests. Data from these programmes are curated in the NVS database. To date, information from monitoring programmes has not been systematically collected and provided at a national level.

The Department of Conservation is transforming approaches to its measurement and reporting systems. The national monitoring framework and managed place monitoring standards are being developed as part of the Natural Heritage Management Systems (NHMS) programme. The framework (see Lee et al, 2005) and standards are intended to provide a common platform for assessing status and trends in the health and functioning (ecological integrity) of ecosystems; they will also assist in monitoring the effectiveness of DOC's management. Indicators are used to show progress towards intermediate outcomes, to provide a verifiable broad-based picture of ecological integrity on conservation lands, and also to meet multi-level needs of international and national reporting. Although these indicators can be applied at many spatial scales, the design currently being piloted has a national focus.

LAND USE AND CARBON ANALYSIS SYSTEM (LUCAS)

The Ministry for the Environment is developing the Land Use and Carbon Analysis System to meet New Zealand's reporting requirements under the Kyoto Protocol and the United Nations Framework Convention on Climate Change.

The LUCAS programme uses satellite imagery and aerial photography to map changes in land use since 1990. The carbon inventory of plantation forests is being assessed by airborne scanning light detection and ranging (LiDAR) and field plot measurements of about 700 plots from a 4 x 4-kilometres grid overlaid on all forests in New Zealand planted after 1989. About 1400 permanent plots have been identified and 1255 established on an 8 x 8-kilometre grid to measure indigenous forest carbon (these will also provide information on biodiversity). The indigenous forest plot design is essentially the same as the standard NVS permanent plot, and the LUCAS programme uses existing NVS plots wherever they are available

The establishment of plots and initial collection of data were undertaken between 2001 and 2007. The intention is to re-measure the plots to record carbon change and as part of a data quality assurance programme. Plantation forests will be re-measured every 5 years and indigenous forests every 5–10 years from 2009.

COMMERCIAL FORESTRY

New Zealand has a rich set of production forestry statistics, some dating back to the 1920s. These statistics cover forest planting, harvesting, processing and trade in forestry products.

NATIONAL EXOTIC FOREST DESCRIPTION

The *National Exotic Forest Description* is New Zealand's commercial plantation forest resource description. It is prepared by the Ministry of Agriculture and Forestry and the New Zealand Forest Owners' Association, to assist with resource and policy planning.

The NEFD comprises two data sets. The first is an area-age class data set with net stocked forest area by district/city council administrative area, year of planting, species and management regime. The second is a yield table data set with stem volume broken down into pruned, sawn and pulp logs by location, age, species and management regime.

In addition to the area-age class and yield information, data on planting, harvesting and some ancillary forest resource data are collected. NEFD forest area reports are published each year; yield tables are published from time to time. At about five-year intervals, national and regional wood availability forecasts are prepared from the NEFD data sets.

The 24th edition of the annual *NEFD report* describes the plantation forest resource as at April 2007 (http://www.maf.govt.nz/mafnet/publications/nefd/).

The report provides:

- an overview of New Zealand's plantation forests;
- a description of survey methods, sources of information and details on the reliability of data;
- statistical tables that describe New Zealand's plantation forests in detail.

FORESTRY STATISTICAL RELEASES

The Ministry of Agriculture and Forestry produces eight detailed forestry statistical releases each year. These cover the production of forestry products, forestry trade, employment, and roundwood removals. Some of these statistics have been collected and published from as far back as the 1920s. The releases include the following statistical information:

ANNUAL PRODUCTION SURVEYS

National postal surveys (year ended March) of sawmilling, pulp and paper production and panel products are undertaken by MAF annually. The surveys cover the production of the main forestry products, mill capacities, fibre supplies and known mill expansion plans. Results are made available through *Statistical Releases* issued by September each year.

QUARTERLY PRODUCTION AND STOCK LEVEL SURVEYS

National postal surveys for the quarters ended March, June, September and December of sawmilling, pulp and paper production, and panel products are also conducted

by MAF. The surveys are designed to estimate quarterly production of outputs and stock levels at the end of each quarter. Results are made available through *Statistical Releases,* issued six to eight weeks after the end of each quarter.

ROUNDWOOD REMOVALS

The results from the annual and quarterly surveys of production described above are combined with log export volumes from Statistics New Zealand. Using roundwood conversion factors, MAF compiles roundwood removals for the quarters ended March, June, September and December. A reconciliation of wood flows is undertaken for the March year. The quarterly results are made available through *Statistical Releases,* issued six to eight weeks after the end of each quarter. The March year reconciliation is generally released by October of the same year.

EMPLOYMENT IN FORESTRY AND WOOD PROCESSING ACTIVITIES

Total New Zealand employment in forestry and wood processing activities are compiled by MAF from information supplied by Statistics New Zealand. The reference date is mid February; the *Statistical Release* is normally available in the March of the following year.

EXPORTS AND IMPORTS OF FORESTRY PRODUCTS

A series of compilations on forestry exports and imports are also prepared by MAF, using detailed trade data supplied by Statistics New Zealand. This work is included in the quarterly *Statistical Releases,* available six to eight weeks after the end of each quarter.

STATISTICS NEW ZEALAND

Statistics New Zealand is central government's statistics agency. It publishes a number of forestry-related statistics in addition to those published by MAF. A core focus of Statistics New Zealand is the production of key economic and population statistics.

NEW ZEALAND LAND COVER DATABASE

The New Zealand land cover database (LCDB) is a Crown-owned, digital thematic database of land cover designed for use in geographic information systems or as printed maps. The LCDB programme is administered by the Ministry for the Environment.

The current version 2 (LCDB2) uses Enhanced Thematic Mapper Plus (ETM+) imagery acquired by Landsat 7. Images from the summer of 2001/02 are the primary data source for thematic land cover classification. Planning has begun for the development of LCDB version 3.

The LCDB2 land cover classes are hierarchical, with eight top-level classes based on the physical characteristics of the land cover; more detailed second-level classes are based on characteristics such as phenology and floristic composition. In total there are 43 second-level classes of land cover, including eight classes of exotic and indigenous shrublands, one indigenous forest class, six plantation forest classes, and two classes of shelterbelts.

LCDB information is available at the cost of dissemination only.

ENVIRONMENTAL REPORTING

Environmental management is a shared responsibility in New Zealand. Many agencies are involved in developing environmental indicators, and collecting and reporting data against indicators.

NATIONAL ENVIRONMENTAL REPORTING

The Ministry for the Environment formally resumed responsibility for national-scale environment reporting in 2006. MfE works with other government departments, local government, Crown research institutes, and reporting partners to collate national environmental monitoring data for its environmental reporting.

The national environmental reporting programme primarily focuses on reporting a core set of 22 national environmental indicators. Additional national-scale information is reported on as needed, to supplement

indicator-based information. The indicators that relate to forests are:

- emissions and removals of greenhouse gases;
- land cover;
- land use;
- soil health;
- erosion risk;
- river water quality;
- lake water quality;
- groundwater quality;
- indigenous land cover;
- indicator species.

Environment New Zealand 2007 used the core indicator set to provide a quantitative picture of key aspects of New Zealand's environment. It produced a snapshot against which future reporting can assess changes over time.

OTHER ENVIRONMENTAL REPORTING

Local government must monitor the state of the environment for their region or district under the Resource Management Act 1991. Although reporting the results of this monitoring is not a legislative requirement, councils must make a *review* of the results of their monitoring available to the public at least every five years.

Universities, researchers elsewhere, businesses, and iwi also collect data and information to assist environmental decision-making.

SOURCES OF INFORMATION

Landcare Research. http://www.landcareresearch.co.nz

Landcare Research (undated) *What is the NVS databank?* http://nvs.landcareresearch.co.nz/html/NVSdatabank.aspx

Lee, W; McGlone, M; Wright, E (2005) *Biodiversity inventory and monitoring: a review of national and international systems and a proposed framework for future biodiversity monitoring by the Department of Conservation*. Landcare Research Contract Report: LC0405/122.

Ministry for the Environment (2007) *Environment New Zealand 2007*. Ministry for the Environment; Wellington; 456 p. http://www.mfe.govt.nz/publications/ser/enz07-dec07/index.html

Ministry for the Environment (2009) *Reporting on New Zealand's Environment.* Ministry for the Environment; Wellington. http://www.mfe.govt.nz/publications/ser/reporting-nz-environment/reporting-nz-environment.pdf

Ministry for the Environment, Land Use and Carbon Analysis System (LUCAS). http://www.mfe.govt.nz/issues/climate/lucas/index.html

Ministry for the Environment, The New Zealand Land Cover Database http://www.mfe.govt.nz/issues/land/land-cover-dbase/

Ministry of Agriculture and Forestry. http://www.maf.govt.nz

Ministry of Agriculture and Forestry (2008) *A National Exotic Forest Description as at 1 April 2007*. Ministry of Agriculture and Forestry; Wellington. http://www.maf.govt.nz/mafnet/publications/nefd/

Ministry of Agriculture and Forestry. *Forestry Production & Trade Statistics*. http://www.maf.govt.nz/statistics/forestry/

Statistics New Zealand. http://www.stats.govt.nz

FURTHER READING

Landcare Research (undated) *Designing monitoring systems for forests*. http://www.landcareresearch.co.nz/research/research_details.asp?Research_Content_ID=60

Indicator 7.4.b Statistical reliability

International reporting requirements and the application of revised survey methods manuals and field protocols are assisting to raise the reliability of indigenous forest data. The reliability of plantation forest data continues to be supported by the commitment of forest owners to provide detailed resource descriptions. The development and use of satellite imagery continues to raise the reliability of land cover area data.

Quality of information: M/H **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.4.b: Scope, frequency and statistical reliability of forest inventories, assessments, monitoring and other relevant information.

RATIONALE

See Criterion 7 and Indicator 7.4.a.

2008 COUNTRY REPORT

INDIGENOUS FORESTS

NATIONAL VEGETATION SURVEY

The NVS database is a physical archive and computer databank of records from the assessments of indigenous vegetation plots (see Indicator 7.4.a). The quality of data was evaluated by Wiser et al (1999), who noted confidence in the accuracy of data from the permanent plots, especially with respect to taxonomy of trees, tree growth rates, and location data. Scope for improvement in recording of site data for plots, and in taxonomic accuracy for non-woody species was reported.

Manuals for revised survey methods, and field protocols were published in 2007. Along with reports on sources of error and improving quality, these are available at http://nvs.landcareresearch.co.nz/html/NVSmanual.aspx

Two broad types of NVS data are collected. These are:

› 1. general survey data, from plots that are usually not permanently marked. This data includes reconnaissance descriptions ("Recces") and Protected Natural Areas data. It is suitable for vegetation description, studies of species distributions, and studies needing only coarse measurement of changes in vegetation. More than 58 000 survey plots in NVS comprise:

- point-based compositional (and usually) structural description of vegetation;
- relative abundance in fixed structural tiers (usually included);
- location information (80 percent have New Zealand Mapping Series grid references).

Examples of uses include:

- vegetation description;
- detecting biodiversity trends;
- studying weed invasions;
- relating species distribution to environment.

› 2. permanent plot data, where fixed area plots or transects have been established, and the vegetation has been measured precisely (for example tagged trees, sapling and seedling counts, species lists). Assessments of about 19 000 permanent plots in NVS are ideal for monitoring vegetation changes and the effects of management. Nearly all permanent plots are established and assessed following standard methods involving:

- permanently tagging all trees within a fixed area of a forest plot (usually 400 square metres) to allow

repeat measurements;
- permanently marking seedling subplots in most forest plots, to determine changes in seedling and herbaceous composition with time;
- objectively locating most plots along transects;
- recording New Zealand Mapping Series grid references (on more than 80 percent of all plots and more than 95 percent of forest plots).

Examples of potential uses are:
- forest plots: growth, mortality, and recruitment of tree species, changes in structure and composition;
- shrubland and grassland plots: change in structure and composition.

Further details are available at http://nvs.landcareresearch.co.nz/html/NVSdatabank.aspx

Podocarp/hardwood-forested stream catchment, Turere Stream, Wellington. Photo: Alan Reid.

LAND USE AND CARBON ANALYSIS SYSTEM

The LUCAS programme involves the systematic monitoring of carbon stocks, in indigenous forests as well as plantation forests, shrublands and soils (see Indicator 7.4.a). Biodiversity data are also collected. For indigenous forests, the plot design is essentially the same as the standard permanent NVS forest plot. A data collection manual for indigenous forest and shrublands has been published (Payton et al 2004).

As LUCAS contributes to New Zealand's reporting requirements for the Kyoto Protocol and the United Nations Framework Convention on Climate Change, it is subject to international expert review. This has driven the LUCAS programme to implement rigorous quality control/quality assurance strategies, and to submit information and research undertaken for publication in peer-reviewed literature.

COMMERCIAL FORESTRY

NATIONAL EXOTIC FOREST DESCRIPTION

The NEFD is a quantitative database of New Zealand's plantation forests, and is New Zealand's official source of statistics on plantation forests (see Indicator 7.4.a).

From its inception in 1983, the NEFD has operated as a partnership between the government (through its forestry department) and the private forest industry. The work is overseen by a government/industry steering committee. The NEFD partnership model has proved to be highly effective in providing stability for the programme over a period of unprecedented change in government agencies and the forest industry. It has ensured the willing participation of forest owners, in providing quite detailed information on their forest resources for the collective benefit of the forest industry and the government.

The New Zealand net stocked forest area is thought to be accurate to about plus or minus 5 percent. This estimate of accuracy is based on expert judgment and has not

been determined statistically.

The majority of the data captured in the NEFD survey is through a census of forest owners. Every year all owners with 1000 hectares of forest or more are asked to provide updated forest description data. These owners made up 69 percent of the total forest area in 2007, and the data they provide are considered the most reliable segment within the NEFD area database. The quality of data provided by owners with less than 1000 hectares is likely to be more variable, with some possibly reporting gross forest area rather than net stocked area. The difference is generally of the order of 10 to 20 percent.

Yield table information is provided periodically by the large-scale forest owners.

STATISTICAL RELEASES

Statistical releases (see Indicator 7.4.a) are mostly prepared from data received directly from processors of wood products, forestry employers and the port companies that export wood products. The Ministry of Agriculture and Forestry (unpublished) surveyed users of this information in 2004. The results indicated that the data were considered to be of high quality, and the level of detail sufficient for 77 percent of the users.

Roundwood removals are derived from production and export data, and not directly assessed. They are regarded as good estimates.

LAND COVER DATABASE

The LCDB is a digital thematic map of New Zealand's land cover (see Indicator 7.4.a). Imagery for LCDB2 was acquired over the 2001/02 summer period using Landsat 7 ETM+, and pan-sharpened to 15-metre spatial resolution. The minimum mapping unit is one hectare.

The accuracy of the mapped land cover classes has been supported by an intensive field programme that gathered data used to inform the classification, as well as ground-truthing draft maps. Ancillary data from vegetation surveys and aerial photography have also been used to support the mapping process.

The overall accuracy of the first LCDB was assessed by Forest Research at 93.9 percent, meaning a 93.9 percent probability that the class represented on the map is indeed that on the ground. It has been assumed that the accuracy of LCDB2 is at least of that magnitude.

SOURCES OF INFORMATION

As for indicator 7.4.a.

Payton, I J; Newell, C L; Beets, PN (2004) *New Zealand carbon monitoring system: indigenous forest and shrubland data collection manual*. Landcare Research, Lincoln; and Forest Research, Rotorua.

FURTHER READING

As for indicator 7.4.a.

Erosion control poplar and willow plantings, East Coast of the North Island. Photo: Alan Reid.

Indicator 7.4.c Compatibility with other countries

New Zealand has supported initiatives to work towards common international frameworks for the reporting of sustainable forest management and the preparation of associated technical guidelines. This will raise inter-country compatibility, and the integrity of information will reflect the relative importance of indicators to individual countries.

Quality of information: M **Progress against indicator:** ▲

DESCRIPTION
INDICATOR 7.4.c: Compatibility with other countries in measuring, monitoring and reporting on indicators.

RATIONALE
See Criterion 7 and Indicator 7.4.a.

2008 COUNTRY REPORT

New Zealand reports to a number of international forestry and forestry-related processes, notably the Global Forest Resource Assessment of the Food and Agriculture Organization, the Montreal Process, and the Convention on Biological Diversity.

Compatibility of information reported by countries on the components of sustainable forest management depends on an agreed understanding of those components; but it also depends on the integrity of the information collected.

Internationally there is widespread agreement on seven thematic elements (or criteria) to provide a reporting framework on sustainable forest management. However, the relative importance of the biological, social and economic parameters (indicators) that are associated with each thematic element will vary – depending on the values placed by society in each country on the uses of forest and forest land. In addition, societies' values will change over time, influenced by national and personal economic well-being, levels of education and knowledge, and ethics. This dynamic environment may need to be reflected in the refinement of parameters over time.

The integrity of data and other information on individual parameters of sustainable forest management will reflect the relative importance of the parameters to a particular country. The levels of importance will influence the level of expertise, the resources and methods available to gather and assess data and information. High-quality data and other information from one country may not be directly compatible with data and information of lesser quality from another country.

The *Technical Notes on Implementation of the Montreal Process Criteria and Indicators* specify *what*, and *why*, information is to be collected. *How* the information is collected is described rather than prescribed, and different methods adopted by countries may impact on compatibility.

Ultimately, C&I-based processes are focused on providing frameworks for individual countries to monitor, assess and report on trends in forest conditions, and thus progress towards sustainable forest management. Compatibility across countries is important in terms of the framework, but not necessarily for the detail of the information generated.

INDICATORS 7.5 RESEARCH AND DEVELOPMENT

Capacity to conduct and apply research and development aimed at improving forest management and delivery of forest goods and services.

RATIONALE

Forest policies in all countries rely upon a base of knowledge that functions within socio-economic and legal frameworks. An integration of this knowledge into the various frameworks is essential for reporting on and demonstrating sustainability. In order to do this, countries and societies must develop, maintain and enhance the intellectual capital and be willing to share and disseminate this knowledge openly and freely. New methods, approaches, concepts and techniques must be developed and integrated within the decision-making frameworks if full benefits from forests are to be realised. Countries and societies accept that many types and degrees of knowledge can be valuable in attaining sustainability. Efforts at attaining the goal of sustainability can be enhanced by the degree to which innovative techniques are developed and used to assess human activities and needs from the forest and their relationship to the ecology of forests.

Indicator 7.5.a Scientific understanding

New Zealand has a long history of high-quality forest science, especially in commercial plantation forests. Several research consortiums have been established to facilitate and oversee research programmes. These organisations link with industries, as well as prioritise the research programmes

Quality of information: H **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.5.a: Development of scientific understanding of forest ecosystem characteristics and functions.

RATIONALE

See Indicators 7.5.

2008 COUNTRY REPORT

New Zealand's experience of the scientific understanding of forest ecosystem characteristics and functions is drawn from expert reports and peer-reviewed scientific studies, published internationally and in New Zealand. These cover pure long-term research into ecosystem functions, in addition to applied topics such as monitoring the extent and condition of forest ecosystems.

New Zealand's Forest Research Institute Ltd is one of the oldest forest-based research organisations in the world. Founded in 1947, it was preceded by the Forest Experiment Station, established in 1920. It is now a Crown Research Institute which changed its trading name from Forest Research to Scion in 2005.

By building on this forestry expertise, Scion has extended its research programmes to include the development of new bio-based materials, energy systems, high-value products and environmentally friendly processes from renewable resources and waste streams.

Research in forestry is distributed across several CRIs, universities, consulting and research companies and

individuals (see Table 7.10A and 7.10B). Various research consortiums have been established to facilitate and oversee research programmes. These organisations link with industry, as well as prioritise the research programmes.

SOURCE OF INFORMATION

Ministry of Agriculture and Forestry (2009) *Forestry sector study.* Ministry of Agriculture and Forestry; Wellington.

TABLE 7.10A: NEW ZEALAND FORESTRY RESEARCH PROVIDERS

NAME	KEY ROLES	RELATIONSHIPS/PARTNERS
Scion	Crown research institute – dominant forestry research and development provider	Research collaboration with Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia
Other CRIs • Landcare Research • AgResearch • Industrial Research • NIWA	Research on forestry and forestry-related topics	Work often in partnership with other CRIs and universities
University of Canterbury	Dominant university research provider Professional forestry education	National Centre of Excellence in Wood Manufacturing
University of Auckland	Focus on wood processing, pulp and paper	National Centre of Excellence in Wood Manufacturing
National Centre of Excellence in Wood Manufacturing	Wood manufacturing	A partnership with Forest Industries Training and Education Council (forestry industry training organisation), Waiariki Institute of Technology and University of Auckland
Building Research Association of New Zealand (BRANZ)	Independent company: research, testing, consulting and information for the building industry	37% income from building research levy; administered by Building Research (see Table 7.10B)
Department of Conservation	Operational research on conservation management techniques and outcomes	In-house research capacity supplemented by contract research and partnerships with other research agencies

Source
Ministry of Agriculture and Forestry (2009).

TABLE 7.10B: NEW ZEALAND FORESTRY RESEARCH CONSORTIUMS

NAME	KEY ROLES	RELATIONSHIPS/PARTNERS
Wood Quality Initiative Ltd (WQI)	Wood quality improvements, including characterisation, appearance, performance, structural properties and stability	13 timber industry companies, CSIRO (Australia) and Canterprise
Structural Timber Innovation Company (STIC)	Development of engineered structural timber solutions for multi-storey and single-storey buildings	Timber manufacturers, industry associations, universities and an Australian research corporation
Radiata Pine Breeding Company	Tree improvement research to increase yields and reduce production costs through superior germplasm provision	16 New Zealand and Australian timber group interests and Scion
Forest Biosecurity Research Council (FBRC)	Oversee research to protect New Zealand's forests from biosecurity threats	An unincorporated joint venture, including representation from NZFOA, Biosecurity NZ and NZ Forest Health Collaborative
National Centre of Advanced Bio-Protection Technology	Provides some of the research for FBRC	Hosted by Lincoln University
Future Forest Research (FFR)	A trust company replacing industry-Scion research co-ops. Forest management research: species diversification; radiata management; harvesting; environmental and social	Key relationship with Scion; over 50 members from industry, local government, University of Canterbury and consultants
Building Research	Industry-good research and knowledge dissemination to building and construction industry	Owned and directed by building and construction industry
Solid Wood Initiative	Research into solid-wood technologies, processing systems and identification of market products and consumer needs	New Zealand and Australian processing companies and industry organisations

Source
Ministry of Agriculture and Forestry (2009).

Indicator 7.5.b Costs and benefits

The "non-market" benefits of forests in New Zealand are now being recognised as having monetary values, although methodologies and policies for determining those values need further analysis.

Quality of information: M **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.5.b: Development of methodologies to measure and integrate environmental and social costs and benefits into markets and public policies, and to reflect forest-related resource depletion or replenishment in national accounting systems.

RATIONALE

See Indicators 7.5.

2008 COUNTRY REPORT

The contributions that plantations and indigenous forests can make to soil stabilisation, catchment improvement and wildlife protection have been known for generations. Yet, only in recent decades have these services come to be seen as having a tangible financial value (NZFOA, 1995). These environmental gains were viewed as "public" or "free" goods. For example, property owners in flood-prone catchments have not recognised that upstream plantings add to the income of their properties (through reduced maintenance and improved pasture). This attitude is starting to change, as community and political leaders recognise the need to maximise these environmental benefits for society.

While forestry is generally viewed as having positive environmental benefits, there are situations where the establishment and harvesting of plantations raise some concerns. These concerns have focused around wilding tree spread at higher altitudes, reduced water flow in sensitive catchments, post-harvest sediment run-off, and the establishment of monocultures. Mitigation measures, such as excluding take-off zones from planting and using the latest management practices for harvesting, can minimise these potential impacts.

THE RANGE OF ENVIRONMENTAL GOODS AND SERVICES GENERATED BY FOREST ECOSYSTEMS

The principal benefits provided by indigenous and plantation forests can be grouped into six broad categories:

- hydrological services;
- soil erosion mitigation/protection of soil productivity;
- biodiversity/conservation services;
- land rehabilitation/absorption of pollutants;
- carbon sequestration and storage services;
- renewable/naturally occurring timber and non-timber products.

VALUING THE NON-MARKET BENEFITS AND COSTS OF FORESTS

Plantation forests in New Zealand are normally valued on the volume and grade of recoverable timber. While this provides an assessment of the standing crop, it fails to recognise the broader benefits of forestry, such as sustainable development, community development and environmental protection.

Assessing the full value of forests can be difficult, as many of the non-timber benefits and costs are not currently

traded. A trading system provides a mechanism for determining a market price for outputs; in the absence thereof, these outputs are likely to be viewed as having a negligible value, or will be seen as a public good.

A range of valuation methods are used internationally to estimate the benefits and costs of non-traded activities. One of the principal areas where these methods are used, is in valuing on- and off-site environmental effects. Four general valuation methods are recognised:

- cost-based methods (also known as market value approaches);
- revealed preference methods (also known as surrogate market approaches);
- stated preference methods (also known as simulated market approaches);
- benefit transfer techniques.

The decision as to which valuation method should be used in a particular situation depends on the environmental attributes to be assessed. For example, different methods would be used to examine direct values such as stock protection, as opposed to indirect values (water quality enhancement), future values (flood mitigation) or non-use values (habitat protection). The practicality of any method depends on how well the relationship between the forest resource and the particular effect is known, and on the availability of associated economic or survey data.

These valuation methods are being used increasingly to identify the public demand for various attributes (and the need for government intervention). From a policy perspective, it is important to assess whether the costs of intervention (to correct a market failure) will induce sufficient change in behaviour to outweigh the marginal costs associated with the policy.

A point worth making is that, if forest owners are compensated for non-market benefits (also known as externalities), then those paying the compensation will probably want a say in the way the forests are managed. This may have implications for forest managers.

Erosion control radiata pine plantation, Waipaoa River, East Coast of the North Island. Photo: Alan Reid.

FORESTRY ACCOUNTS

The decision to produce national environmental accounts was announced in 2000. The production of these accounts has, and will continue to, help New Zealand meet its commitments under various ratified international conventions.

The environmental accounts are compiled using an internationally led framework, the United Nations Integrated System of Environmental and Economic Accounting (SEEA). This is a satellite system to the *System of National Accounts* and measures the value and volume of many of New Zealand's natural resources. The system identifies the industries that are using natural resources; it also provides environmental information that complements traditional measures of economic activity, such as Gross Domestic Product. Producing environmental information on an accounting framework allows direct comparisons between environmental and economic information. For example, measures of energy efficiency can be made, or comparisons between natural and man-made capital. In 2002, Statistics New Zealand produced the *Natural Resource Accounts for New Zealand – Overview Document.*

The forestry accounts aid the sustainable management of this resource by showing the composition of forests, changes over time, harvesting rates, consumption by industry, and other values that inform decision-making. The forestry accounts include physical stock accounts, monetary stock accounts, and five physical and monetary flow accounts. Links to all Statistics New Zealand's forestry account publications are listed in the Sources section below.

STOCK ACCOUNTS

The forestry stock account shows the composition of New Zealand's forest resource, how the resource changes annually, and the reason for the changes. Harvesting is identified in the stock account, as it is a major component of change in commercial forests. The stock account presents information on the forest resource in terms of total hectares, total cubic metres and total dollar valuation.

The physical stock account provides information on the physical stock of forestry resources in New Zealand for 1995–2000. It provides estimates of the annual size of the forestry estate in New Zealand, both in hectares and cubic metres. The account shows the changing level of forestry resources in New Zealand over time and provides an insight into the reasons and types of change.

The forestry monetary stock account provides information on the monetary stock of commercial forestry resources in New Zealand. The account shows the changes in monetary stock levels over time, and the value of annual growth and harvesting. The account does not yet value sustainably managed indigenous forests, or non-commercial forests. Future updates of the monetary stock account may provide information on these categories.

FLOW ACCOUNTS

The forestry flow account shows how the annual harvested timber from the stock account is processed through the economy, by which industries, and what the value of these products is. The flow accounts also try to show what and how many waste residues are being produced by the wood processing industry, and how these are being utilised. The physical flow accounts present the supply and use of forest commodities in standard volume units.

DATA AVAILABILITY

Supply use National Accounts data are available up to 2005; data for 2006, 2007 are due for release in November 2009.

INTEGRATING COSTS AND BENEFITS INTO STATE-OF-THE-ENVIRONMENT REPORTING

People who make decisions about managing natural resources, or who develop environmental policy, depend on reliable evidence-based information on the state of the environment. Environmental reporting provides this.

Cost and benefit information, including the growing body of information on non-market benefits, will continue to provide important input into such reporting. For more information on environmental reporting refer to Indicator 7.4.a.

SOURCES OF INFORMATION

New Zealand Forest Owners' Association (March 1995) How Do We Rate? *New Zealand Forestry Bulletin,* NZFOA; Wellington.

Statistics New Zealand. http://www.stats.govt.nz – forestry accounts:

Forestry Monetary Stock Account 1995–2000: http://www.stats.govt.nz/NR/rdonlyres/51753A4D-88DA-4EE1-99AA-486BD1A5308B/0/ForestryMonetaryStocks.pdf

Physical Stock Account for Forestry Resources 1995–2000: http://www.stats.govt.nz/NR/rdonlyres/A090298E-8EAE-495B-8E17-DBD0D73B0278/0/Forestryphysicalstockaccount.pdf

Wood Product: processes and use June 2006: http://www.stats.govt.nz/NR/rdonlyres/0740126F-662B-47EA-95AF-8CF763B9D7A9/0/WoodusearticleJun06.pdf

Forestry Flow Account 1996–2002: http://www.stats.govt.nz/NR/rdonlyres/A834DB5E-F227-4BF8-A306-2CEC75C93E2D/0/ForestryFlowAccountdoc.pdf

Forestry Flow Tables 1996–2003: http://www.stats.govt.nz/NR/rdonlyres/42E9C54E-06FD-41B3-A3C6-F93DCE8703CD/0/ForestryFlowTables9602.xls

Forestry Monetary Flow Account 1996–1999: http://www.stats.govt.nz/NR/rdonlyres/E3B45C15-E6E4-40AB-9B11-C67B21F81712/0/Forestrymonetaryflowaccount.pdf

Forestry Physical Flow Account 1995–2000: http://www.stats.govt.nz/NR/rdonlyres/FE82519D-3588-4B88-B53E-9D37F3FD046F/0/ForestryPhysicalFlowAcc.pdf

Erosion control poplar and willow plantings, East Coast of the North Island. Photo: Alan Reid.

Indicator 7.5.c Socio-economic consequences

Assessing socio-economic consequences of forestry in New Zealand is a legislative requirement under the Resource Management Act. Also, 55 percent of the commercial plantation forest estate is certified under the Forest Stewardship Council system, which requires evaluation of socio-economic impacts as part of the certification process.

Quality of information: M/H **Progress against indicator:** ▲

DESCRIPTION

INDICATOR 7.5.c: New technologies and the capacity to assess the socio-economic consequences associated with the introduction of new technologies.

RATIONALE

See Indicators 7.5.

2008 COUNTRY REPORT

New technologies may have quite profound impacts on land use and communities. In reality, the effects of change are more likely to be felt within communities associated with plantation forests than with the indigenous forest estate, given the level of economic activity associated with them. The Resource Management Act 1991 makes provision for the assessment of impacts on people as well as the environment. The Act contains a mandatory requirement to assess social and cultural impacts in the definitions of both "environment" and "effects". The Fourth Schedule to the Act refers to the need to assess "any effect on those in the neighbourhood and, where relevant, the wider community including any socio-economic and cultural factors". It goes on to state that in interpretation, regard should be had to any effect that has a bearing on "natural and physical resources having aesthetic, recreational, scientific, historical, spiritual, cultural, or other special value for present or future". The Act makes provision for mandatory community consultation and also for monitoring effects if change takes place.

Forest certification through the Forest Stewardship Council process has been adopted by 19 forestry companies in New Zealand; the combined area amounts to over 1 million hectares, that is 55 percent, of the exotic plantation forest estate (New Zealand Forest Owners' Association et al, 2008). The "Principles and criteria" of FSC forest certification require management planning and operations to incorporate the results of social impact assessment. FSC Principle 4.4 states "Management planning and operations shall incorporate the results of evaluations of social impact. Consultations shall be maintained with people and groups directly affected by management operations."

THE ROLE OF FORESTRY IN COMMUNITY DEVELOPMENT

The forestry sector's contribution to building social capital and community resilience is generally not well understood by many community participants. The research undertaken on this issue has generally focused on the impacts of land conversion or the consequences of restructuring. Although important, these issues do not examine the ongoing (and positive) contribution forestry makes to sustaining and building rural communities. Only in the past 10 years have forestry companies started to look seriously at this issue (for example, as part of their FSC reporting).

According to Business and Economic Research Ltd (2005), the wide regional distribution of the people

working in the forest and wood processing sector means that a large number of small communities benefit from incomes generated by the sector. A high proportion of those employed are in younger age groups, which assists communities in retaining active sports clubs, schools and retail services as well as other facilities of young, vital communities.

The sector contributes to community formation at a variety of levels:

- Forestry sector employment diversifies the economic base of communities.
- Communities with both forestry and agricultural employment tend to have a more even growth pattern.
- Forestry provides both seasonal and permanent employment. The seasonal employment can be incorporated into the low seasons for agricultural activity (for example, planting can be combined with meat-processing employment).
- Forestry activity brings additional skills to communities. In particular, it provides a management layer that is important for managing public affairs (for example, school boards of trustees, community boards and sports halls).
- Plantation management and timber processing generally attract a younger workforce than the agricultural sector.
- Forestry investment has helped to stem out-migration and provide local career opportunities. This can be seen particularly in the central North Island, where forestry development has helped to retain the Māori population and traditional community structures.
- The industry generates significant employment in related manufacturing, servicing and transport activities.[1]

AGE STRUCTURE OF THE FORESTRY WORKFORCE

One of the challenges facing rural communities is the retention of younger workers and families. The forestry sector can play a positive role in this respect, as it has an appreciably younger age profile than agriculture (particularly in the harvesting and silviculture workforce). The sector provides an employment source for local workers, and it attracts new residents (and families) to a district. The forestry workforce helps to bolster the school-age population and is an important source of recruits for sporting clubs and community services, such as the volunteer fire brigade.

LABOUR DEMANDS ASSOCIATED WITH FORESTRY INVESTMENT

Employment opportunities associated with forestry development vary as a crop matures. The benefits are maximised when the estate reaches its sustainable harvest. Transition to this mature state can take from 15 to 50 years (depending on the crop). This extended transition period is often difficult for a community to appreciate, and there can be concerns over employment opportunities and the impact on population levels. In New Zealand, a long transition period is often considered to be two to three years, not 50.

New Zealand research on this issue was reviewed by Fairweather et al (2000). They found that forestry has significant potential to increase net employment in districts with areas of marginal or unimproved land. The net employment benefits declined as the livestock capacity of the land increased. These authors made the following observations (Fairweather et al, 2000):

- The on-land employment generated by forestry development (at maturity) is generally higher than that produced by agriculture (on comparable land).
- The ratio of total employment (on-land, processing and indirect but not induced) to on-land employment is similar for both agriculture and forestry (at about three to one).
- Forestry processing employs about the same as on-land employment.
- The total employment generated by forestry can be

1 Business and Economic Research Ltd (2005) found that core sectors, such as forestry, play a critical role in building job opportunities in their immediate communities. From a study of 13 communities and towns, BERL concluded that, for every 100 jobs in a core industry, a further 115 positions are created in the local finance, retail, hospitality and public service sectors.

several times that of agriculture, depending on the type of farming, soil conditions and climate.

Fairweather et al (2000:33) noted that a significant proportion of the plantation forest estate is still in its first rotation and has not reached maturity. As such, "it is reasonable to expect that total employment per 1000 hectares will increase in future as relatively more wood matures". It is also important to recognise that any employment generated in silviculture management and harvesting is not tied to specific sites, as is the case in agriculture. Individual communities may experience a loss of employment, while the broader district has a net gain in employment opportunities and population.

In looking at employment trends, it is important to recognise that forest growers and processors are under as much pressure as agricultural producers to increase their productivity and to adopt more capital-intensive systems. This means the labour input per area (for example a thousand hectares) will progressively decline. The social impact of capital replacement is more visible in the forestry sector, as there are relatively few companies (and contracting firms) compared with the about 70 000 full- and part-time farmers in New Zealand.

Business and Economic Research Ltd (2005) provided some general discussion about forestry as a driver of community formation, and family structures in the southern South Island of New Zealand. Forestry's total contribution accounts for 6.7 percent of the southern region's total real gross domestic product compared to the national average of around 3.4 percent. The sector's total economic impact upon the region is therefore highly significant.

The level of employment associated with the forest and wood processing sector is notable for another reason: it spans across the whole region to include small as well as large settlements and communities. These jobs often offer year-round employment, which encourages people to stay in small settlements. The employees are on average in younger age groups that raise families there.

The forest and wood processing sector is a core driver industry; it employs significant numbers of people in at least nine of the small rural centres as well as in the regional centres. The sector strengthens communities in the southern region by its spread of quality employment of younger, active people raising families; and this helps communities retain active sports clubs, schools, other social services and retail outlets. Community involvement by the sector also includes a wide range of support such as recreational access to forest blocks, firewood for fundraising, supporting education and building community assets.

SOURCES OF INFORMATION

Fairweather, J R; Mayell, P J; Swaffield, S R (2000) *A comparison of the employment generated by forestry and agriculture in New Zealand – research report 246.* Agribusiness and Economics Research Unit, Lincoln University; Lincoln; 46 p.

Ministry of Agriculture and Forestry (2009) *Forestry sector study.* Ministry of Agriculture and Forestry; Wellington.

New Zealand Forest Owners' Association; Wood Processors Association of NZ; Ministry of Agriculture and Forestry (2008) *New Zealand forest industry facts & figures 2007/2008*. http:www.nzfoa.org.nz/index.php?/File_libraries_resources/Facts_figures

Resource Management Act 1991, published under the authority of the New Zealand Government, Wellington.

Business and Economic Research Ltd (2005) *The contribution of the forest and wood processing sector to Otago and Southland*. BERL; Wellington; 52 p.

FURTHER READING

Forest Stewardship Council. http://www.fsc.org/

Indicator 7.5.d Impacts of human intervention

Impacts from, and mitigation of, human intervention on plantation forests are well known in New Zealand through a history of in situ scientific field experiments, modelling, and decision support systems. There are few impacts that cannot be mitigated. Research on mitigating human-induced climate change issues is well underway.

Quality of information: H **Progress against indicator:** ▲

DESCRIPTION
INDICATOR 7.5.d: Enhancement of ability to predict impacts of human intervention on forests.

RATIONALE
See Indicators 7.5.

2008 COUNTRY REPORT

The ability to predict impacts of human intervention on forests in New Zealand has been strongly enhanced. This is especially so in the area of modelling plantation forest management, and for radiata pine forestry in particular.

New Zealand has developed a sophisticated and accurate modelling system to predict the growth and yield of radiata pine. The system is built around a suite of growth models embedded in a growth and yield modelling programme. Called Standpak, the overall system and the models it includes were developed at the New Zealand Forest Research Institute. Now called Scion, this Crown research institute continues to develop, support and market the system. Various other modelling systems have evolved out of the core Standpak principles, for example a carbon modelling system.

Standpak is able to model the impacts of a range of human interventions on the growth and yield of radiata pine plantation forests. Examples are impacts of tree-breeding improvements and effects of different silviculture regimes and rotation lengths.

Scion has also developed a system for forest resource assessment (called ATLAS Cruiser). This is specifically tailored to pre-harvest inventory and involves three distinct phases:

- planning and designing an assessment;
- field cruising to gather data on the forest resource;
- analysing data to determine forest state and potential yield, both current and future.

Traditional forest assessment methods focus on area as the basis for sampling, resulting in estimates of mean per-hectare yields. In many situations it is preferable to leave area out of the yield equation, individual stems being the unit of sampling. New methods for automatic stem-counting from remote images may, in future, make this approach the norm. (LUCAS at the Ministry for the Environment is already using light detection and ranging, LiDAR, for its reporting – see Indicator 7.4.a.) The Cruiser system supports individual-stem-based sampling and the statistical design of assessments on this basis.

Growth projection is an important adjunct to a forest assessment system, as it enables the prediction of product yields through time. Individual tree growth models, as well as stand-level models, have been incorporated into Cruiser, allowing the more flexible tree-list approach to be used in the generation of yield data for forest planning. Prediction of branching patterns and branch

growth is also available, through the use of branch models.

Research into harvesting New Zealand's plantation forest resource started in the early 1980s with the establishment of the Logging Industry Research Organisation (LIRO). As well as researching the economics of harvesting, LIRO investigated the effects of harvesting systems on soil, water, landscape and aesthetic values. Predictive models and decision support systems were developed from this until LIRO was disbanded in the mid 1990s. Logging research had a resurgence under the auspices of Future Forest Research in 2008 (see Indicator 7.5.a).

Growth and yield predictions have been supplemented by some three decades of research into radiata pine silviculture. This covered areas such as the effects on growth and sustainability from:

- soil compaction and soil management (for example, ripping of hard pans);
- fertiliser application;
- slash burning and slash retention;
- methods of establishment;
- use of herbicides;
- effects of slash residues.

Various research programmes are also measuring the long-term sustainability of successive rotations of radiata pine. These show that generally, under New Zealand conditions and with the types of silviculture commonly practised here, successive rotations of radiata pine do not unduly degrade sites. In some situations, such as on podsolised soils, site conditions could be improved.

Effectively, this research investigates the impacts of human intervention on radiata pine plantation forests. Its results have also been incorporated into predictive models and decision support systems.

Impacts of indigenous silviculture have not been researched to the same level. Particularly in the last couple of decades, timber production has not focused on indigenous forestry. Interest in silvicultural research is renewing, however, particularly as it relates to sustainable indigenous forest management. Some past work is still applicable for timber production on private indigenous forest land (under sustainable management plans or permits). Examples are work on beech in relation to coupe size, and regeneration of rimu after group- or single-tree harvesting. Research being carried out into kauri and tōtara silviculture (such as the effects of thinning and provenance trials) may prove similarly applicable.

Research into the impacts of human-introduced pests, on indigenous forests in particular, has been undertaken and can now be modelled. Other human-impact research, for example on recreation activities in indigenous forests, could be improved/increased. Many potential research programmes that have a blurred connection to specific economic outcomes raise the question who pays for them. Funding this type of research in New Zealand also needs further debate.

SOURCES OF INFORMATION

Forest Research. http://www.forestresearch.co.nz)

Ministry of Agriculture and Forestry (2009) *Forestry sector study.* Ministry of Agriculture and Forestry; Wellington.

FURTHER READING

Roche, MM (1990) *The history of forestry*. New Zealand Forestry Corporation in association with GP Books; Wellington.

Maclaren, JP (1996) Environmental effects of plantation forests in New Zealand. *Forest Research Institute Bulletin*198. Forest Research; Rotorua.

Indicator 7.5.e Climate change

Research on predicting climate change-induced impacts on forests is well underway in New Zealand. More CO_2 in the atmosphere could benefit tree growth, but benefits are likely to be outweighed by higher risks from increased severity of weather events (drought, flood, wind).

Quality of information: H **Progress against indicator: ▲**

DESCRIPTION

INDICATOR 7.5.e: Ability to predict impacts on forests of possible climate change.

RATIONALE

See Indicators 7.5.

2008 COUNTRY REPORT

The ability to predict impacts of climate change and global warming on New Zealand forests is based on expert reports and peer-reviewed scientific studies. These are published internationally and in New Zealand.

More than $5 million was allocated in 2007/08 to fund a first tranche of research through the Plan of Action for Sustainable Land Management and Climate Change. Climate change and forestry was part of this programme.

CLIMATE CHANGE AND FOREST ECOSYSTEMS

The mean annual temperature for all of New Zealand is projected to increase by around 2° centigrade by 2090. Annual rainfall projections indicate the western side of both islands trending towards increasing rainfall, while the eastern side trends towards decreasing rainfall. The projected increase in temperature is likely to lead to a significant reduction of frost days, an increase in hot days, and an increase in the intensity of heavy rainfall events. Drought risk is likely to increase in currently drought-prone areas where reductions in rainfall and increases in evaporation are anticipated. There are indications that the annual mean westerly wind component may increase by about 10 percent by 2090, and that the occurrence of high winds may increase by around 2–3 percent.

CLIMATE CHANGE AND TREE GROWTH

Climate change is likely to have a significant impact on the future growth of trees in plantation forests. This is because tree growth responds directly to changes in CO_2 concentration, temperature and nutrient and water availability. There are direct responses to these drivers and indirect interactions and feedback processes.

Increasing CO_2 concentration is generally beneficial for the growth of plants. The magnitude of the response varies with species and growth stage. The "CO_2 fertilisation effect" interacts with other environmental factors such as lack of essential nutrients that can limit growth, or warmer and drier conditions that can enhance it. CO_2 fertilisation is likely to be most beneficial in the drier parts of the country: Otago, Canterbury, Hawke's Bay and East Cape. Limitations of nutrients (especially nitrogen) are unlikely to limit the CO_2 response. Nutrient levels are currently sufficient in most of New Zealand's plantations and are likely to be maintained into the future. Increasing temperatures also stimulate decomposition of soil organic matter and mineralise more nitrogen to further boost the nutritional status of trees.

Increased air temperature, as expected with climate change, is likely to have a predominantly positive effect

on plantation growth by lengthening the growing season.

Radiata pine is New Zealand's most important plantation species. But to date, there has not been a comprehensive modelling study to investigate its likely growth response to the combination of likely climatic changes over the short or longer terms. Comprehensive models that include these processes are already available. They still need to be tested in New Zealand before being used to quantify the forest growth response across the wide edaphic and climatic range over which plantations are grown in New Zealand.

Climate change is likely to affect many abiotic and biotic factors, which in turn may also affect plantation growth and productivity. Weeds, insects, pathogens and the risks from wind and fire are all factors to be considered as they currently cause significant economic losses in plantation forests.

CHANGES IN RISK FROM FIRE AND WIND

Climate change is likely to increase fire risk and the incidence of damaging winds. Previous research has shown that fire danger is likely to increase significantly in the eastern areas of New Zealand; the length of the fire season will probably also increase. Increases in fire risk are likely to result in more fires and larger plantation forest area burnt.

It is also predicted that the westerly wind speed component will increase during the winter and spring periods. This will lead to an increase in the mean and extreme wind speeds for many regions of New Zealand. The central and upper regions of the North Island contain a large proportion of the plantation forest estate, but extreme wind speeds associated with conventional storm systems are predicted to decrease here. The upper and eastern parts of the North Island may be subject to more severe ex-tropical cyclones.

In regions where severe wind is predicted to increase, a substantial increase is likely in the annual frequency of winds that are of sufficient magnitude to cause widespread damage to forests. Previous research and simulations indicate that the impacts from these projected increases in extreme wind speeds will vary widely. Differences in the underlying vulnerability of forests explain the differences within and between regions. Impacts are likely to range from little or no change, to a significant risk increase in wind damage to plantation forests.

CHANGES IN RISK FROM EXOTIC PESTS

Biotic factors are also likely to be strongly influenced by climate change. Distributions of weeds, insects and pathogens are strongly determined by climatic conditions. Therefore, climatic changes are likely to shift the geographic range of many species. Global regions from which future invasions might occur are also likely to shift, and simulations suggest an expansion of the global areas that pose an invasion risk for New Zealand.

INDIGENOUS ECOSYSTEMS

With few exceptions, climate change alone is unlikely to be a dominant cause of indigenous species extinction. Rather, it may act as a compounding pressure on ecosystems already under threat. Probably the most vulnerable are fragmented indigenous forests of drier lowland environments in Northland, Waikato, Manawatū, and in the east of the country, from East Cape to Southland. Some terrestrial and freshwater species that are currently at the (climatic) limit of their natural range are at long-term risk of extinction.

SOURCES OF INFORMATION

Watt, MS; Kirschbaum, MUF; Paul, TSH; Tait, A; Pearce, HG; Brockerhoff, EG; Moore, JR; Bulman, LS; Kriticos, DJ (2008) *The effect of climate change on New Zealand's planted forests: impacts, risks and opportunities.* Contract report for the Ministry of Agriculture and Forestry; Wellington.

New Zealand Climate Change website and associated reports. http://www.climatechange.govt.nz/sp/resources/resources_publications_alt.htm

APPENDIX 1
Common and corresponding botanical names

Acacia	*Acacia* spp.
Ash	*Fraxinus excelsior*
Beech	*Nothofagus* spp.
Black beech	*Nothofagus solandri*
Broom	*Cytisus scoparius*
Cypress	*Cupressus* spp.
Douglas-fir	*Pseudotsuga menziesii*
Elm	*Ulmus* spp.
Eucalypts	*Eucalyptus* spp.
Ginseng	*Panax ginseng* and *P. quinquefolium*
Gorse	*Ulex europaeus*
Hall's tōtara	*Podocarpus hallii*
Hard beech	*Nothofagus truncata*
Hawthorne	*Crateaegus* spp.
Hinau	*Elaeocarpus dentatus*
Kahikatea	*Dacrycarpus dacrydioides*
Kamahi	*Weinmannia racemosa*
Kānuka (tea tree)	*Kunzea ericoides*
Karamu	*Coprosma robusta*
Kauri	*Agathis australis*
Kohekohe	*Dysoxylum spectabile*
Koromiko	*Hebe salicifolia*
Kotukutuku	*Fuchsia excorticata*
Makomako (wineberry)	*Aristotelia serrata*
Mangrove	*Avicennia marina* var. *resinifera*
Mānuka (tea tree)	*Leptospermum scoparium*
Matagouri	*Discaria toumatou*
Matāi	*Prumnoptys taxifolia*
Miro	*Prumnoptys ferruginea*
Northern rata	*Metrosideros robusta*
Oak	*Quercus* spp.
Pahautea	*Libocedrus bidwillii*
Podocarps	*Podocarpus* spp.
Pohutukawa	*Metrosideros excelsa*
Poplar	*Populus* sp.
Radiata pine	*Pinus radiata*
Rata	*Metrosideros robusta*
Red beech	*Nothofagus fusca*

Rewarewa	*Knightia excelsa*
Rimu	*Dacrydium cupressinum*
Silver beech	*Nothofagus menziesii*
Southern rata	*Metrosideros umbellata*
Sphagnum moss	*Sphagnum cristatum*
Taraire	*Beilschmiedia tarairi*
Tawa	*Beilschmiedia tawa*
Tāwari	*Ixerba brexiodes*
Tea tree (kānuka)	*Kunzea ericoides*
Tea tree (mānuka)	*Leptospermum scoparium*
Tōtara	*Podocarpus totara*
Tussock grass	*Stipa trichotama*
Willow	*Salix* spp.
Wineberry (makomako)	*Aristotelia serrata*

APPENDIX 2
Acronyms used and their meaning

ACC	Accident Compensation Corporation
AFOLU	Agriculture, forests and other land uses
AGB	Above ground biomass
AGS	Afforestation Grant Scheme
ANZCERTA	Australia-New Zealand Closer Economic Relations Trade Agreement
ANZIC	Australian and New Zealand industry classification
APEC	Asia Pacific Economic Cooperation
BGB	Below-ground biomass
BERL	Business and Economic Research Ltd
BRANZ	Building Research Association of New Zealand
C&I	Criteria and indicators
CO_2	Carbon dioxide
COHFE	Centre for Human Factors and Ergonomics
CRI	Crown research institute
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CWD	Course woody debris
DOC	Department of Conservation
DSIR	Department of Scientific and Industrial Research
ECFP	East Coast Forestry Project
EMS	Environmental management system
ETM+	Enhanced Thematic Mapper Plus (Landsat 7)
ETS	Emissions trading scheme
FAO	United Nations Food and Agriculture Organization
FBRC	Forest Biosecurity Research Council
FFR	Future Forest Research
FIC	Forum Island Countries
FIDA	Forest Industry development agenda
FITEC	Forest Industries Training and Education Council
FSC	Forest Stewardship Council
FTA	Free trade agreement
FTE	Full-time equivalent
FRST	Foundation for Research, Science and Technology
FWD	Fine woody debris and litter
GATT	General Agreement on Tariffs and Trade

GDP	Gross domestic product
GPG-LULUCF	Good Practice Guidance for Land Use, Land-Use Change and Forestry
GIS	Geographic information system
GST	Goods and services tax
HWP	Harvested wood products
IPCC	Intergovernmental Panel on Climate Change
IRIS	Incident reporting information system
ITO	Industry training organisation
IUCN	International Union for Conservation of Nature
LCDB	Land cover database (versions 1 and 2)
LENZ	Land Environments of New Zealand
LIRO	Logging Industry Research Organisation
LRI	New Zealand land resource inventory
LTSA	Land Transport Safety Authority
LUCAS	Land use and carbon analysis system
LULUCF	Land use, land-use change and forestry
MAF	Ministry of Agriculture and Forestry
MAI	Mean annual increment
MfE	Ministry for the Environment
MoRST	Ministry of Research Science and Technology
MSPA	Morphological and spatial pattern analysis
n.e.c.	not elsewhere classified
NCEWM	National Centre of Excellence in Wood Manufacturing
NEFD	National Exotic Forest Description
NHMS	Natural heritage management system
NIWA	National Institute of Water & Atmospheric Research
NVS	National vegetation survey
NWFP	Non-wood forest products
NZ	New Zealand
NZEEM	New Zealand empirical erosion model
NZETS	New Zealand emissions trading scheme
NZFOA	New Zealand Forest Owners' Association
NZFSA	New Zealand Food Safety Authority
NZPCN	New Zealand plant conservation network
NZSNA	New Zealand system of national accounts
NZQA	New Zealand Qualifications Authority

NZU	New Zealand unit: unit of trade for the Emissions Trading Scheme, 1 NZU = 1 tonne of CO_2-equivalent emissions
OSH	Occupational Health and Safety
PACER	Pacific Agreement on Closer Economic Relations
PCE	Parliamentary Commissioner for the Environment
PFSI	Permanent forest sink initiative
PICTA	Pacific Island Countries Trade Agreement
PJ	petajoule
PNB	Physiological needle blight
QEII	Queen Elizabeth the Second [National Trust]
QES	Quarterly employment survey
R&D	Research and development
RMA	Resource Management Act 1991
RS&T	Research, science and technology
RUC	Road user charge
SEEA	United Nations Integrated System of Environmental and Economic Accounting
SFF	Sustainable farming fund
SFM	Sustainable forest management
SMF	Sustainable management fund
SPARTECA	South Pacific Regional Trade and Economic Co-operation Agreement
STIC	Structural Timber Innovation Company
TIMO	Timber industry management organisation
TPA	Trans Pacific [Strategic Economic Partnership] Agreement
UMF	Unique mānuka factor
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
US	United States of America
WPS	Wood processing strategy
WQI	Wood Quality Initiative Ltd
WTO	World Trade Organisation