Will there be a Demand for Radiata Pine in the Future?

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Summary
We have a major dilemma, We cannot develop the market for the supply of wood if there is no immediate supply of that wood. But in the absence of a market, investors in new plantations need confidence that a profitable wood market will develop.

The major advantages of wood are its renewability, its sustainability and its environmental friendliness. New Zealand's five rotations of plantation experience give it a unique insight into the future of forestry:
- the emergence of only one dominant plantation tree species, radiata pine;
- the importance of early management decisions in determining final tree marketability and profitability;
- that global wood supplies will increasingly come from plantations.

In our changing world, projections of future wood demand will be increasingly difficult. Wood supply projections will also be difficult. The only aspect of the future that can be predicted with any confidence is the population growth. There are also likely to be constraints on energy. These advantages and trends all enhance the future of wood.

The opportunity for New Zealand that offers the most promise and poses the least risk is radiata pine extensively managed for clearwood production.

When the wood becomes available for harvest, plantation owners may have to be far more pro-active in the development of new wood markets.

Introduction
One of the papers presented to the Forest Investment Conference, held as part of the 1998 Annual General Meeting of the New Zealand Institute of Forestry in Wanganui, was by Peter Martin. Peter Martin is head of a New Zealand plantation investment company, Arbor Forests Ltd and he said that the question asked most often by potential plantation investors was will there be a demand for radiata pine in the future?

To help answer this question, let us begin by evaluating the past.

What can we learn of relevance from the New Zealand plantation experience?
New Zealand has been practising plantation forestry for just over 140 years. In that time New Zealand has gone from 100% indigenous supply, as well as being a net importer of wood, to almost 100% plantation supply, as well as exporting about half of all wood harvested. Chile is the only other country to have done this.

Few may yet agree but it is my conclusion that this switch from natural (even if it is managed) forest to almost a total reliance on plantations (which may of course be with an indigenous tree species) will one day be the norm for almost all of the world's industrial wood supply.

Some other countries have been growing plantations for longer than New Zealand. However, most have rotations that are longer than the 20 to 35 years rotation norm in New Zealand. In the 140 year experience, New Zealand has had the equivalent of five rotations, although it is doubtful if, on any one site, there have been more than three consecutive rotations.

A few countries with fast growing pulpwood rotations may have had experience with more than five rotations but no country has had as much experience as New Zealand in growing sawlogs for lumber end-use markets.

It may be hard to accept, but New Zealand forest owners, both state and private have put enormous effort into attempts to diversify into other tree species. To date about 400 promising tree species have been trialed in New Zealand. Despite this we have, at the end of the 1990s, over 90% of our plantation estate, as well as over 90% of new plantings, in one tree species — radiata pine.

It is my interpretation that this is not because of any narrow-mindedness on the part of New Zealand plantation owners. Rather it is an inevitable consequence of intensive plantation forestry.

There is a parallel in agriculture. Agriculture started with a multitude of food plants, animals and birds. As practices became more intensive and markets more price competitive, the number of food types, species and varieties declined greatly. Today most of the world's agricultural food comes from less than 10 plants (wheat, potatoes, corn, rice, etc.), two animals (the pig and the cow), and one bird (the chicken). This is because a preferred agricultural food must have more than desirable attributes (pleasant taste, ease of preparation, ease of genetic manipulation, etc.). Winners must also demonstrate ease of domestication, including the ability to respond to management.

The New Zealand plantation dominance of radiata pine comes both from the desirable attributes of the wood and the species' ability to grow well on a wide range of sites, with the additional ability to respond predictably to stand management treatments especially pruning and thinning.

It is my prediction that by the end of the 21st century most of the world's wood will not just come from plantations but from plantations that will be mono-cultural of probably no more than five dominant tree species (Sutton, 1995). Radiata pine will be one of those few favoured tree species.

The long plantation experience, especially economic research, has clearly demonstrated that plantation forestry is very capital intensive. Few industries, if any, are more capital intensive. If relatively short rotation radiata pine plantations are capital intensive then plantations in those countries with slower growing species and far longer rotations must be even more capital intensive.

Combined with the five rotations experience of plantations in New Zealand, the country has invested in well focused research. One of the key insights that comes from that research is that even though the rotation may be as long as 25 to 30 years most aspects of both tree size and tree quality at harvest are pre-determined by the decisions at the time of planting and in the first few years. This poses a real dilemma for the forest grower/investor.

The problem is that the major determinants of a tree's value and marketability on the day of harvest are pre-determined by the decisions made at the time of plant-

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The first is the global population. In mid-1998 the global population is fast approaching six billion people. The rate of population growth, which is mostly driven by the birth rate, is slowing down. However, the average rate of growth is still high and there are large differences between countries. Those with high average incomes (either most of those in wealthy countries, or the wealthy classes in poorer countries) have, on average, fewer children than those on low incomes. A democratic solution that reduces population growth is to increase average wealth. The problem is that increased wealth also increases consumption. Increased consumption increases energy use. Where might the world find an additional energy source of the size required to provide the energy needs of a world where the average income level was high enough to greatly reduce the growth in human population? Possible global energy demand, even with major energy conservation efforts, could, by the year 2040, be of the order of more than ten times the current global use (Sutton, 1996). An increased energy demand of that size cannot come from increased fossil fuel use. The continuing global commitment to actually reduce the release of fossil carbon into the atmosphere alone will ensure that. Where can the world quickly find an energy source that could even double the amount of energy we use, let alone a tenfold increase in consumption. A partial answer is a greatly increased use of solar energy. The usual approach to the utilisation of solar energy is direct conversion to a fuel or electricity production. But an indirect route may be just as realistic. We might consider using solar energy through the phytosynthetic process to make very energy efficient material(s). Such a material is wood. Wood used in its solid state (sawn timber, plywood, etc.) requires far less additional energy than almost all wood substitutes, e.g., steel, concrete or plastic.

A far greater use of solid wood in the global economy reduces not only the need for energy but could also reduce the amount of fossil carbon that is released into the atmosphere — fossil carbon comes not only from the use of fossil fuel but also from the manufacture of cement (which is based on the release of carbon dioxide from limestone).

Because wood is a low energy use alternative to steel, concrete and plastic, there is, contrary to the views expressed by urban and affluent environmentalists determined to lock up their own natural forests, a strong environmental case for a far greater use of wood in the future. The development which would challenge this scenario is the emergence of a new energy source. That source must provide a massive energy supply that is cheap, renewable, sustainable and environmentally friendly. Currently, no such energy source seems likely in the near future. If an acceptable and large energy source is developed it does not necessarily mean there is a limited future for wood. A case can be made that a large wealthy global population will have a preference for products made from a natural and variable product like wood, rather than mass-manufactured synthetic products.

The population trend and questions about the world’s ability to greatly increase the amount of cheap energy should provide some optimism for investors in plantations.

The global position of wood

Wood is one of the world’s most important raw materials and yet its significance is hardly ever recognised.

Wood has traditionally come from natural forests. The New Zealand (and Chile) experience suggests that, globally, increasing volumes of wood will come from deliberately created plantations. In many countries these will be of exotic species that is not indigenous to the region or country. However, at present less than 15% of the world’s industrial wood currently comes from plantations. Globally, plantations are not yet very significant.

Wood is very versatile. We use it in up to 100,000 different ways. Many uses for wood require little energy, especially when used in solid form. Wood is renewable, sustainable and very environmentally friendly. But almost every wood use has a substitute. The world could maintain its currently complex lifestyle with any wood at all but of course we would require a lot more energy.

Let us assume for a moment that we have a world that uses no wood at all and never has. And let us assume that we have just discovered wood for the first time. Wood would be promoted everywhere as a new miracle raw material. Advocates all over the world would stress its renewability, its sustainability, its environmental friendliness, its low energy requirements, etc. Every day new and exciting wood uses would be developed. Talented bright people, as well as investors, would be eager to get into the wood sector. Wood would be seen as the new raw material with so much going for it.

But wood doesn’t enjoy this reputation. Why not?

Wood harvesting has been attacked, perhaps unfairly, by the environmental movement who have found operations like clear-cutting to be easy targets for raising public concern. The wood using
industry generally is neither visionary nor aggressive in the market place. Wood producers who are often small companies are rarely able to mount a coordinated response to market penetration by wood substitutes like steel, which are usually promoted by very large companies. The wood producers of the world have largely been apathetic when it comes to substitution. However, substitution should be a two-way process. A superior wood product should and could be able to substitute for steel, concrete or plastic. The global environment would benefit because wood is the most environmentally friendly raw material we know.

One new major end-use could greatly increase wood demand. An example was the additional wood market created by the development of wood preservation by pressure treatment. The world’s wood users must be more pro-active and innovative. But this is a “Catch 22” type situation. If a major new wood use is developed, the global demand for wood could increase significantly. However, because we are reaching the limits of any additional supplies coming from natural forests, any increase in the supply of wood must come from deliberately created new plantations. For those plantations to come into production we require not just a huge capital investment but, and probably even more importantly, a delay of at least two decades between the initial investment and the wood availability.

Being realistic it is unwise of industry to develop new products and markets before the wood can be harvested.

Hence the dilemma: We cannot develop wood products/markets without the immediate availability of additional wood. But for that wood to be available to the wood using industry, there had to be plantation investors 20 to 30 years earlier. Those investors had to be prepared to risk that at maturity, several decades ahead, there would be a profitable market for their wood.

Understandably today’s plantation investor wants confidence that a wood market will exist at final harvest. But, as we have just discussed, the wood market for plantation wood can only be developed when the plantation matures. There have to be factors other than the actual existence of a wood market to encourage investors to risk the investment in plantations. (The dilemma now being faced has parallels with the dilemma faced by advocates of pruning in the 1960s and 1970s. How to advocate pruning for clearwood markets when a log market for pruned logs could not exist until the mid 1990s? We did that by presenting some of the arguments used in this paper).

Plantation investors should also take some reassurance from the knowledge that globally wood supplies from natural forests are increasingly reaching their limit. Future supplies will increasingly come from plantations. They must be aware that wood is a very versatile raw material. Also that plantation wood is sustainable and very environmentally friendly, especially for its low energy requirements.

Many plantation investments to date have been justified on the predicted short-falls in the global wood supply from natural forests. However, over the last 100 years, foresters generally have had a poor track record of predicting global wood demand and even of predicting the global wood supply.

It may be more realistic to consider wood market creation and innovation. One new market for wood could create a huge demand for extra wood. This is especially so for New Zealand as it still only accounts for about 1% of the global supply of industrial wood. Given wood’s great versatility, its major energy and environmental advantages creating new wood markets should not be difficult.

The potential global market is huge, especially given the many environmental advantages of wood.

New Zealand’s competitive advantage

Almost all of New Zealand’s wood harvest comes from plantations, over 90% of which are radiata pine. New Zealand exports about 60% of its harvest but the total harvest still only accounts for just over 1% of the global industrial wood harvest (17 million m^3 of a total of 1.5 billion m^3 in 1995 — FAO 1997).

As only 5% of the land area is currently in plantations, New Zealand has the potential for more plantations, especially in the regions. These are the areas with the most need for employment and industry.

New Zealand has no competitive advantage in access to cheap land, cheap labour or cheap capital. But New Zealand has major advantages in plantation experience, in plantation research, and in radiata pine. For many New Zealand investors no other tree species is considered worthy of investment.

Given the uncertainty over future wood markets, what wood quality/wood end-use(s) should New Zealand target?

Radiata is a very good pulping species. However, few New Zealand investors would consider growing and managing a tree crop just for pulp. Neither New Zealand nor radiata pine have any comparative or competitive advantage in the growing of pulpwood. The reasons:

- radiata pine as pulpwood does not attract a price for purpose-grown plantations because the market is dominated by major pulp producers used to “residue pricing” of non-sawlog quality material;
- compared with radiata pine, there are globally some other fast growing tree species which have higher total yields and shorter rotations for pulpwod. Most of these species do not have the same other end-use alternatives as radiata pine (e.g. some Eucalypts and southern pines in South America and Asia).

A more contentious issue is the growing of structural lumber. I realise others may disagree, but I have never favoured the growing of radiata for structural grades, especially when it comes to export markets because:

- most of the world’s forests (either managed natural forest or plantations) will only produce small trees with small branches. These trees are more suited for the production of structural lumber than radiata;
- even with conservative silviculture, radiata pine will always have larger branches (and hence larger knots) than most of the world’s traditional structural timber tree species;
- radiata, for its density, is not a stiff wood. Unfortunately, a high level of stiffness (modulus of elasticity) is the prime requirement of high quality good structural lumber. The New Zealand (and Australian) domestic markets have learnt to accept radiata’s lack of stiffness. But outside these markets radiata’s stiffness compares unfavourably with many of the world’s preferred structural timbers (e.g. Douglas-fir and southern pine);
- the prices for even the best structural grades of lumber/plywood are never relatively high. This could be because most trees currently being utilised in the world produce large proportions of high-grade structural lumber. I suspect, but this has not yet been proven, that structural grade lumber is probably the lumber most vulnerable to substitution;
- a major reason for not growing structural lumber is because to do so greatly restricts radiata’s ability to grow a large volume of its most valuable product — clearwood. The production of structural timber, unless it is to be knot-free, requires conservative silviculture close initial spacing, delayed thinning, high final crop stockings and, consequently, small final tree size. In contrast, the silviculture for radiata clearwood allows a wider (lower cost) initial spacing, but requires early and timely thinning and pruning, and lower
Close liaison with ACC reduces business costs

A pro-active approach to managing injuries and a close working relationship with ACC has kept costs down for the Wellington Regional Council.

With 400 staff working in a diverse range of jobs from aerial operations to forestry to clerical work, the Wellington Regional Council (WRC) faces a variety of injury prevention and management challenges.

Peter Kelly has been health and safety co-ordinator at the WRC for the past three years. He is proud of his role in minimising the council’s injury and rehabilitation costs.

“We have total ACC costs of only $55,000 a year and, if you exclude long term or tail costs, it comes down to less than $10,000,” he says.

Kelly says he’s achieved this partly by helping council staff create a safe work environment. He also says that careful management of injuries, with an eye on short and long term costs, and a close working relationship with ACC have played a critical part in minimising costs.

Three money saving strategies

He says he has three strategies for minimising costs.

“When somebody injures themselves at work you have to look at the whole scenario,” he says. “Firstly, I keep our experience rating down by absorbing some of the cost. This approach is very effective cost wise as long as we provide an equivalent service to our employees as ACC would.

“Second, if employees are likely to be affected by an injury for some time, we’ll minimise our costs by finding alternative duties for them until they can go back to their former job. If they are permanently disabled, we’ll endeavour to find a permanent job for them that they can do.

“With the third strategy, if an employee has been off for some time, I can go to ACC and ask them to check that they’ve done all they can to work with the employee to identify his or her rehabilitation needs.

“This is often helpful for the employee and it can help reduce our costs. It’s very easy to run up massive expenses for long term claims, say up to $400,000 over four years for a back injury.”

Case management key to cost reduction

Kelly says that ACC’s approach to case management is a critical element in minimising the costs of injuries. “With an assigned case manager you get the same person whenever you have dealings with ACC. Our case manager is Genevieve Prior and...
she goes all out for us because she knows our needs and takes an interest in our people.”

When Prior was first assigned to the council, she spent a day touring their operations and learning about the challenges staff faced in their work. “With my knowledge of their operations I know the full range of tasks staff undertake and I know what injury risks they face,” she says. “When working to rehabilitate injured employees I have a good idea of how they can be eased back into the workplace by undertaking alternative duties.”

While Prior works alongside injured employees, ACC account manager, Carl Stent, is in regular contact with Kelly and the council’s management team.

“It’s my role to ensure the WRC are getting what they need from ACC,” says Stent. “I’ve got a good understanding of how the WRC works, what their business goals are and how their health and safety policy helps them achieve those goals.

“They’re a major employer and need an efficient way of dealing with us so we provide co-ordinated case management services to them. We’re exploring ways of increasing how we provide this type of service to more big employers.

“The WRC is an impressive organisation in that they understand the financial impact of injuries. They take a proactive approach to minimising the cost of injuries, firstly by preventing them happening and secondly by taking a long term approach to managing injuries and rehabilitation.”

Peter Kelly says that it’s well worth developing a close working relationship with ACC. “There are real benefits to both employer and employees from a close relationship with ACC. They should work closely with their case manager and, if they don’t have an account manager, they should develop a good relationship with their branch manager.”

One of the Wellington Regional Council’s responsibilities is the Wellington Harbour. Deputy harbourmaster, Patrick Atwood, is shown with pollution control equipment.
final crop stockings, all with the objective of large final tree size with a small defect core. It is not practical to have a silvicultural regime that maximises yields of both clearwood and structural grades.

A lifetime experience has done nothing to diminish my conviction that clearwood is radiata pine’s and New Zealand’s most competitive and comparative advantage. My reasons are:

- As a clearwood, radiata is one of the world’s best. Its even texture ensures the clearwood is easy to process, to finish, to stain, to glue etc.
- Radiata’s growth attributes greatly favour clearwood. The species is not the world’s greatest volume producer but few other species can achieve, even with appropriate management, a large diameter, say 60 cms, sooner than radiata. For the production of clearwood, a large tree diameter is essential.
- Radiata also has the ability (but New Zealand has, at least up until now, largely failed to explore this opportunity) to produce long internodes in the second and third logs above the butt log. Logs with long internodes can produce sawn timber with clear lengths of 1.2 m to 1.8 m.

I recommend plantation investors consider only the management option of clearwood. The current Asian crisis has confirmed our faith in radiata clearwood. Over the first few months of 1998 pruned log prices and markets have largely maintained previous price levels. Unpruned logs have generally lost value.

The New Zealand concentration on one species is sometimes criticised but it has resulted in a concentrated research effort. That concentration has made up for New Zealand’s relatively small size.

The other factor in New Zealand’s favour is the establishment of a large resource with a predictable supply of consistent quality material.

There is much recent comment about the coming ‘wall of wood’ — the increasing volume of wood soon to be harvested because of the second planting boom in the 1970s and early 1980s.

I helped create that great opportunity. There are few trends in which we can have any confidence. However, we probably have sound reasons for optimism about the future of plantation wood, especially radiata pine. They include:

(a) the sustainability, the renewability and the environmental friendliness of wood,
(b) that future wood supply will increasingly come from plantations.

Intensive plantation management, instead of being a global exception, will increasingly become the global norm.

There will always be pressures to plant tree species other than radiata pine. It would take an environmental disaster (say the emergence of some insect or disease which devastated radiata and for which no cure could be found) before we seriously look for another plantation tree species.

After 140 years and five rotations of success, I cannot see another tree species emerging and I cannot see the necessary research effort being applied in New Zealand to any other tree species. We should continue to use silviculture, genetics and utilisation to make radiata a more desirable tree species with, if possible, a lower biological risk. We can achieve the latter by breeding into our trees resistance to the possible introduction of potentially harmful insects, diseases and other organisms.

Future wood prices are just as unpredictable as the size of the wood market. Some anticipate that wood prices will fall because of possible over-supply and because of the continuing threat of wood substitution by steel, concrete, plastic and other materials. Others argue that wood has major advantages, especially its low energy requirements, which will maintain wood’s competitive position. Another argument is that the economic cost of wood is little understood in New Zealand. As more countries adopt realistic costing and valuation methods, and, as subsidies to forestry seem likely to be reduced, the favourable position of New Zealand radiata pine plantations will be enhanced. This is because most of the world’s wood comes from slower growing tree species. The true cost of growing most of the world’s wood is therefore higher than that of radiata pine. This factor alone should maintain or even increase wood prices.

While we may have reason to be optimistic about the long-term trend in world wood prices, we should be realistic and consider the consequences of a price fall. A wood price fall will not always be the disaster that it may appear. Most of the costs of growing wood are not the direct costs but the cost of capital being tied up for decades. A lower wood price would rarely equate to a loss; it would only reduce the percentage profit. A halving of wood prices might only reduce radiata plantation investment returns from say a 9% real return to a 6% real return on invested capital. Even at these lower price levels, radiata plantation investment returns may still be acceptable.

Radiata plantation owners might consider being more pro-active. We now appreciate that there is little to be gained by encouraging market development decades or even several years before an increase in wood harvest. But just before an incremental increase in the harvest level, growers should vigorously promote the plantation opportunity. By being pro-active, plantation owners have more chance of influencing market returns. Some of those owners may even become processing and marketing entrepreneurs.

Concluding comments

I am reminded of a recent visit by a wood buyer concerned about New Zealand’s ability to sustain supplies of clearwood. The sight of all our pruned trees quickly dispelled any fears. This, of course, led to the evolution of our silviculture. He was most impressed by our vision. "You mean you were pruning trees in the 1970s for us in the 1990s!". Then he added the comment that really surprised me. "But you never told us about it!"

To realise the most from their investment and their vision, plantation growers must do far more promotion of the wood opportunity.

I am reminded also of a recent statement by Dr George Staebler. George, unfortunately dead now, was for many years Weyerhaeuser’s Chief Forest Researcher. He was one, if not the originator, of proposals for Weyerhaeuser’s high yield forestry which, in a global context, equates to intensive plantation management.

In his 1992 remarks at the celebration of “25 years of high yield forestry”, Staebler said: “We had a period when Timberlands thought that every decision should be made on the basis of return on investment, so many practices were accordingly rejected. My comment is that if Frederick Weyerhaeuser had surrounded himself with a bunch of economists and MBA’s in 1900, he would never have bought 900,000 acres
The importance of vision cannot be overstressed. There are risks in everything we do. Some see risks in everything about plantation forestry: some see little but optimism.

To answer the question that is posed by the title of this paper, I am confident that even though there are risks there are good reasons for confidence that there will be a future wood market for our radiata pine plantations. Furthermore, those opportunities can be enhanced by plantation owners themselves being more proactive.

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References


Investment in Indigenous Forestry

Tim Thorpe

Introduction
The management of New Zealand's indigenous forests has to take account of broader considerations than in plantation forests. It must incorporate a wide spectrum of economic, ecological and social elements. It follows then that this paper reflects this wider perspective in considering where investment should be placed in indigenous forestry management.

The world at large
The amount of destruction that is being carried out to the world’s natural forests provides a useful backdrop against which to place the management of New Zealand's indigenous forests. Between 1980 and 1995 the world's forest cover decreased by approximately 180 million ha, an area about the size of Indonesia or Mexico (FAO, 1997). Some 200 million ha of natural forest was lost in the developing world but around 20 million ha was gained in the developed world through the establishment of new forest plantations. The rate of loss is, however, slowing down. From 1980 to 1995 the rate of natural forest loss changed from 15.5 million hectares per annum to 13.7 million ha per annum over the latter five.

The Food and Agriculture Organisation tips that plantations will play an increasingly important role in national forest programmes in the future (FAO, 1997). However it also notes that in developing countries, which account for the majority of the natural forest estate, the total net plantation estate in 1995 was only 81 million hectares out of a total forest area of 1961 million ha 4.1 percent. The distribution is not equal. Some 80 percent of plantations in the developing world are found in Asia/Oceania, and 40 percent in China alone.

Interestingly FAO note that the proportion of plantations established as large blocks in the tropics as a whole decreased from 40 percent to 35 percent between 1980 and 1990. It is community woodlots, farm forestry and agroforestry which has grown in importance, a similar situation to New Zealand.

Between 1970 and 1994 world consumption of wood expanded by some 36 percent reaching more than 3 400 million cubic metres in 1994. Of this industrial roundwood consumption rose by 15 percent to almost 1 500 million cubic metres. Fuelwood consumption rose however by 60 percent to almost 1 900 million cubic metres. Based on these figures fuelwood accounts for 55 percent of total world wood consumption.

According to FAO rural population growth (directly tied to fuelwood usage) coupled with agricultural expansion and economic development programmes are the major causes of changes in forest cover. They further note that the world's forests and forestry sector are shaped as much by external economic, political, demographic and social trends as they are by forces working within the sector.

Where then should be the best investment in natural forestry in the global context. Population control, increases in agricultural production and improved distribution of food, economic and political reform are all factors that spring to mind. Forestry reform? Yes, sure we have our role to play and it will be obvious to all that the harvesting and other forestry practices of yesteryear cannot be used today. But, all in all, forests are just one small component in a very wide picture.

Indigenous forest cover in New Zealand

Forest database
The story of the decline in New Zealand's indigenous forest cover since the advent of human interference is only too clear. Suffice to say that when the Maori first visited New Zealand in approximately 900 A.D. indigenous forests covered some 20 million hectares in New Zealand. By the time of European settlement around 1800 A.D. about 14 million hectares remained and today the area under indigenous forest in New Zealand is thought to be between 6-9 million ha, usually assumed to be 6.4 million ha. About 24 percent of New Zealand’s total land area of 27 million ha.

6-9 million hectares is a fairly wide estimate to place on the area of our indigenous forests. The vagary of the figure is a consequence of the work that Steve Thomson from the Ministry of Agriculture and Forestry and others are doing to update the area of New Zealand's forests. This work has so far shown, using modern satellite and computer technology, that the original 1950s estimate of tall forest-