

claims near where anything is happening. There are no concessions at all to public interest. I spent a night in a large roadside picnic area dating from Forest Service days. The only sign in it is by a tree planted to commemorate an accident victim. Opposite was a very large area of clearfelling and an extremely messy road verge: presumably both cutover and picnic ground are in the same ownership, but no acknowledgement, no explanations. This simply is not good enough.

So what can be done about it? Andrew Ezell made some suggestions last year at many meetings of Institute sections, and his views are summarised in the November issue of our journal. They may be further summarised as "if you don't want to be king-hit, don't lead with your chin".

He argues, convincingly, that, as in the USA before us, foresters have arrived at a fork in the road. Either we take the clear open road, doing what we are doing now but soon tangled in regulation, confrontation and restriction, or we take the more overgrown and uncertain path of discussion and reconciliation of difference before grievance arises. The choice is ours and our past experience should tell us

which road will lead us where we want to go.

If that is not clear enough, he cites two cases in his home country – the Pacific north west and Oregon where confrontational policies of business as usual have resulted in a great reduction of the forest industry, and the south east where cooperative policies of explanation and discussion have had the opposite result.

I have spent the past year in England and often went walking in Forestry Commission plantations there. These are a large part of the accessible public estate land and very popular for all sorts of recreational activities.

But they are also production forests with a dark host of treasury discounters at their heels. Production, both clearfelling and thinning, goes on in the midst of recreation and is not much remarked upon. That acceptance has not come lightly. Every operation, every deviation or closure of a track, has an explanatory sign where you hit it. The operation is explained, alternative routes pointed out, and all is signed by a named officer, together with address and telephone numbers.

This cooperation with the public has borne wider fruit: a government policy to sell off the Forestry Commission was abandoned earlier this year (1994) in the face of strong protest by recreational organisations. I do not know if that decision was good for forestry in the UK, but members of the Commission certainly think so, and it is certainly the result of their efforts to sit well with their neighbours.

Ironically, while our pot simmers, there are mutterings of discontent in corners of the forest industry, that the Resource Management Act constrains certainty, that under it no man knows if he may reap what he has sown.

Setting aside the doubt that certainty has ever existed in this context, the quickest way to remove it in forestry is to carry on as some in the industry seem to be doing, inviting regulation by their disregard of public opinion. Thus do they make the fear self-fulfilling, when in fact the Act offers the choice of roads and destinations that Ezell describes.

The choice is ours.

The sustainability paradox – an examination of *The Plantation Effect* – a review of the environmental effects of plantation forestry in New Zealand

Colin O'Loughlin*

Introduction

A recently published book on management principles outlined how the author's seven-year-old daughter surprised her father after a morning church service when she asked: "What if God is a mouse?" No matter what seemingly logical arguments he put up to refute such a possibility, the young girl, with innocence and enthusiasm on her side, successfully countered with equally logical arguments supporting the possibility that God might indeed be a mouse. After reading Rosoman's review *The Plantation Effect* I was struck by the similarities in the approaches adopted by the author of this review and the young girl. Both assembled their arguments in a logical fashion, both were very selective in the way they used evidence to support their viewpoints and both were

inclined to disregard knowledge which tended to work against their contentions. Furthermore, the focus of the young girl's attentions (the nature of God) and the focus of the Greenpeace review (sustainability) have some commonality – both are difficult to define in quantitative terms. In this comment on *The Plantation Effect* I attempt to provide a view of the ecological and other benefits and disadvantages of the radiata pine forest industry, focussing on those areas where the body of evidence from research and accumulated knowledge and Rosoman's views diverge.

Plantations and Soils

In debates about forest land-use sustainability and what should be sustained, it seems to me that maintaining and protecting the quality and integrity of the soil mantle should be accorded the highest priority. The general implication in Rosoman's commentary is that the forest

plantation industry is not sustainable, partly because radiata pine forests and forest activities degrade the soil. Rosoman recognises the importance of soil organic matter in storing and supplying water and nutrients and maintaining soil structure and porosity. He implies that organic matter disturbance by a range of forestry practices (root-raking, windrowing, burning etc), the relatively slow decomposition rates and acidic nature of pine litter compared to other forest litter types, the large reliance of the plantation industry on petrochemical fertilisers, the influence of acid soil conditions and of fertilisers on soil fauna and flora and the removal of nutrients in tree biomass at harvesting time, will degrade soil quality and lead to a decline in soil productivity. Rosoman refers to a number of research papers to substantiate his rather pessimistic viewpoint. Some of Rosoman's claims are at least partly supported by research results; others are more dubious. Overall, his com-

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mentary is frustrating because he leaves no room for the possibility that plantations can be managed to protect soil productivity over the long term.

Although detailed studies of the influences of intensively managed radiata pine forests have not been carried out over more than one rotation and harvesting cycle, there is sufficient scientific evidence to suggest that pine forests can either degrade soil quality where they deplete soil nutrients and improve soils where they increase the availability of nutrients (Smith 1994). The most significant threats to pine plantation soils are the removal of nutrients in tree biomass at harvest time and the disturbance and compaction of the topsoil and its loss via erosion during harvesting and in the first few years following harvesting when clear-felled sites are least resistant to erosion. There is some evidence that soil pH tends to decline under radiata pine (Hawke and O'Connor 1993) but the implications of this trend for long-term soil productivity are yet to be elucidated.

The soil classifications provided by Hunter *et al* (1988 and 1991) reinforce what has long been suspected; that the potential for soil degradation due to pine plantation management and particularly harvesting, varies substantially from soil type to soil type. As explained by Smith (1994), they hypothesise that soils with low availability of a particular nutrient are more likely to reveal growth decline after successive rotations due to a deficiency in that nutrient than soils with greater nutrient supplies. They also hypothesise that nitrogen depletion is more serious than depletion of other nutrients. According to their classification system, loamy soils rich in organic matter and with good availability of nitrogen and other elements such as potassium, that were previously covered in native forest and receiving adequate rainfall, are least likely to suffer loss of productivity due to nutrient loss. On the other hand, soils with low natural fertility are more likely to show nutrient deficiencies and nutrient imbalances after several rotations of fast-growing radiata pine. However, New Zealand studies of the influence of tree growth on low fertility sites on sand dunes (Smith *et al* in Smith 1994) and on South Island montane soils (Davis and Lang 1992) have indicated increased soil quality under planted conifers.

Although the understanding about the long-term influences of pine plantations on soils is incomplete and fragmentary, the information that is available suggests that the intensive management of short-rotation (25-30 years) radiata pine crops through a number of successive rotations should be possible without serious loss of

soil quality if management practices are geared to take into account protection of the soil and retention of the soil organic matter content. Use of low-impact harvesting methods which do not seriously disturb the soil mantle, avoiding the burning of clearfelled sites, the retention of tree foliage and branches on site and the establishment of inter-rotational grass and legume crops on low fertility soils are some of the more important approaches to plantation management that will be required in future to help circumvent declines in productivity.

Assuming that branches and foliage are left behind in the forest, Maclaren (in press) has calculated that harvesting of a mature stand of radiata pine (370 oven dry tonnes of wood and bark) removes the following elements once per rotation:

Element	Kg/ha
Nitrogen	217
Phosphorus	31
Potassium	286
Calcium	221
Magnesium	67

Maclaren also expresses these removals in terms of equivalent annual removals and compares them with average annual removals associated with other land uses.

Annual Nutrient Removal in Products (kg/ha)

Product	Productivity	Element			
		N	P	K	S
Milk	2.4 cows / ha	29.8	5.4	6.3	2.2
Meat & Wool	10.6 s.u. / ha	12.4	1.6	2.6	2.1
Wood	n/a	7.5	1.1	9.9	0.0

These data suggest that the management of plantation forests over the longer term is less demanding on the soil nutrient store than other intensive forms of land use.

Over the last decade improved forest management practices, underpinned by modern planning techniques and research, have substantially reduced the impacts of plantation management on soil quality. There is a growing belief among forest managers and researchers that, on most sites where extensive plantations exist or are planned for the future, pine forests can be managed through successive rotations without loss of soil quality. Probably the largest risks to soil quality are on the steeper northern and eastern North Island hill country where periodic cyclonic storms, clay rich soils, and steep slopes combine to make soils, unprotected by substantial forest cover, susceptible to mass wasting and surface erosion. The susceptible period is from the onset of harvesting until substantial new reinforcing

root networks and protective forest canopies have developed about seven or eight years after replanting of clearfelled areas (O'Loughlin in press). On some of the most unstable steepplands, particularly in the East Cape region, there is a good case for managing plantations on a relatively long-rotation (maybe 40 years or more) basis.

Plantations and Water Quality

Rosoman provides a distinctly negative view about the impacts of plantation management on water quality. He correctly indicates that water quality of streams draining maturing plantations is generally high and comparable with stream water quality in indigenous forest areas, but his main emphasis is on the damaging effects of plantation management to water quality. There is no disputing that some past plantation forest practices have been very damaging to water quality. Poor harvesting and forest road-building practices in particular have contributed to severe siltation in streams and serious degrading of physical stream water quality (Hoare and Rowe 1992, O'Loughlin 1994). However, in broad terms, the plantation forest industry has had only a relatively small part to play in the overall decline in the water quality standards in New Zealand compared to other land uses such as pastoral-

ism, partly because the impacts on forest land are mainly related to increased rates of soil delivery to streams during the harvesting phase. The impacts of harvesting on water quality, although sometimes severe, are generally shortlived and throughout most of the term of the forest rotation water quality is usually protected by the forest cover.

Furthermore, the total extent of forest harvesting which causes water quality problems (steep hill country, unstable soils, poor harvesting and road-building operations) in any one year is very localised and probably restricted to less than 5 per cent of the total annual harvest area of about 20,000 hectares.

Over recent years the influence of the Resource Management Act (RMA), improved knowledge about the relationships between forest management and water quality, access to new technologies (low impact harvesting systems, GIS, modern harvest planning tools), and a generally more environmentally responsible

approach to forest operations than in the past, have combined to vastly improve forest management operations and reduce hydrological impacts. Further improvements in this respect will depend on special and careful management of riparian areas and other sensitive valley bottom sites and unstable hill slope areas. I would expect that within the next two decades it should be possible to manage plantation forests so that water quality is protected throughout the full rotation except perhaps when, on infrequent occasions, exceptional storms coincide with or immediately follow harvesting activities in steep hill-country plantation forests.

Plantations and Biodiversity

Rosoman is very critical of the influence of forest plantations on biodiversity. He supports the notion that plantations are uniform, monotonous and are a threat to biodiversity, conservation and sustainability. More specifically, Rosoman suggests that New Zealand plantations are poor habitats for native birds and lack species with specific requirements such as birds which feed on nectar and honey, species which depend on dead wood, epiphytes and creepers and vines. Furthermore, he indicates that some plantation tree species in New Zealand are aggressive pioneers which invade and fragment and displace native plant communities,

thereby reducing biodiversity in ecosystems adjacent to plantations. The overall picture painted by Rosoman is that pine plantations are "blots on the landscape", biological deserts with no ecological merits, and a threat to the ecological integrity of neighbouring ecosystems.

Although there are elements of truth running through most of the claims presented by Rosoman, a more balanced appraisal of the relationship between New Zealand's forest plantations and biodiversity reveals that plantations are often biologically diverse and substantially more diverse than other introduced ecosystems such as agricultural crops and pasture and may be comparable with some indigenous ecosystems such as manuka stands and high-altitude mountain beech forests.

Allen *et al* (1994) have shown that second and third rotation radiata pine plantations can support a diverse range of indigenous species. Although their study focussed on vascular plants and did not consider soil organisms, insects and birds, the evidence strongly suggests that plantations are not "biological deserts". Rather than comparing the biodiversity of plantations with the biodiversity of indigenous forest ecosystems, it might be more appropriate to compare plantations with pasture land and shrubland. It is on these types of land that the bulk of new plantations are being established.

There is little argument that exotic conifers have a propensity to regenerate and spread aggressively onto some types of landscapes and Rosoman correctly identifies the natural spread of conifers on the North Island's central plateau and in the eastern South Island high country as a land-use problem. However, there are approaches and techniques to deal with existing tree wilding spread and enable future problems to be avoided (Ledgard and Crozier 1991, Delamore 1994). The careful selection of species and of planting patterns of species, avoiding the establishment of trees on sites favouring the wide dispersal of tree seed (take off points) and the application of special conditions in consents to ensure adequate management of wilding spread are some of the approaches that should be implemented in future.

Plantations and Landscape Values

Rosoman is critical of the effects of plantations on landscape values; he claims they create homogeneous landscapes and that many people find pine plantations monotonous and visually unappealing. Although I do not have the same views, I appreciate that many people do consider pine plantations to be visually unattractive. The foresters of yesteryear could be legitimately criticised for not enhancing the visual attractiveness of their forests by



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planting roadside and plantation edge belts of attractive tree species and adopting some of the forest landscape design approaches highlighted by Ministry of Forestry (1994), Anstey *et al* (1982) and Lucas (1992). In future, I imagine there will be a good deal of public and local government pressure on plantation forest owners to improve the visual and aesthetic attributes of their forests along with recreational opportunities.

Rosoman specifically refers to the serious implications for landscape values of plans for afforestation in the Mackenzie Basin. My view on this is that properly located forest plantations that are well integrated into the broader landscape will not only enhance the visual appeal of the Mackenzie Basin but will also help protect a rapidly declining soil resource, possibly help reduce the incidence of heavy infestations of *Hieracium* sp. and rabbits in the longer term and increase the long-term productivity and the economic returns from the land, especially in areas with more than 500 mm rainfall per year. The very dry areas where soil degradation is most advanced provide difficult conditions for tree establishment and growth. In these areas commercial forestry will be severely constrained by lack of water but there may be opportunities for carefully-planned dryland conservation forestry.

Plantations and Risks

Rosoman strongly contends that lack of biological diversity causes conifer plantations to be inherently vulnerable to pests and diseases but concedes that temperate plantations are much less susceptible than plantations in tropical regions. If New Zealand's forest managers held similar views to Rosoman's about the vulnerability of monoculture plantations to fire, disease and insects, there would be a much smaller estate of radiata pine than the present estate and the current surge of private

plantings would be non-existent. Nevertheless, the forest industry and the sector at large are conscious that the huge investment in one species is accompanied by a level of risk that requires careful management.

Recent evaluations of the risks to the health of New Zealand's plantation forests provide more optimistic outlooks than that provided by Rosoman. Over the last 60 years radiata pine plantations have been influenced by a number of damaging diseases (*Sirex-Amylostereum*, *Dothistroma*, *Armillaria*, *Cyclaneusma* needle cast, *Sphaeropsis* die-back), but their impacts were not devastating, as they could be either controlled or the level of damages were considered to be acceptable (Chou 1991). Chou indicates that the removal of a large proportion of the stand biomass before age 10 to 12 years raised the acceptable level of disease loss and the practice of clearfelling and short rotations reduces the disease risk common in other forest systems. New Zealand's geographic isolation may also help reduce the incidence of airborne diseases and damaging insect attacks. In an earlier appraisal of the safety of monocultural plantations Bain (1981) pointed out that outbreaks of pests in artificially established stands are no more common than they are in natural forests and indicated that the management of pests is more easily facilitated in even-aged plantations.

Handiside (1994), in his review of plantation forest protection, concludes that New Zealand's radiata pine plantations are free from major pests and diseases and are vigorous, healthy and very fast-growing by overseas standards. He does not expect this situation to change in the foreseeable future.

The recent publicity about the threats to New Zealand's forests presented by the voracious Asian Gypsy Moth (AGM) highlighted the probability that a great

range of forest types including indigenous forest types would be susceptible to damage if this insect established itself in New Zealand. Overseas the AGM has a very wide host range (Bain 1993) and has been recorded from about 600 species of plants. Although it is not known what the varying resistance among our indigenous and exotic trees might be to defoliation by AGM, the likelihood that a great range of tree species would be susceptible to attack seemed to escape the considerations of Rosoman. In the light of the risks as perceived by Greenpeace, he makes a strong plea to safeguard our forest resources by planting alternative species, especially indigenous species, apparently "instead of" rather than "in addition to" radiata pine.

Plantations of indigenous tree species will probably have a place in the forest industry of the future but, at least over the foreseeable future, I don't envisage that planted indigenous forests will be established over large areas for industrial purposes.

Rosoman's focus on the vulnerability of monoculture plantations to disease and insect attack disregards the protection of forest health provided by the forest surveillance and border protection systems that have been put in place. These are comprehensively described by Handiside (1994). The Ministry of Forestry, the forest industry and NZFRI work closely together to ensure that New Zealand has one of the most efficient and effective border protection services and forest health surveillance systems in the world. Nevertheless, Carter (1989) determined that the systems do not prevent the entry of small numbers of new forest insects and fungi and their establishment in forests and the level of tolerable risk has to be balanced against the considerable costs of surveillance and border protection.

The elevation of risks to plantations associated with possible future climate changes (warmer temperatures, increased storminess, increased rainfall, decreased rainfall) are accorded a good deal of attention by Rosoman. A mediaeval soothsayer could not conjure up a gloomier forecast. Any significant change in climate could conceivably bestow advantages (faster growth rates, extended range for certain species) and disadvantages (increased storm damage, increased disease risk) upon the plantation estate but, with the current understanding of climate forcing factors and processes and current level of development of climate models, we can only speculate about the nature of the future climate. Amongst climatologists there is growing confidence that future climates will be warmer, which could have more serious implications for some indigenous forest species with rather spe-

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cific requirements than radiata pine which is very adaptable and resilient. Rosoman seizes on a possible future increase in storminess to justify replanting kauri forests in Northland. My understanding is that kauri might be one of the tree species at risk in northern New Zealand if mean annual temperatures increase by more than 3°C.

In summary, the gloomy risk forecast for radiata pine plantations provided by Rosoman is not supported by fact. The health of New Zealand's plantations is not in a state of serious decline and the prognosis is that plantation health will remain in good condition into the next century. Ironically, it is some of the indigenous forest communities and not the plantation forests that are in a poor state of health and at most risk from pests and disease. For instance, the montane mixed hardwood forests dominated by rata (*Metrosideros umbellata* and *M. robusta*) and kamahi (*Weinmannia racemosa*) in parts of the North Island axial ranges and in central Westland face a rather uncertain future (Taylor 1994). The influence of possums and other factors on the health of these indigenous forests are reported by Veblen and Stewart (1982) and Payton (1990). It could be argued that there is little point in attempting to artificially estab-

lish fragile indigenous forest species susceptible to browse and die back until possums and other browsing animals are eliminated or permanently reduced to very low densities.

Plantations and the Economy

The most unpalatable aspect of Rosoman's review was the total disregard of the economic and social benefits that the plantation forest industry produces for New Zealand. Currently, the growing, harvesting, processing and marketing of wood and wood products employs about 24,000 people, earns more than \$NZ 2.5 billion in foreign exchange and contributes more than 6% of GDP. Furthermore, the modern surge in new plantings of radiata pine, mainly on pastoral land, provides a carbon sink which will help New Zealand achieve its commitment to reduce net CO₂ emissions by the year 2000 to 1990 levels. The rapid growth in the forest industry is hailed as a great success that plays an important part in New Zealand's improving economy. The success is built on more than 70 years of experience in growing plantations of mainly radiata pine and more than 40 years of field trials and detailed research covering all aspects of establishment, growing, harvesting, processing and mar-

keting. The value of the plantation estate is estimated to be more than \$NZ 10 billion. The profitability of the plantation industry is largely attributed to the fact that it is mainly based on one species that can be manipulated silviculturally, genetically and during wood processing to meet the needs of domestic and overseas markets.

Implementation of Rosoman's strong recommendation to adopt the 15 Greenpeace policies outlined in *The Plantation Effect* which include at least a 20% native forest species component and at least a 20% mixed exotic species component in annual plantings, restricting the size of harvested areas to "small coupes" and lengthening the rotation for exotic plantations, would substantially lower the long-term profitability of forestry in New Zealand and preclude any possibility that timber exports would grow to be New Zealand's number one foreign exchange earner within the next five decades. Adopting such policies would also produce a forest cover that would be much more at risk from pests and diseases than radiata pine plantations. A forestry industry based on mixed exotic and indigenous species plantations would be a high-cost, low-return industry that could only be sustained if it was heavily subsidised by Gov-



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There is a good deal of evidence that a prosperous, growing economy provides many environmental benefits. Similarly, prosperous, growing industries also provide environmental benefits. The forest industry can afford the additional costs of protecting the environment and, over the last decade, the industry has managed its plantations and many of its wood-processing plants in a way which takes the protection of the environment into account. The industry is not perfect in an environmental and ecological sense but, backed by a world-renowned forest and wood-process research facility, the industry is becoming more sophisticated, technically competent and environmentally aware as it expands its contribution to the national economy and strives to ensure it remains environmentally and ecologically sustainable. To assist the forest industry to meet the sustainability goals a set of criteria is required against which the performance of the forest industry can be judged. Furthermore, there is a need for a sound and comprehensive forestry sustainability/environmental policy which clearly outlines the requirements of Government with respect to forestry and protection of the environment.

To return to the little girl saga in the introduction, her claims about the nature of God and Rosoman's claims about the unsustainability of New Zealand's forest industry do differ in one vital respect. There is little sound evidence to refute the girl's claims but Rosoman's unsustainability claims are full of more holes than the cheese the little girl intended to put on the church collection plate.

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Ecoforestry – towards a responsible plantation industry

Grant Rosoman*

Introduction

The language of sustainability is seductive. It has become the oil of any debate over the use of natural resources. The plantation industry has been quick to adopt the language of sustainability to provide itself with a wholesale green endorsement. Examples include Shirley (1992), *Forestry Insights* (1994), and by nearly half the key industry people asked to comment in a forest industry magazine (*NZ Forest Industries* 1994). Yet where in the industry's rhetoric is the justification, a definition of what standards are being met, and the monitoring and auditing which go with it? In Greenpeace's review *The Plantation Effect* (Rosoman 1994), we sought to examine this suspicious 'greenwash', focusing on the environmental effects using a life-cycle analysis of the large-scale monoculture plantation industry.

The intention of the review was to stimulate debate. We did not intend to

offer a full comparison of the plantation industry with other primary industries. Furthermore, the review clearly states in both the subtitle and the introduction that economic and social aspects were not included. In this issue of *NZ Forestry*, Colin O'Loughlin bases much of his case against *The Plantation Effect* on the basis that it is "very selective". The scope and environmental focus of the Greenpeace review was clear. You will read in this issue of *NZ Forestry* how O'Loughlin selectively chooses information to back his case.

We also make the point that *The Plantation Effect* sought to offer positive solutions as a path towards ecoforestry. Greenpeace desperately wants trees and forests planted, but in a way that maintains and restores ecosystems, and recognises the multitude of values that go with forests. Greenpeace believes that land users have responsibilities as stewards of the land, and that this goes far beyond the simple maximisation of short-term profit. The plantation industry has itself chosen to apply the broad brush of sustainability

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