utilisation of coniferous and eucalypt plantations, and which presents much technical information which will be of interest to New Zealand readers, especially with respect to the management of eucalypts;

LAND AND IMPACTS, which covers the availability of land for forest plantations, the lack of information upon which social impact can be predicted, landscape considerations, and the need to be concerned for populations of rare and endangered fauna;

PRIVATE PLANTATIONS, which covers the contribution of non-industrial forest growers, the adequacy of incentives to support their efforts, and the general lack of interest in tree plantations on farms in spite of potential benefits;

RESOLVING THE CONFLICTS, which covers the intense community opposition to the planned expansion of plantations in Victoria, and approaches to the resolution of this conflict, and which covers the successful use of mediation in environmental disputes in USA.

This set of conference papers is valuable as a comprehensive record of Australian plantation experience, and as an expression of its forestry sector's attitudes and aspirations at one point during a period of significant change.

The conference was held shortly after the Wesley Vale pulpmill project in Tasmania was abandoned by the NBH-Norander joint venture. This had demonstrated the strength of the environmental movement's political influence on both State and Federal Governments. The pulp and paper industry was facing increasing environmental constraints and bureaucratic procedures at a time of boom in world markets, which was stimulating investment in new plantations and manufacturing capacity elsewhere in the world. This optimism in the pulp and paper industry was possibly the catalyst for the awakening of interest in the eucalypts as plantation crops. The enthusiasm and optimism of researchers in the eucalypt programmes is apparent in several of the conference papers.

But investment in plantations in Australia has been even more dominated by the taxpayer than in New Zealand (the area of State owned plantations made up 70% of the Australian total in 1987), and the expected return on investment in new plantations is substantially lower for sawlog crops (3 to 4% v 10+% real before tax). It is implicit in both the FAFIC and the ACF "major" plantation proposals that the taxpayer will again be expected to be the dominant source of funding for these expansion projects. While the influence of the cost of capital is raised in a few papers, there is little evidence of concern that the changes then occurring in New Zealand, and in fact reported by Evans at the conference, would shortly be affecting the forestry sector in Australia. The increasing cost of debt, and an increasing lack of confidence in the efficiency of government businesses, is now apparently also influencing some of the Australian State Governments to seek to withdraw public support for afforestation and to consider privatisation of their forestry businesses.

The conference papers therefore reflect the state of a sector at the end of a long period of public investment in afforestation. The set of statistics attached as an appendix in the book demonstrate the remarkably steady increase in the rate of afforestation in Australia since the mid 1960s. In spite of all the debate and soul searching that has surrounded the Australian involvement in plantation forestry, State foresters have clearly been remarkably successful at not letting it affect their planting programmes, until now that is.

D.A. Elliott

Evaluating resource use in the NZ Regional Economy : IMPLAN

Dr Patrick Aldwell*

The Forest Reseach Institute has recently acquired IMPLAN (IMpact Analysis for PLANing), a PC-based input-output program produced by the United States Forest Service. This program is widely used for evaluating impacts of resource-based industries. It was used extensively in the Northern Spotted Owl issue in the Pacific Northwest.

IMPLAN is currently structured according to inter-industry and inter-regional trade relationships in the United States. The objective at FRI is to strip the model of its US content and replace it with New Zealand content before conducting a series of validation and updating trials. This costly and time-consuming process is expected to take three to five years. However, it is hoped to have a demonstration version available in about two years.

A useful feature of the model is that it will show inter-industry transactions at the sub-national level. Once modified, the New Zealand version will have many applications. These include:

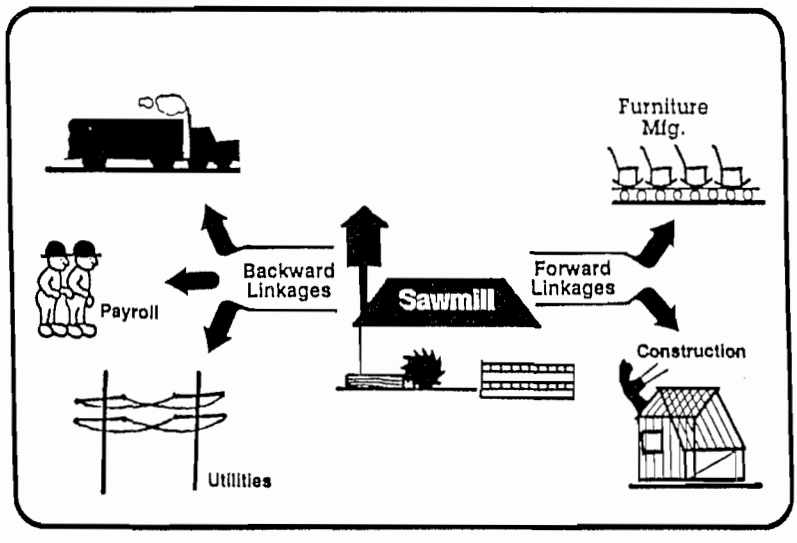
(i) **Industrial market studies:** Identification of potential markets – by industry and by region.

(ii) **Economic impact assessment:** Estimation of changes in regional income, employment and total value-added associated with changes in industry composition, final demand and resource use.

(iii) **Strategic planning for venture capital financing:** Identifying sensitive businesses, product cycle bottlenecks and competitive position.

(iv) **Natural resource policy analysis:** Analysing the impacts of resource and planning policies on industries, communities, and employment.

IMPLAN has been designed to incorporate user-supplied data at each stage of the model building and application process. Thus, the initial data supplied in



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the model is the starting point. Superior data based on local knowledge plays an important role in improving the accuracy of model applications.

From any one run of the model up to 40 reports can be produced. These include reports on market share, trade and investment, consumption and demand, income and employment multipliers, value added multipliers, and a variety of impact reports.

IMPLAN uses input-output transaction tables which show the interdependence of all industry categories in terms of how much every industry buys from and sells to every other industry. Because the NZ version of IMPLAN is being regionalised it will be of particular value for analysing changes in the forestry sector. This is because regions such as the Bay of Plenty, which have a strongly integrated forestry based economy, can be used as a basis for estimating the development requirements of the "new" forestry regions. For example, firms not yet present in Northland or Otago can use IMPLAN to assist them in identifying opportunities in these regions once the wood supply increases.

The modification programme is being developed by Dr Patrick Aldwell at FRI and Dr Jeff Weber of the Agricultural Economics and Business Department at Massey University. IMPLAN's value is that it will greatly reduce the time needed to conduct impact analyses and it will facilitate responses to "what if" questions associated with industrial activity.

Advances in forest biotechnology – an update

Colin O'Loughlin,[1] Peter Carter[2] and Michael Menzies[3]

Modern biotechnology research is increasingly opening doors of understanding to a vast array of complex biological problems. The application of new technologies such as micropropagation, cryogenic storage, protoplast fusion, gene mapping and establishment of gene libraries, gene transfer and DNA manipulation, are unfolding opportunities to understand the genetic structure of forest trees and populations, identify the key factors in responses of forest trees to environmental stress and define linkages between genetic markers and important traits allowing accelerated selection and breeding. Furthermore, these technologies make possible the use of genetic material not currently in the natural breeding population of forest species, including genetic material from other plants, bacteria, viruses and animals, to confer increased resistance to diseases, pests and toxic chemicals as well as the ability to detoxify pollutants and respond to environmental stresses.

Recent visits to a range of Canadian and USA biotechnology laboratories and one private biotechnology company (Promega) provided an improved appreciation of the range of opportunities that biotechnology offers, particularly for application to conifers such as radiata pine in New Zealand. It also provided information about where biotechnology could play a role in the future development of the wood processing industry.

Based on what was learnt during these visits to biotechnology laboratories and knowledge of forest biotechnology progress in New Zealand, the following conclusions are drawn about the potential opportunities that biotechnology developments provide, especially for New Zealand's forest industry.

1. Molecular biology programmes involving gene mapping and genetic engineering are now important forestry research programmes in Canada and USA. However, this work is very costly, requires highly skilled biologists, biochemists and other technical people, is usually long-term and is high risk from the viewpoint of providing early applicable results. Nevertheless, there have been a number of successes.
2. To be successful, a molecular biology research programme must be integrated with a sound forest genetics programme. In this respect New Zealand's long-established radiata pine forest genetics programme at the Forest Research Institute (FRI) provides a sound basis for a radiata pine molecular biology programme.
3. The requirements for forest genetic engineering are:
   - a micropropagation system to regenerate plants
   - a gene(s) of interest
   - a gene transfer system, e.g. using bacteria, microinjection or ballistic gun or other techniques
   - gene control mechanisms or promoters.

   Many laboratories are only working on one or two of these aspects. Gene transfer technology is developing rapidly. For conifers, it appears that ballistic guns or other bombardment techniques which transfer DNA material into target tissues or individual cells of meristematic tissue, embryonic tissue or cotyledons, offer the greatest promise for engineering transgenic or transformed plant material. Generally, the lack of effective micropropagation methods has restricted work with conifers but it is in this area that New Zealand is strong. However, the most significant obstacle to advancing the application of molecular biology/genetic engineering in forestry is the lack of understanding about the basis of gene expression. Gene mapping and the isolation of genes controlling selected traits is complex and expensive.
4. In forest genetic engineering research the most economically useful developments to date involve genes that impart increased resistance to herbicides and insect damage. Over the next decade we expect that most progress in molecular biology studies with radiata pine will be made in increasing herbicide tolerance and raising resistance to *Dothistroma pini*. A joint DSIR-FRI molecular biology programme aimed at increasing radiata pine resistance to *Dothistroma pini* has already been initiated. Increasing wood production in radiata pine through gene manipulation is probably many years away but is certainly not beyond the realms of possibility within the next two decades. Male sterility is another useful target, both for increasing productivity and also preventing pollen flow from genetically modified trees.
5. The application of biotechnology in the wood processing industry holds great potential. For instance, in the USA biotechnology research is expected to provide a cost-effective treatment process for effluents from kraft-process pulp mills using fungal pellets, a treatment for reducing levels of pentachlorophenol in landfills using woodchips inoculated with bio-organisms, a bio-pulping technique based on lignin-degrading fungi and an improved pulp bleaching process using bio-organisms. The application of such developments in New Zealand is probably several years away.
6. One of the problems hindering the commercial development and use of genetically-engineered forest and agricultural plants in the USA and Canada is the lack of comprehensive rules or legislation for marketing and testing genetically modified organisms. This has led to limited testing of genetically-altered plants outside

(Continued on page 28)

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