reinforced by recent political trends, including the science reforms, largely engineered by the accountancy and economic religions, and without much understanding of the synergies of integrated systems. Integrated systems are bad news for bean-counters because the discrete little boxes start to disappear.

Integration is to some extent the opposite of reductionism. At its most integrated is the GAIA hypothesis, which suggests that the whole planet is a web of interrelationships, perhaps even an organism itself! But integration may be reliant upon reductionism in the first instance to provide its basis, suggesting that reductionism is a necessary prerequisite. Alvin Toffler, in his book "The Third Wave", seems to think so, believing that the world is trending from reductionism to integration in management and other systems. If that is really the case someone had better tell the forestry and science communities.

Some Specific Examples

It is not entirely fair to pick on one part of the science community, particularly when the argument is speculative and based on suspicion rather than hard evidence. That being said, research into genetic gains does provide an obvious target, some would say a tall poppy.

The genetic gain in every trait must adhere to the law of diminishing returns. That cannot be doubted. Whether research on a trait is worthwhile relates to where that trait currently sits on that curve, as this will determine whether returns are accelerating or diminishing.

Here there is disagreement. Those considering only the trait itself (for instance wood growth) may claim continuing exponential gains. However, if the whole integrated system is considered, including such things as marketability, practical environmental constraints, management risk, susceptibility to pests and diseases and so on, then the position of the trait on the law of diminishing returns curve must be placed differently, possibly even at a point where the gains match the losses to some other part of the system.

The problem will always be that many of these other parts of the system are intangible, and without clearly understood linkages. Therefore it comes down to whom you believe. Who ever said there is no art in science.

Risks and Decision Making

This is not the first time these editorials have argued against the simplistic and rigid application to decision criteria such as the internal rates of return (IRR). But it has to be said that one of the main culprits in this intensification trend is the use of such decision criteria. In desiring higher and higher IRRs, shorter rotations and greater productivity will always appear desirable. This is the production mentality apparent in our habit of allowing such decision criteria to **set** our strategies, instead of using them as tools for fine tuning **within** a strategy. A net present value or internal rate of return cannot give a marketing perspective and works against the innovator and entrepreneur, who use intuition as much as calculation.

The danger in following the IRR nose is that there is no judgement about the added risks and uncertainties that eventuate from such pressures to produce the "fustest with the mostest", to use a military analogy. It could well be that any additional gain in IRR is more than offset by gains in the premium for risk. A stand that yields 500 cubic metres per hectare on a rotation length of 18 years at an IRR of 15% real may actually be an inferior investment to the more conservative regimes in operation today when risk is taken into account. Taking an opposite tack, I am not totally convinced that our current regimes are superior to those of the past, nor that Douglas fir at 60 years isn't a superior investment, at least for a proportion of an estate.

Perhaps our approach to risk in New Zealand forestry is what most needs developing. We hardly ever hear of the application of concepts like portfolio theory or option value theory, yet they must have some application in diversifying species, regimes, forest locations and markets.

I am sure a more sophisticated approach to risk would necessitate a questioning of some of the trends in forestry and forest research. Many do not believe that more intensive management is necessarily better management. Nor is establishing isolated ivory towers within the walls of competitive ivory towers (read CRIs) necessarily a better means of managing research, irrespective of the personal satisfaction gained by accountants and economists.

I await the return salvo with anticipation.

Chris Perley

The Stratford power station decision

Simon Upton's decision to grant an emission permit for ECNZ's proposed power station with the proviso that the CO_2 emissions are fully mitigated has some interesting implications for the forest industry. In the case of the proposed Stratford gas-fired power station, the Minister ruled in March 1995 that the power station owner would have to offset emissions by either planting sufficient trees to absorb the carbon emissions (in this case about 4000 ha of plantation) or through arrangements with other businesses which would see the operators of Stratford power station receive credit for reductions in emissions from these other businesses.

Several commentators have correctly pointed out that contracting of forests by power companies to plant trees will amount to the consumers of electricity subsidising the forest industry's tree-planting activities. The establishment of "offset" plantations would probably benefit both the power companies and the forest industry through the sale of wood, but would do little to help provide electricity at a low cost to consumers.

At best, the planting of trees to mitigate CO_2 emissions will provide only a short-to-medium-term solution to reducing net emissions. A "one off" planting project will only provide benefits for perhaps 40 years. There will be a need to replant logged sites after harvesting if the mitigation is to be sustained. There will also be a need to extend the area of planting with time to balance the additional emissions associated with harvesting, transport and processing of wood. This is particularly important because CO_2 has a lifetime of 60 to 90 years in the atmosphere.

If New Zealand's energy (CO_2 emission management) policy is going to include the use of "carbon storage plantations" and the implementation of tradeable forestry carbon storage credits, then there may be a strong case in the future for developing plantations which maximise the rate of carbon immobilisation, the total amount of carbon stored and the total storage time. Such plantations would need to be managed differently and possibly consist of different species from the modern commercial radiata pine plantations which are designed to maximise wood product value. There is little doubt that if forestry carbon credits do become a reality, then the value of forest plantations will increase.

Although some research has been completed, there remains a need to accurately quantify the carbon stores and emissions provided by various types of forest plantations (including the soils) from the time of site preparation for planting through planting, forest growing, harvesting, wood processing and wood and paper product use. Over the longer term extending through a number of rotations, fast-growing, short-rotation plantations and their wood products may be less effective as immobilisers of carbon than assumed by some policy makers.

Simon Upton's decision also poses an interesting divergence away from the policy of voluntary reductions of industrial emissions. This may lead to the removal of the control of CO_2 emissions from the Resource Management Act.

Colin O'Loughlin

Alternative species revisited: categorisation and issues for strategy and research

R.D. Burdon and J.T. Miller[1]

Abstract

For the issue of alternative species to Pinus radiata in New Zealand to be addressed satisfactorily, the various purposes that such species might serve must be properly defined. Accordingly, three main categories of plantation-forestry species are proposed, on the basis of their purposes: (1) ***Special-purpose species****, to occupy utilisation niches for which P. radiata is not well suited; these cover a spectrum ranging from very high-value timbers to fuelwood or special-purpose industrial wood such as short-fibre pulpwood; (2)* ***Extreme-site species****, which can perform satisfactorily on sites that are unsuitable for P. radiata; and (3)* ***Contingency species****, which might replace P. radiata should it encounter serious problems within its existing range. Various species of interest are reviewed briefly in relation to this categorisation, to illustrate the conceptual approach, rather than to attempt full or definitive coverage. Some species belong in more than one category, notably Douglas fir (Pseudotsuga menziesii) in all three. Disturbingly, there appear to be large areas particularly in the north of the country for which the first-choice contingency species are not clearly identified, let alone adequately researched or preparations made for their being needed. In some 'extreme-site' species appropriate provenances for such sites remain unconfirmed.*

Introduction

The issue of plantation forestry species that are alternatives to *Pinus radiata* is topical. There is now a surge of international concern over biodiversity, which, with the signing of the International Convention on Biodiversity, is placing New Zealand, as a signatory, under specific obligations. This reinforces (1) a long-standing concern over our dependence on *P. radiata*, which is so difficult to avoid when it is so much more economically attractive than other species in such a wide range of situations and (2) the emphasis on sustainability in the Resource Management Act.

In the area of public policy this concern is now being addressed through increased funding by the Foundation for Science and Technology (FRST) of research on alternative species (FRST 1993). Among the forest growers, individual companies have pursued alternative species where they perceived profitable or strategic niches for such species, although corporate perceptions have tended to fluctuate. There is, however, sufficiently broad interest to support two FRI/Industry Cooperatives concerning Douglas fir and a few eucalypt species. In addition, action groups have been formed for *Cupressus macrocarpa* and *Paulownia*.

In other respects, public policy has effectively carried through from the days of the Forest Service (c.f. Burdon 1982, Sweet and Burdon 1983). Pre-emptive diversification of species came to be rejected as an option in the light of past experience; planting 'insurance' species had incurred formidable opportunity costs yet eventually incurred worse forest health problems than were encountered with *P. radiata*. Potential vulnerability of *P. radiata* was therefore addressed in later years by a combination of measures including silvicultural practices, maintenance of genetic diversity within the species, and propagation technology that allows both breed specialisation and rapid deployment of new selections. Thus the front-line genetic defences against biological hazards in plantation forestry lie in maintaining genetic variability within *P. radiata*. Use of other species has been viewed primarily as a fall-back genetic defence.

To go right back to basics, we should consider what features are required for a species to succeed in plantation forestry:

- availability and acceptable germination behaviour of seed, unless easily propagated vegetatively;
- amenability to transplanting;
- rapid growth rate and good productivity;
- tolerance of a range of site conditions;
- satisfactory resistance to pests and diseases;
- acceptable tree form, possibly with the help of genetic improvement;
- failing one or more of the above, producing wood of special value; and
- value of wood not being dependent on trees being very old.

Given this set of requirements, *P. radiata* inevitably provides a yardstick by which any alternative species must be judged, in view of its growth rate, tree form, general amenability to cultivation, site tolerances, general health, and versatility of the wood.

Discussion of alternative species has continued sporadically over the years. However, we consider that, in order to give it proper focus, it needs to be based on an appropriate categorisation of species. We propose that a set of partly overlapping categories be recognised, based on the actual or prospective roles of species concerned. For a species to be a contender for a role in commercial plantation forestry in New Zealand it must merit a place in at least one of these categories. For information as such, we do not purport to supersede the article of Wilcox (1993).

The Categories

The categories we propose are:

1. Special-purpose species

These are species that fill wood utilisation niches for which *P. radiata* is not well suited. They represent quite a broad spectrum, ranging from very high-value furniture or veneer timbers, at one end, to specialty industrial wood (e.g. for short-fibred pulp) or fuelwood, at the other end. This broad category is already well recognised.

2. Extreme-site species

This category comprises species for forestry sites that are unsuitable to *P. radiata*, because it will not perform or at least

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