# The quality of the present harvest is the result of early management decisions

**A comment by Dr W. R. J. (Wink) Sutton**

*As a contribution to the current debate about the quality of trees now being harvested I want to record my understanding of the last 40 years.*

In the 1960s Britain's proposal to join the European Economic Community (now the European Commission) led indirectly to an export focussed plantation forestry industry. Prior to the 1960's plantation forestry, especially that of the New Zealand Forest Service (NZFS), was generally regarded as a strategic resource - to provide New Zealand with an alternative wood source as the supply of indigenous wood diminished.

Although there were advocates, such as the NZFS's Director-General A. R. Entrican, for increasing plantation forestry exports and there were already some forest products exports (e .g. log exports to Japan and newsprint to Australia) these forestry exports were small compared to the traditional exports of butter, cheese, sheepmeat and wool. Because of the almost certain loss of free access to the British market for our dairy products and sheepmeat, the New Zealand Government desperately sought diversification. Given the prospect of an increase in forest products exports, funding for forest research was increased. The expansion of the Forest Research Institute (now the Crown Research Institute, Scion) coincided with the appointment of a new Director of Research, Dr. S. Dennis Richardson. Richardson reasoned that plantation forestry was most likely to expand if it were a competitive land-use. The result was the Economics of Silviculture group led by Dr R. (Bob) Fenton. I joined the group in the mid-1960s.

The group began with a comparative land-use study (where plantation forestry proved to have returns at least comparable to those of sheep and cattle) and then evaluated all aspects of silvicultural regimes (almost exclusively those of radiata pine). One outcome was the 1968 proposal by Bob Fenton and me of what became known as the Direct Regime, variants of which now dominate plantation management (Fenton and Sutton 1968). This regime was considerably more profitable than regimes then in practice because it reduced costs, lowered risks and offered increased final returns.

The regime typifies an important, but obvious, forest management principle viz. that the size and especially the quality of trees at harvest is largely determined by early management decisions - the site, genetic stock, nursery treatment, establishment methods, initial spacing, timing and intensity of pruning and thinning and the final crop stocking. These are all decisions that have to be made in the first 7 to 8 years. After that there are few silviculture decisions that can influence the quality of the trees that will be finally harvested. The major implications of this principle are that:

(1) The quality of trees that are now being harvested was largely determined by decisions taken in the 1970s.
(2) The quality of those trees that will be harvested is already pre-determined for the next 20 to 25 years.
(3) Other than changing the rotation length, there is very little that can be done to change tree quality.

In the 1970s, when the annual wood harvest was about 9 million $m^3$, the Head Office of the NZFS published a series of wood supply projections- e.g. Hosking 1972 and Levack 1979. These projected, assuming a high rate of new planting (which there was until the last few years), an annual wood harvest in the period 2001- 05 of 22.6 and 24.4 million $m^3$ respectively. The actual wood harvest in 2003 was 22.2 million $m^3$ (NZFOA 2006). As domestic demand was not expected to increase significantly nearly all the increased wood harvest would be available for export. The question then was what products offered the best prospects for profitable exports.

Some in the forestry sector argued that there was no future for solid wood. In 1974 there was the prediction in NZ Forest Industries Review "…that in ten years time most timber will be reconstituted and faced with veneer". Although there has been some substitution, there is still a strong market for solid wood.

In 1975 I completed my doctorate on the potential for New Zealand's forestry exports around the year 2000 (Sutton 1975). I reasoned that while it was virtually impossible to predict markets 25 years hence, it was possible to predict the quality of most of the trees that would be harvested (this being an application of the management principle detailed above). Since most of the trees that would then be harvested were much slower growing than our plantations of radiata pine, the quality of those trees was already determined.

Much of my doctorate was an evaluation of the world's forest resource and what wood quality might be harvested around the year 2000. My conclusion was that a global wood shortage was unlikely. Also, that there would be no shortage of pulpwood. By year 2000 most of the world's large old growth trees would have been harvested and small trees would dominate the global wood supply. Small trees, especially if they had small knots, could be sawn into structural timber. Only large old growth, and large, early pruned, trees produce clearwood. The global clearwood market may not be large but New Zealand would only be a small supplier. In the 1970s the USA alone was estimated to produce 10 million $m^3$ of clearwood annually (Sutton 1978). As very few forests in the world were being pruned and as the supply of old growth trees was predicted to decline, clearwood appeared to be New Zealand's most promising export option. Fortunately, we had already researched how to manage plantations to maximize the yield of clearwood. Our research had also shown that it was difficult to restrict the branch size of radiata pine required in high quality structural timber (and expected returns were poor).

The initial problem was how to convince plantation owners to grow high quality pruned logs when no market yet existed and radiata pine clearwood outside New Zealand was an unknown product. In the 1960s quality pruned logs were virtually unattainable and very few were available in the 1970s. Adding to the confusion about the export potential of our clearwood were the doubts of many sawmillers. I remember the Director of the Commercial Division of NZFS dismissing my claims for the prospects for our clearwood exports with the statement "You will never sell that crap [radiata clearwood] anywhere overseas. You can prune as much as you want but I [as a sawmiller] will never pay you a cent more for doing so." Could the supply of poorly pruned logs (i.e. those late pruned and so having very large defect cores) explain why sawmillers were then so anti-pruning?

Although many of the plantations were owned by the State, forestry companies and private owners adopted regimes with timely pruning and heavy early thinning, some companies (e.g. NZ Forest Products and Carter Holt) were generally more conservative (either by not pruning and/or thinning later). We realised then that although clearwood maximisation would produce low quality structural timber the local market for structural timber could be supplied from those plantations that had been more conservatively tended.

In the 1970s we were confident that clearwood was our best export option. We had doubts about our ability to grow quality structural timber, especially for the export market. The major degrading factor then was knot size. One of the consequences of radiata pine's rapid growth rate is that branches (and hence knot size) tend to be large. It was predicted that there would be no global shortage of quality structural timber (i.e. with small knots). We were aware that in the global market radiata pine was not a preferred structural timber even if the knot size could be small. We could export structural radiata pine timber to Australia but they planned to be self-sufficient by year 2000 and their radiata pine was generally denser than that of New Zealand. Also Australia's plantation management was generally conservative and branch sizes were usually smaller.

Compared with the 1970s we now have a better understanding of why radiata pine is an excellent finishing timber but a poor structural timber. With the latter it is more than just the importance of the size of knots.

I'm not a wood technologist but my understanding is that, relative to its density, radiata pine wood has a high breaking strength (modulus of rupture or MOR) but low stiffness (modulus of elasticity or MOE). In contrast, a superior structural timber, such as Douglas fir or Southern pine, is one that is stiff (i.e. has a high MOE). The difference may be explained by the wood density variation within the annual rings. In radiata pine the density of the earlywood is only about 25% lower than that of the latewood and there is a gradual density change between them. In superior structural timbers the earlywood has significantly lower density than the latewood. The greater stiffness of superior structural wood is explained by the high density of the bands of latewood which also explains why such timbers usually have poor finishing properties). The small difference in density within the annual rings explains why radiata pine is an excellent finishing timber. It was recognised in the 1970s (and further confirmed by comparative studies in the 1980s) that radiata pine was one of the world's best coniferous finishing timbers.

Although the global market for our clearwood has not developed as I originally envisaged, I'm convinced that timely pruning and heavy early thinning was, and still is, the best silvicultural option for New Zealand. There is on going debate about final crop stockings and age of harvesting but the fundamentals of the regime are unchanged.

Regimes that maximise clearwood production are more profitable than regimes for either just pulpwood or structural timbers. I fail to understand those who are surprised that clearwood regimes produce poor structural timber. We never claimed they would. We knew 40 years ago it was almost impossible to maximise the production of clearwood while producing high quality structural timber. There were enough conservatively treated plantations in New Zealand to supply the domestic market. We had doubts about the long-term prospects for structural timber exports. Fenton and I were well aware that there could be log quality problems above the pruned butt. We originally suggested that the second log might also be pruned and rotations lengthened, but long term studies showed the tree growth loss from the pruning was not fully compensated by the gain of improved clearwood recovery. In the first revision of our 1968 proposal (Fenton *et al*. 1972) we also suggested selecting trees with long internodes in the second log while only second log pruning those of a multi-nodal habit. Long internode trees were known to produce factory grade timber from which short clears can be recovered. This aspect of our proposal appears to have been universally ignored. Tree breeding initially concentrated on reducing the internode length (because the Captains of industry wanted shorter rather than longer internodes).

If the New Zealand forest products industry wants plantation owners to grow a different quality of tree, and, assuming such trees can be grown, it will another 20 to 30 years before they are ready for harvesting. Before plantation owners are prepared to commit to an alternative product the forest products industry must advance a convincing argument and probably provide guarantees that there will be profitable market at final harvest.

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