PLANTATION MANAGEMENT IN AUSTRALIA

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ABSTRACT

The management of plantations of exotic pines in Australia has evolved from an earlier preoccupation with getting large areas established to a more discriminating approach in which commercial considerations, rational land use, and non-wood values play an increasingly important role. Silvicultural regimes are becoming more diverse as different trends develop in different regions and markets within Australia. The role of the public sector in commercial plantations is coming under closer scrutiny. Marketing issues now assume a much greater prominence in terms of investment in additional plantations and in more intensive silviculture, and possible competition from overseas imports.

INTRODUCTION

Plantation management in Australia is changing in a number of ways. The difficulty in describing these changes is that an already diverse array of practices and problems has become more diverse. Thus any attempt to provide a national perspective must be selective and will fail to do justice to important regional and other differences, not to mention very recent changes. Nevertheless, the aim of this paper is to provide an Australian perspective, with due appreciation of its likely failings in these respects and apologies to those who will feel aggrieved by the omissions and simplifications.

THE PLANTATION ESTATE

An initial survey of the data summarising the nature of the plantation estate might suggest that, apart from some expansion of area, little has changed in terms of species, ownership and the relative distribution of age classes since the last national survey summarised for the FORWOOD (1974) Conference. These species and ownership patterns are summarised in Table 1, being derived from the work of the Forest Resources Committee and published by the Australian Forestry Council (1981).

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TABLE 1: AREAS OF PLANTATIONS BY STATES AND SPECIES, AND OVERALL PROPORTION OF PUBLIC OWNERSHIP

State	*Areas of Plantation (10^3 ha)*				*Overall Proportion in Public Ownership*
	Radiata pine	*Southern pine*	*Other conifers*	*Broad-leaved*	
N.S.W.	155.9	13.5	6.1	18.3	0.74
Vic.	157.4	—	5.0	12.9	0.53
Qld.	3.7	106.1	46.8	3.4	0.80
S.A.	88.6	—	6.0	0.9	0.79
W.A.	35.5	—	24.1	8.3	0.83
Tas.	51.5	—	0.3	4.0	0.61
N.T.	—	1.5	2.5	—	0.30
A.C.T.	12.8	—	0.9	—	1.00
Total	505.4	121.1	91.7	47.8	0.71

Source: Australian Forestry Council (1981).

Radiata pine remains the dominant species in southern Australia but is supplanted by the Southern pines in Queensland. Of the other species, only hoop pine in Queensland and maritime

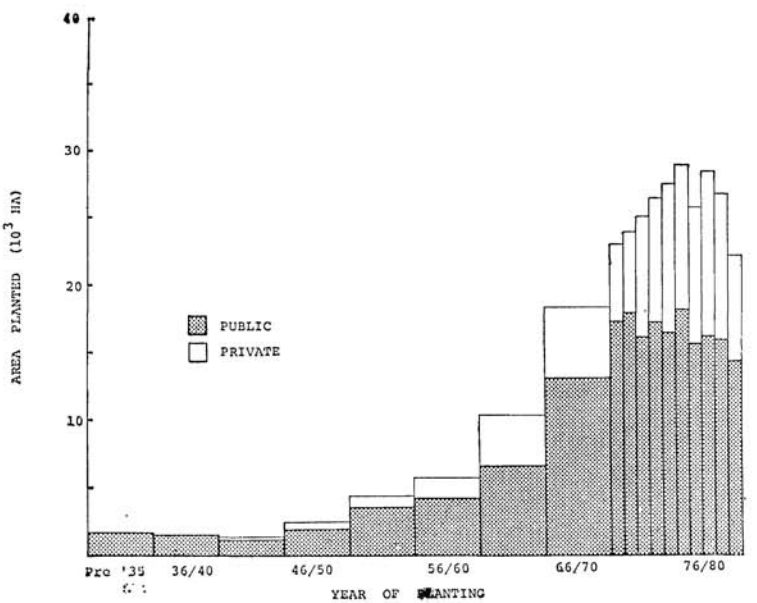

FIG. 1: *Radiata pine plantations: areas planted by year and ownership.*

pine in Western Australia are truly significant. Plantations of eucalypts are still limited in area and do not form a significant component in wood supply. Thus most subsequent references will be confined to coniferous species. Public ownership still predominates.

The distribution of radiata pine plantations by year of planting (as at 30 March 1980) and ownership is shown in Fig. 1.

While this distribution is markedly skewed, there are important differences between organisations. In South Australia, for example, the Woods and Forests Department is much closer to a balanced distribution. The distributions for other coniferous species are also generally skewed.

The most recent data available (Bureau of Agricultural Economics, 1984) enable the average net additions over the period 1978 to 1982 to be derived. Table 2 summarises the coniferous plantation estate as at 30 June 1982 as well as the average annual net additions.

TABLE 2: AUSTRALIAN PLANTATION AREAS AND AVERAGE NET ANNUAL ADDITIONS, 1978-82

Tenure and Species	*Plantation Areas* *Total as at 30/6/82 (10^3 ha)*	*Average net addition p.a. 1978-82 (10^3 ha/yr)*
Public ownership		
Radiata pine	364.6	9.08
Other conifers	184.6	6.65
Private ownership		
Radiata pine	186.5	13.75
Other conifers	41.4	1.05
Totals		
Radiata pine	551.2	22.83
Other conifers	226.1	7.70

Source: Bureau of Agricultural Economics, 1984.

Table 2 shows that the area of privately owned radiata pine plantations has increased in significance and now represents one-half the area of the total estate of that species. The average annual net addition to this privately owned estate has exceeded that of the public estate over the last four years.

The trend towards an increasing proportion of private planting pre-dates 1978. According to the national summaries (FORWOOD, 1974; Australian Forestry Council, 1971), the total area of privately owned coniferous plantations doubled between 1972

and 1980, while that in public ownership increased 1.6 times. Comparisons of these summaries also show that the rate of expansion of the privately owned estate has been evenly spread across industrial forestry, investment company and small-owner classes of ownership.

The most recent data available show that the rate of new public planting has declined substantially. Average net (excluding replanting) planting of publicly owned coniferous plantations has declined from a level of about 24 000 ha/yr in the period 1970 to 1974, to 21 500 ha/yr in the period 1975 to 1978, down to 15 700 ha/yr in the most recent period. The figures for privately owned planting have increased from 8 000 to 11 000 ha/yr, and most recently to 14 800 ha/yr for the same periods. Thus although the *gross* overall planting rate has remained in excess of the figure of 28 500 ha/ya recommended by FORWOOD (1974), and much above the figures of 16 000 ha/yr recommended by the Bureau of Agricultural Economics (1977) and 22 700 ha/yr by Douglas and Treadwell (1977), there has been a major change of emphasis, with the private sector becoming increasingly important. It is therefore appropriate to examine some of the reasons for this change.

FOREST POLICY

National forest policy in the 1960s and early 1970s was based on the goal of achieving self-sufficiency. At the FORWOOD Conference this was to become "net" self-sufficiency although it was never clear what the word "net" referred to. Since that time, the Australian Forestry Council has progressively changed its stance on that goal. In 1976 it responded (Carron, 1980) to its Standing Committee's recommendation that it "should endorse the aim of self-sufficiency in forest products", on which the FORWOOD Development Plan was based, by arguing that "forest policy should be directed towards ensuring that Australia had a long-term capability to supply such of its own requirements of forest products as might be consistent with economic and environmental considerations". In May 1982, the "Australian Forestry Council agreed that the planning of forest products is most efficiently undertaken by each authority and company faced with the commercial realities of its own situation". This report (Hall, 1982) goes on to note that the Council "totally rejected the goal of net self-sufficiency . . . as being irrelevant to the practical commercial planning of production levels".

This change reflects a number of factors. Commonwealth funding of State planting programmes under the Softwood Forestry Agreements Acts of 1967, 1972 and 1977 effectively ceased in 1978, other than maintenance funding for plantations already established under the scheme. Thus the Commonwealth no longer has the leverage or the necessity to determine the minimum levels of planting in each State. The State forest services, on the other hand, have lost access to subsidised funding and now have to compete for Loan Funds and other sources of investment funds within their State. Furthermore, increasing political support has developed for a greater emphasis on private planting at both the Commonwealth and State levels, together with an increasing aversion in some States to the clearing of native forests for State plantations.

All of these factors mean that the State forest services are competing for funds with other State public enterprises and for land with private enterprises. Thus the trend has been for the State forest services to concentrate more on consolidation of those plantations which have yet to reach the critical mass required for secure development of industries and for the private sector to engage in expansion within existing supply zones, as well as venture capital investment. This pattern seems likely to continue.

PLANNING AND MARKETING

All the major Australian organisations have developed or have access to computer-based stand models which enable the growth of their particular species and sites to be simulated and future yields predicted (Elliott, 1979). These models are utilised in larger forest models for planning the cut from plantation areas. These forest models take two forms. The majority of organisations use simulation of user-nominated strategies and operate on a trial-and-error basis to determine the set of silvicultural strategies which will satisfy the marketing commitments and plans. APM Forests Pty Ltd and the Forestry Commission of N.S.W. use linear programming models to optimise the set of strategies subject to various market and resource constraints, thereby considering a wider set of strategies.

Both types of planning model involve close integration with a computer-based information system containing the basic statistics concerning the individual stands within the forest. Information systems and stand growth models are entering a new phase of development in concert with advances in computing technology.

Currently, land-use data banks are being developed in some States with access to computer mapping for all land-use information. Improvements in plantation information systems are also linked with the development of commercial accounting systems for some State forest services. After a long period of inertia following the initial development of computer based planning models, new developments across the entire mensuration, inventory and planning area can be expected to follow as access to computing facilities becomes available at the district office level.

Competition for land and investment funds has also strengthened the role of these growth and planning models in the evaluation of alternative options (Cromer *et al.*, 1977). However, advances in establishing techniques, genetically improved planting stock, and later age fertilising are creating new demands on the underlying growth models. Refinements to recognise soil type differences (Leech, 1978; Turvey, 1983) are being developed but the growth models are still in a pioneering stage with respect to other advances (*e.g.*, Turner *et al.*, 1977).

Marketing of plantation produce is already assuming a much greater importance in the major organisations. Table 3 summarises the predicted volumes of sawlogs and pulpwood likely to be available from Australian coniferous plantations.

As Table 1 shows, there are marked differences between the various States and Territories; South Australia and the Australian Capital Territory having only modest growth compared with the other States. The relationship between pulpwood and sawlog sales deserves special attention.

In most States, the data in Table 3 are predicated on the use of a commercial forest thinning in the case of radiata pine plantations. In 1982-3, the volume of pulpwood sold was about 1.6 million m^3. Even after due allowance for forthcoming expansions of plant and plant under construction but likely to be in operation between 1985 and 1990, there is likely to be a substantial residue of unsold smallwood, especially as the above comparison takes no account of the use of sawmilling residues for pulp and related products.

Thus the smallwood problem (Ferguson and Shepherd, 1979) continues to give cause for concern in some localities. Of course, some pulpwood supply zones, notably those centred on Albury and Morwell, are seeking increased supplies to cater for recent or planned expansions. Nevertheless, the more general problem of unsold smallwood has implications for sawlog availability. If the

TABLE 3: FUTURE AVAILABILITY OF LOGS FROM CONIFEROUS PLANTATIONS

State and Product	*Availability of Logs (10^6 m^3 net)* 1985	1990	2000	2010	2020
N.S.W.					
Sawlogs	0.6	0.7	2.0	2.6	2.6
Pulpwood	1.0	1.3	1.2	1.1	1.1
Vic.					
Sawlogs	0.8	1.1	2.3	3.1	3.3
Pulpwood	0.8	0.9	1.0	1.2	1.4
Qld.					
Sawlogs	0.4	0.7	0.9	1.3	1.4
Pulpwood	0.7	0.8	0.8	0.8	0.9
S.A.					
Sawlogs	0.7	0.8	1.0	1.1	1.1
Pulpwood	0.6	0.5	0.4	0.4	0.4
W.A.					
Sawlogs	0.1	0.2	0.6	1.0	1.1
Pulpwood	0.2	0.4	0.7	0.9	1.0
Tas.					
Sawlogs	0.3	0.4	0.5	0.9	0.9
Pulpwood	0.3	0.7	0.9	0.9	0.9
A.C.T.					
Sawlogs	0.1	0.1	0.2	0.2	0.2
Pulpwood	—	—	—	—	—
Australia					
Sawlogs	3.0	4.0	7.5	10.1	10.6
Pulpwood	3.7	4.6	5.2	5.4	5.7

Source: Australian Forestry Council (1982).

smallwood buildup continues, the effect will be to defer some of the increases in sawlog volume. Some States are already taking action in recognition of this problem, as will be seen in the next section.

Despite recent problems stemming from the Closer Economic Relations Trade Agreement between Australia and New Zealand, marketing sawlogs and the produce thereof seem less likely to present long-term problems, principally because of the extensive withdrawals of native forest from wood production and consequent reduction in future availability (Australian Forestry Council, 1981).

PLANTATION OPERATIONS

Plantation silviculture in Australia is becoming increasingly diverse, not only between different organisations and species, but for the same species at different locations. Kerruish and Shepherd

(1982) reviewed recent trends in silviculture and harvesting in relation to thinning practices. Shepherd and Squire (1982) compiled a set of papers on establishment practices which summarises yet further sets of detailed papers. This review draws heavily on both these sources to provide a summary of some of the developments which have major implications for plantation management, either now or in the future.

The spectre of a substantial decline in productivity in the second rotation of radiata pine on sandy soils has hung over the heads of plantation managers for some time (Keeves, 1966). Establishment techniques have now been developed which seem likely to overcome this problem. Earlier research by Woods (1976) in developing what is now known as the "maximum growth sequence" of site preparation, weedicide and fertiliser treatments, has linked up with that by Squire *et al.* (1979) on conserving nutrient losses. Where possible, burning of first rotation debris is being phased out. Rolling and crushing are being introduced to break down the debris and incorporate it in the soil. Weedicide and fertiliser applications continue to be refined and improved, although this statement does scant justice to important contributions by various research workers in different States (see Shepherd and Squire, 1982).

In one locality, these refinements and related improvements in establishment practices have lowered the cost of growing "wood" by about 14%, according to work by Turvey and Cameron (1982). However, this work also suggests that the reduction in cost is only of the order of 6% if likely pulp yields are taken into account. This finding illustrates a continuing source of concern regarding the impact of new techniques on wood *quality* as well as quantity (Cowan, 1981; McKinnell, 1981).

The use of planting stock from genetically improved sources continues to increase, as more seed becomes available. The first commercial sales of cuttings of radiata pine (or stecklings, more accurately) commenced in 1984, as yet on a small scale (Borough *et al.*, 1984). Despite improvements in planting stock, initial espacements of larger-scale plantings remain in the range corresponding to stockings of 1 000 to 1 500 stems/ha.

In contrast to these trends, the Forestry Section of the Australian Capital Territory is increasing its reliance on natural regeneration for second and later rotations of radiata pine (Lea, 1982). No seed trees are retained. Advance growth is destroyed by Marden rollers following logging. Regeneration has been especially successful on steep (over 20°) slopes following skyline

harvesting. On flatter areas logged with tractors, competition from grasses and blackberries has sometimes been a problem. Compaction along snig tracks and at landings has also resulted in patchy regeneration (see also Sands *et al.*, 1979).

The natural regeneration is thinned to a spacing of about 3.6 by 3.6 m using hand pulling and pruning shears (ages 1 to 2 years) or motorised cutters and chainsaws (ages 2 to 4 years). Natural regeneration appears to be far more drought-tolerant. The expected economic returns are less than the planting of improved stock with slash retention and extensive weedicide and fertiliser treatments, but the latter alternative would place unsupportable demands on the funds available for the total area to be regenerated in this manner (Lea, 1982). Thus natural regeneration is being used on steep slopes and on the remaining flat areas when funding is insufficient to enable planting.

Thinning and pruning practices in Australian plantations now cover a very wide range. Commercial first thinning of radiata pine still predominates in South Australia, Victoria and New South Wales but smaller-scale examples of non-commercial thinning at earlier ages can be found. Both the Tasmanian and Western Australian forest services practise non-commercial thinning and high pruning of radiata (and other) pines, using regimes modelled on earlier New Zealand work.

Similarly, low pruning of radiata pine predominates in South Australia, Victoria and New South Wales, the exceptions being APM Forests Pty Ltd, who do not prune, and some small growers who high prune. Low pruning is mainly carried out to improve access and reduce fire hazards.

Harvesting techniques continue to have a major effect on thinning practices. Where mechanical harvesters are used, the first commercial thinning is generally a row thinning (varying from 1 in 2 to 1 in 5 depending on initial espacement) with selective thinning between the outrows (other than 1 in 2 row thinning). Otherwise outrows are more widely spaced (1 in 6 up to 1 in 12). Despite much experimentation, a cost-effective technique for harvesting first thinning on steep slopes does not seem to have emerged and these stands are often being left unthinned.

In 1983, the Queensland Department of Forestry re-introduced non-commercial thinning of plantations of southern pines in the south-east of the State, reflecting delays in the establishment of a major pulp plant and the resulting build-up of small wood. Thus these pines (principally *P. caribaea* var. *hondurensis*)

are now thinned to a stocking of 750 stems/ha at age 3 to 4 years. Elsewhere in the State, this thinning is to a stocking of 600 stems/ha, the potential markets for small-wood being poorer. On better sites (site index 26 m and above), selective pruning of 300 stems/ha is carried out between the outrows, at age 6 to 7 years. A further pruning from 2.4 to 5.4 m high is carried out some 2 years later.

Initial espacement of hoop pine plantations in Queensland has recently been widened to 5.0 by 2.4 m (833 stems/ha to obviate the need for a non-commercial thinning. Selective pruning of 400 stems/ha is carried out in two lifts.

The timing and severity of later thinnings vary widely according to the dictates of markets and other factors. Thinning from below predominates, except in first thinnings where removal of malformed trees is a major priority.

The age of clearfelling varies widely. The losses of plantation caused by the February 1983 fires will probably necessitate a reduction in rotation length by the Woods and Forests Department of South Australia from 50 years to 45 years for a period. In Tasmania and Western Australia, the respective forest services plan to use a rotation length of about 30 years for radiata pine. A rotation length of about 30 years is also used by APM Forests Pty Ltd in Gippsland, but with a quite different silvicultural regime. Elsewhere, rotations of 40 to 45 years seem to predominate for radiata pine, 30 to 35 years for southern pines in Queensland.

CONCLUDING REMARKS

Plantation management in Australia is evolving from an earlier preoccupation with getting land planted and increasing the biological productivity of that land to a more diverse and discriminating approach. Commercial considerations of growing costs, wood quality, markets, prices and competition with overseas imports are receiving greater consideration. Although not developed further in this paper. the changing environment for plantation planning and management should also be noted. The trend towards increasing controls on all forms of land use, and plantations in particular, means that plantation managers need to be increasingly sensitive to cutural, recreational, aesthetic, wildlife and catchment values.

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