TIMBER PRODUCTION FROM WIDE-SPACED AGROFORESTS

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SUMMARY

The paper outlines why growing trees at wide-spacing is an important option for farmers. In particular it points to the fact that wide-spacing enables timber to be a realistic possibility in farming areas which receive as little as 450 mm of rain per year. It also highlights innovative developments on farms to adapt wide-spaced agroforestry to suit farmers' needs.

One of the layouts favoured by farmers is strips of wide-spaced trees because it fits well with conventional farming practices such as cropping and grazing. The techniques developed for managing wide-spaced trees, mainly pruning, are applicable to all layouts of wide-spaced trees. Results of pruning trials indicate that eucalypts take substantially less time to prune than pine.

Volume of timber from an agroforest of pine is about 80% of that from a conventional plantation. Growth rates of fast grown eucalypts at wide-spacing during the first eight years indicate that they will reach sawlog size by 20 years - sooner in the case of *E. globulus*.

INTRODUCTION

The conventional view of wide-spaced agroforestry is a parkland of pine trees. However, as more areas are established on farms, the picture is changing. Imaginative layouts and different species are some of the adaptions being made to mould the concept into a form which suits farmers.

The combination of wide-spaced pine trees for sawlogs and pasture for grazing has been studied in Western Australia since 1973. The finding that this type of agroforestry can be more productive than a pure grazing enterprise has been widely reported [Anderson *et al*, 1987]. Economic studies support these findings [Malajczuk *et al*, 1984].

Although much of the research has concentrated on wide-spaced pine, the findings are applicable to different layouts and species. For example, the principle that wide-spaced trees must be pruned to produce saleable timber is relevant no matter how the trees are arranged across the paddock.

This paper discusses wide-spaced agroforests in the context of recent adaptions being made on farms. I address four questions:

1. Why consider wide-spaced agroforests?

2. What layout options are there?

3. What are the main tasks in managing the trees?

4. How much timber is produced?

Why consider wide-spaced agroforests?

Growing trees at wide spacing greatly extends the rainfall zone over which trees for sawlog timber can be considered a realistic possibility. The lower limit of rainfall for conventional plantations is about 700 mm in northern areas and 600 mm in the south [CALM, 1987a]. In areas which receive less rainfall than this, there is a high risk that trees will die from lack of water. Spacing the trees out avoids this problem; and enables trees for sawlogs to be grown in areas with as little as 500 mm rainfall per year in northern areas and 450 mm in southern areas. This means that a much greater area of farming land in the South West can produce timber as a part of using trees in farming. It is in lower rainfall areas that salinity and wind erosion are serious problems and trees are urgently needed.

The ability to grow trees at wide-spacing opens up many new options for arranging trees. Flexibility in tree layout means that trees can be arranged in ways which integrate well with conventional farming practice. For example, trees laid out in narrow strips can be effective at preventing wind erosion and at providing shelter as well as enabling the farmer to crop or graze the land. However, because the bulk of the trees are "edge trees" they are essentially wide-spaced. Therefore if the farmer also wants the trees to produce timber he must prune them.

Agroforests are well suited to producing high quality sawlogs. In wide-spaced stands growth of timber is concentrated on a few well formed trees - the poorly formed ones having been culled out in the early years. Thus how to sell thinnings, a problem faced by so many private growers of conventional plantations, is completely evaded with an agroforest. High quality sawlogs are easy to sell.

What layout options are there with wide-spaced agroforests?

There are two main types; strips and windbreaks.

1. Strips

Strips of trees can be laid out in many ways; the number of rows per strip and the distance between strips ~~rows~~ can be varied to suit the needs of the farmer.

In medium rainfall areas [500 to 700 mm rainfall per year] the need to combat salinity is likely to be the primary reason for tree planting. Strips of several rows of trees 30 to 80 metres apart on the contour is a practical arrangement with this objective in mind. It enables the farmer to continue to crop his land and also benefits his pasture and livestock by providing shelter. In addition the farmer can manage the strips as wide-spaced stands. Thus the growth of timber is concentrated on the best trees and so the farmer can expect to produce sawlogs in about 30 years.

Farmers in high rainfall areas [greater than 700 mm rainfall per year] are likely to establish wide-spaced agroforests to increase productivity. They consider that the combination of wide-spaced trees and pasture is a more productive use of land. The benefits trees provide in terms of shelter is part of the reason for greater productivity. A typical layout is double rows 25 meters apart.

2. Windbreaks

Windbreaks differ from strips in that their primary function is to reduce wind speed. In Western Australia this is usually to prevent wind erosion and to provide shelter. These objectives influence the

structure and management of the belt of trees. For example, windbreaks are usually fenced to stop livestock from browsing and low species are planted to provide effective low shelter. A spacing of 200 m is commonly used on Western Australia's south coast to adequately protect the whole landscape [see D. Bicknell's paper in these proceedings].

Windbreaks can also produce saleable timber. A survey of pine windbreaks in the Esperance region found that from 46 to 146 m^3 of sawlogs per kilometre can be produced in 30 years [Moore, 1987].

Most windbreaks consist of two or three rows. Thus the majority of trees are "edge-trees". Therefore they need to be managed as wide-spaced trees, if the intention is to produce saleable sawlogs.

WHAT ARE THE MAIN TASKS IN MANAGING TREES FOR TIMBER?

The bulk of work in tending the trees is carried out from about three to twelve years of age. During this time the best 75 to 200 trees per hectare are chosen and the rest are culled. The retained trees are pruned to a height of six to ten meters.

Pruning is the most costly task, accounting for about eighty per cent of all costs. However, pruning is essential to produce saleable timber and to let in light for the pasture.

Less pruning is required with eucalypts than with pine. Pine trees may require as many as six or seven prunings whereas fast growing species of eucalypts can be pruned to a similar height in two or three prunings. Table 1 below presents data on time to prune pine and eucalypts.

TABLE 1 Total time to prune wide-spaced *P. radiata* and *E. globulus* to 7.5 m.

SPECIES	TIME TO PRUNE [min/tree]
P. radiata	17
E. globulus	8

From 12 years until the trees are harvested at about 30 years, the trees require no further tending. Table 2 lists the main tasks involved in setting up and managing an agroforestry area with pine; their timing and approximate cost.

TABLE 2 Tasks, costs and returns for the tree component of an agroforest with 100 pine trees per hectare. The cost of pruning is less for eucalypts.

AGE [yrs]	OPERATION	COSTS [$/ha]	RETURNS [$/ha]
0	control weeds	20	
	seedlings [670/ha]	70	
	plant seedlings	36	
	fertilize seedlings	32	
3 or 4	cull malformed trees [leave 300 sph]	25	
	prune	75	
4 or 5	cull malformed trees [leave 150 sph]	25	
	prune	75	
5 to 7	cull to final crop [100 sph]	20	
	prune [with "Squirrel"]	100	
8	prune	100	
10	prune	100	
12	prune	100	
18	thin 50 sph for sawlogs [optional]		$1000 to $3000
30	harvest remaining trees		$3500 to $10000

Further details are provided in the booklet entitled, "Agroforestry - an alternative approach to farming" [CALM 1987b]. It is important that attention to detail be given.

Table 3 below presents the total costs and the likely returns per pine tree. It is a simplified but worthwhile comparison to make. The actual costs for any given situation depend on a number of factors including soils, rainfall and management methods.

Table 3. Approximate total costs and returns per tree *[P. radiata]*

TOTAL COSTS [$/tree]	TOTAL RETURNS [$/tree]
$10 to $12	$75 to $150

How much timber is produced?

The volume of sawlogs obtained from a pine agroforest after 30 years is about 80% of the timber produced from a pine plantation [depending on the number of trees per hectare]. Table 4 below presents data from agroforestry trials near Mundaring.

Table 4. Estimated volume of timber at 30 years for an agroforest of 100 pine trees per hectare compared with the volume from a conventional plantation. Data from experimental sites at Flynn's and Wellbucket, Mundaring, Western Australia.

	AGROFOREST [sawlogs]	PLANTATION [chipwood & sawlogs]
VOLUME OF TIMBER [m^3/ha]	190	240

A substantial proportion of the timber from a pine plantation is small logs, used for posts and chipboard. This material is less valuable than sawlogs. Therefore the value of pine timber produced from an agroforestry stand is more than 80% of that produced from a plantation.

Preliminary findings from studies with wide-spaced eucalypts indicate that fast growing species will produce sawlogs in about 30 years. Table 5 presents data for several species of eucalypt growing at wide-spacing near Busselton.

Table 5. Growth data for 7.5 year old eucalypts at 150 sph at an experimental site near Busselton.

SPECIES	DBHOB [cm]	DBHOB Incr. [cm/yr]	HEIGHT [m]
E. globulus	29.4	4.9	15.5
E. diversicolor	23.8	3.5	14.3
E. maculata	21.2	2.8	12.6
E. paniculata	17.1	2.8	10.3

E. globulus, E. diversicolor and *E. maculata* all had diameters at breast height over bark [DBHOB] greater than 20 cm in seven years. It seems likely that by 20 years all three species will have large end diameters [LED] of 40 cm or greater. Forty centimeters LED is the minimum size of hardwood logs being sawn in the VALWOOD process [CALM, 1989].

In the case of *E. globulus* the rotation time may be as short as 15 years. The DBHOB of 7.5 year old *E. globulus* was 29.5 cm and the DBHOB increment in the seventh year was 4.9 cm/yr. By 15 years the DBHOB can be expected to be 50 cm and by 20 years, 65 cm [assuming an annual DBHOB increment of three cm]. The new milling and seasoning technology developed at the Wood Utilization Research Centre at Harvey now makes it possible to use hardwood logs of these sizes and ages to produce VALWOOD.

The time of harvesting trees from a widely-spaced stand is flexible. All, or a proportion, of the trees can be harvested at any time, once they reach sawlog size. It is likely that sawmillers would be interested in buying quite small numbers of logs at a time because they would be of high quality. In the case of pine it pays to leave trees until they are 25 years old because under the present pricing structure in Western Australia a higher price per cubic meter is paid for trees over this age.

CONCLUSION

Wide-spaced agroforestry broadens the rainfall range over which trees for timber can be grown. In most situations producing timber is secondary to improving water quality and preventing wind erosion. However, if trees can be arranged in ways that fit well with farming, then farmers are much more likely to manage the trees for timber as well.

For implementation to be successful, farmers need more than information about how much it costs and what the returns are likely to be. They need to make agroforestry part of their farming practice. There are signs that this is happening.

Farmers are modifying the traditional layout to suit their style of farming. Strips of wide-spaced trees

and a range of timber species are some of the innovative ideas being tried.

It is encouraging to see these steps being taken - steps which are crucial to the development of timber production as an integral part of farming systems with trees.

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