

# LIBRARY

Department of Biodiversity,  
Conservation and Attractions

This PDF has been created for digital preservation. It may be used for research but is not suitable for other purposes. It may be superseded by a more current version or just be out-of-date and have no relevance to current situations.

## Tree Planting Advice and Sales

Trees may be purchased from Forests Department nurseries at Hamel, Phone 097/33 1271 and Narrogin. A price list with information about types of trees, is available from Forests Department offices early each year. The following brochures in the Tree Care Series are also available from the Forests Department.

- More Trees Please
- Trees for Rural Areas - "The Wheatbelt."
- Trees for Rural Areas - "South West."
- Raising Trees for Farms.

## Information

Extension offices of the Forests Department have further information about matters covered in this brochure. These offices are at:

Como 09/367 6333  
Bunbury 097/25 4300  
Manjimup 097/71 1412  
Narrogin 098/81 1444

Written by Richard Moore for B. J. Beggs,  
Conservator of Forests.  
April 1983.



# Agroforestry

the integration of trees and farming

This brochure outlines agroforestry; what it is, the various types and likely benefits.



Tree Care Series



## What is Agroforestry?

"Agroforestry" is a term used in a broad sense to cover a wide spectrum of approaches for integrating trees with farming. Types of agroforestry range from a fully integrated system such as grazing under widely spaced pine trees to strategically placed belts of trees around paddocks for shelter and protection.

The integration of trees and farming is not new as it has been practised for 1000s of years, however, it is only recently that the importance of agroforestry has been reassessed.

## Why Agroforestry?

In high rainfall areas of the South West (900-1400 mm per year), tree growth is rapid and increasing numbers of farmers are seeing trees as a way of diversifying their income by producing timber and other products.

Agroforestry has a role to play in controlling stream salinity in catchment areas. The majority of catchments supplying water to the metropolitan area and other centres, fall within the medium rainfall area of the South West (600-900mm per year). However soils within this zone contain high levels of salt. Where significant areas of forest have been cleared, such as in the catchment of the Wellington Dam, salinity problems have developed. Research aims to determine the extent to which plantings of trees can reverse the trend of increasing salinity.

Agroforestry can provide protection for soils susceptible to erosion as well as shelter for stock and crops. Within the wheat belt (300-600mm rainfall per year) in particular, the combination of light sandy soils, overstocking in late summer and strong winds has caused severe wind erosion on many farms in recent years. Trees are effective at controlling erosion and at the same time can produce a range of useful products. Timber for use on the farm, such as posts, poles and firewood, is an important product from an agroforestry area. While trees can also produce nuts, fodder, fruit and honey, strips of vegetation retained around paddocks can be managed to produce dry native flowers for commercial sale. Less tangible benefits such as encouraging bird species, and enhanced aesthetics, can be important too.

## Types of Agroforestry

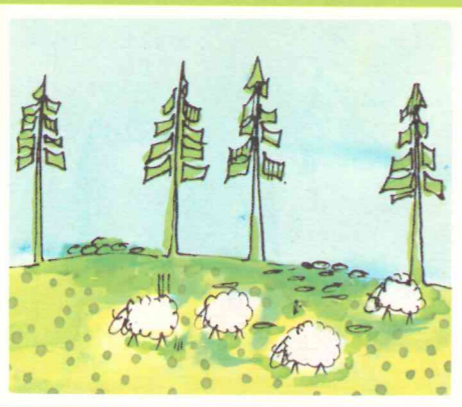
There are many ways of integrating trees and farming. The appropriate form of agroforestry will depend on a number of factors, including; the type of land, the rainfall, the requirements of the farm, distance from markets, and the interests of the farmer.

For example, a farmer in a high rainfall area has a steep corner on his farm that is pastured but erodes easily following cultivation. The farmer considers that widely spaced timber trees with grazing underneath would improve the stability and lift the productivity of the area. On the other hand, a farmer in the wheatbelt has a paddock with light soils that are tending to blow. The farmer also likes the idea of producing his own posts and firewood for use on the farm. He plans to establish a system of windbreaks to meet these two requirements.

## Wide Spaced Trees and Grazing

This type of agroforestry involves the integration of trees and grazing. The combination of trees, pasture and grazing is possibly more productive than either trees on their own or pasture and grazing alone. The fact that clover produces nitrogen, which can boost tree growth, and that trees provide shade and shelter for stock and pasture suggests that there might be mutual advantages in this system.

To let in light for pastures, trees are widely spaced and pruned to at least 6 metres. Grazing is carried out throughout the rotation. The amount of grazing is determined by the density of the trees and the height of pruning. As the trees grow, the size of their crowns increase and pasture tends to be shaded out. Therefore, thinning is necessary from time to time. Thinnings are heaviest during the first six years when the aim is to cull out the poorer formed trees. During the second half of the rotation, thinnings can be sold as sawlogs.



Under this system, trees require careful tending during the formative years (age 3 to 10) to produce high quality timber and to minimise debris. The objective of pruning is to maximise the volume of knot free timber. This is achieved by pruning frequently (preferably annually) to 55% of tree height.

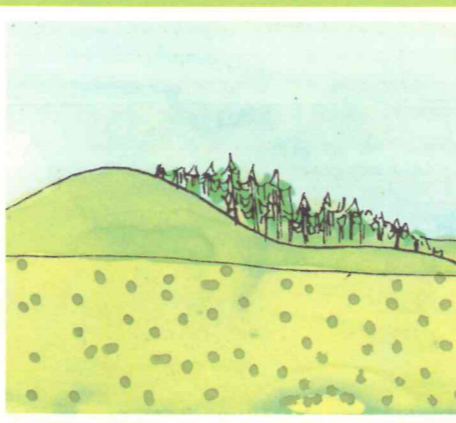
Such a pruning regime removes branches before they become excessively large and ensures that the size of the low quality knotty section in the centre of the tree is kept as small as possible. Debris from thinnings and prunings cover pasture and mulching or removal of debris may be desirable.

This form of agroforestry is being tried mainly in higher rainfall areas where timber growth rates are high and markets are relatively close by. *Pinus radiata* is the main species that has been tried. *Pinus pinaster* is also satisfactory but is better suited to very dry and infertile sites.

## Woodlots

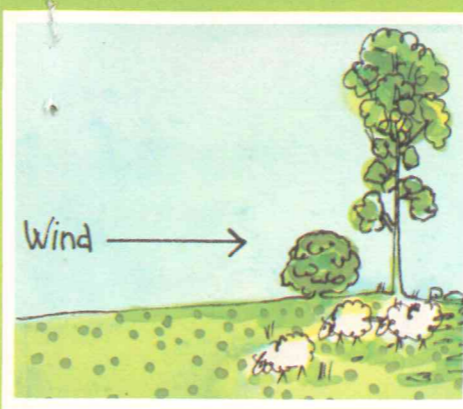
Woodlots are a type of agroforestry in the sense that they can be integrated with the overall management of a farm. For example, woodlots can be positioned on land that has the potential to erode, or on soil that is unsuitable for good pasture and crops. In addition woodlots can provide shelter for livestock, such as newly shorn sheep during bad weather. Woodlots are usually dense and managed as a small plantation to produce timber.

The main management tasks are thinning and pruning.

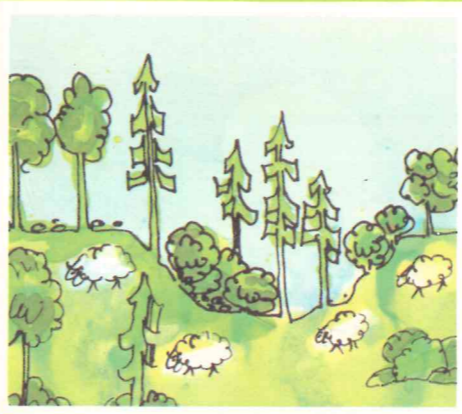


## Windbreaks

Windbreaks are belts or blocks of trees designed primarily to provide shade or shelter. However windbreaks are dynamic and can be managed for firewood or poles by thinning out. With appropriate selection of tree species, honey and stock fodder can also be products of a windbreak. In an established windbreak, grazing may become part of management. The illustrations below depict two types of windbreaks. There are many other possible designs.



Strategically placed blocks



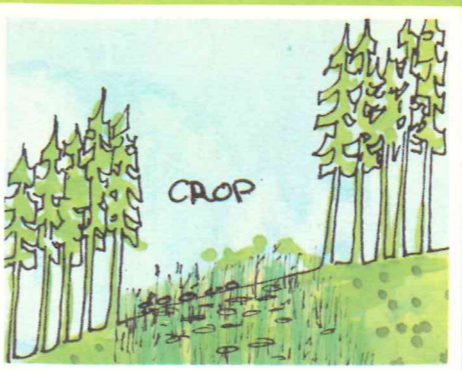
Narrow belts around paddocks

## Strips of Trees and Grazing

This type of agroforestry involves strips of trees with interstrip areas of pasture. The system is attractive because it enables cropping to continue between the strips of trees. Also thinning and pruning debris remains within the strip of trees and doesn't cover the pasture.

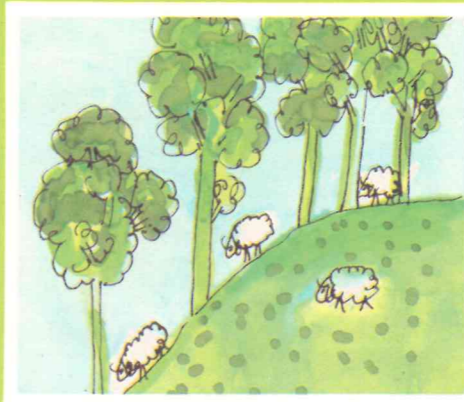
The desired width of pastured land between the strips of trees will depend on the type of farming. Where cropping is the main aim and trees are required primarily to help control wind erosion, strips could be 200 metres or more apart. On the other hand, if the objective is to grow substantial amounts of timber with some pasture then the strips could be as close as 20 metres apart.

Generally it is considered that the strip of trees should contain 3-5 rows as this width should make it possible for all trees to tap nitrogen produced by clover and to receive phosphate fertilizer. If mechanical thinning is envisaged a five row strip is an advantage as this is the number of rows that current machines thin in one pass.



## Pasture under Native Forest

Grazing stock under native forest has been practised since the first settlers arrived 150 years ago. In recent years a few farmers have demonstrated that good pasture can be established and managed under native trees.



The forest is burnt prior to spreading clover seed and superphosphate. To maintain pasture, the grass and leaves must be burnt about every second year and dressings of fertilizer applied. The main advantage of the system is that for relatively little outlay, bush land can produce returns from grazing. This technique may be especially useful on steep slopes where erosion is a potential problem. As the price of jarrah timber rises farmers may see value in tending the trees; removing the poorer ones allows the remaining trees to grow faster.

## Species for Agroforestry

Where timber production is the aim there are numerous *Pinus* and *Eucalyptus* species to choose from. *Pinus radiata* is a particularly versatile species due to its rapid growth and quality timber. The Oaks (*Quercus*) and Walnuts (*Juglans*) are examples of attractive exotic genera that produce high quality timber. Fodder trees with potential include the Carob (*Ceratonia siliqua*) and Tree Lucerne (*Cytisus proliferus*). The range of species tested under agroforestry is limited and there are many others to try.

## Economic considerations

Timber is a form of primary produce and if sold is taxed in the usual way. However, a timber crop has flexibility with regard to timing of sale. For example, thinnings can be carried out in years when income from other sources on the farm is low.

Tending of trees, mainly pruning and thinning, can enable more efficient use of farm labour as the work can be done during the quiet times of the year. Another important feature of agroforestry projects where timber is the aim, is the long time lag between initial expenditure and returns. However this disadvantage is offset to some degree by one of the main advantages of agroforestry, that there are a number of on-going benefits, such as returns from grazing under trees and control of soil erosion.

It is suggested that anybody who is contemplating growing trees for timber should determine, distance to the nearest mills, likely transport costs and the price for delivered logs. An alternative option that should also be considered is the possibility and cost of having a spot-mill come in and saw the logs on site.

## Further Reading

- Anon., (1978). "Agroforestry - a new kind of farming." C.S.I.R.O. Rural Research No. 99.
- Anderson, G.W. and Batini, F.E. (1979). "Clover and crop production under 13-15 year old *Pinus radiata*." Australian Journal of Experimental Agriculture and Animal Husbandry, 1979, 19:362-368.
- Borough, C.J. Clarke, F.B. and Barr, N. (1982). "How to prune wide-spaced radiata pine." Australian Forest Grower, March 1982, 5(1):14-18.
- Brown, A. and Hall, M. (1968). "Growing Trees on Australian Farms." Commonwealth Government Printer, Canberra. 397pp.
- Hall, N. (1972). "The Use of Trees and Shrubs in the Dry Country of Australia." Australian Government Printing Service, Canberra. 558pp.
- McKinnell, F.H. and Batini, F. (1978). "Agroforestry trials in the South-West." Forest Focus No. 20.
- Moore, R.W. (1982). "Managing a radiata pine agroforestry area in Western Australia." Paper presented to A.F.D.I. Conference, Mt. Gambier, April 1982, (limited distribution).
- Shedley, P. (1982). "Supply and demand for forest products in Western Australia. Paper presented to Agricultural Department seminar, "Trees, Forests and Agriculture," Mt. Barker, September 1982, (limited distribution).

Overall, "Grazing Trees on Australian Farms" would be the best value text. It is a comprehensive book on the use of trees for ornament, shade, shelter and timber production in the coastal and table land areas of temperate Australia. For drier areas, Hall (1972) is recommended.

## GROWING PINE TREES ON FARMS

A pilot study by Mr. D.W.G. Treloar of the Centre for Applied Business Research, has demonstrated that the economics of pine plantations are superior to those of grazing on similar land in the Manjimup region.

This applies at the most likely rates of discount, even when a pessimistic assessment is made of plantation costs and returns.

The report by Mr. Treloar draws attention to the question that if this conclusion is correct, why has the opportunity remained unexploited by farmers? The report supplies a range of possible answers.

Some of these answers depend on subjective views which lead to rejection of the evidence in favour of growing pine trees or reflect non-pecuniary opposition to pines. Two in particular, reflect measurable economic reasons why farmers may have opposed pine planting. The first of these is from the very uneven cash flow associated with farm woodlots and Mr. Treloar illustrates an annuity scheme which could be used to overcome such a problem. The second is providing alternative employment for farm family labour displaced by using a significant farm area to grow pines.

This latter issue deserves closer attention, and is dealt with at some length in the following pages, as there are solutions, supported by research results from studies involving combinations of agriculture and tree growing. These solutions not only provide means to ensure continued farm family employment but could overcome at least some of the more subjective opposition to growing pines.

### Trees and Farming Combinations

With the usual form of plantation woodlot, in which trees are generally too densely planted to allow any form of agriculture to be practised on the same area, there are alternative types of employment open to the farmer. Tending the trees, however, may not be to his liking and the work will be somewhat spasmodic. As Mr. Treloar points out, the work will probably fall short after about the fifteenth year of compensating for the minimal average earnings otherwise derived from farm work.

If a combination of more open grown pines and somewhat reduced intensity of either grazing or cropping is adopted on the same area, the perceived disadvantages of a plantation woodlot are considerably diminished. The term agro-forestry has been coined to describe the combination of agriculture and silviculture.

This combination can lead to higher productivity as both the trees and crop or pasture make fuller use of space, soil and water. In some cases, such as where pines and clover pasture are combined, the pines gain additional benefits from the nitrogen fixed by the clover. The tree shelter can give improved stock performance through, for example, lower lambing losses. Heavy grazing before the grass dries off reduces the fire hazard and also serves to recycle nutrients. Pruning debris from the trees is crushed by the animals as it dries out.

On the negative side, there can be some top soil compaction by stock and thinning or pruning debris causes some interference with grazing and machinery movement.

Clearly, the degree to which farming can continue on an area will depend on the density of trees it carries, but it is possible to maintain grazing potential as high as 65% of that on open pastures throughout the plantation life

whilst still obtaining attractive returns from timber produced. On the other hand, higher returns from timber can be obtained if lower grazing intensities are acceptable. Whatever combination is adopted, it is possible to use the annuity scheme proposed by Mr. Treloar as a means of evening out cash flow and the management regime including the involvement of farm labour for tree tending can be defined in lease agreements if a farmer chooses to be involved in a joint venture.

Examples of farming and tree growing combinations:

Two examples are included here to illustrate farm management programmes using the approximate upper and lower limit of tree density which would provide effective combinations with grazing.

Example 1. (Graph 1) favours grazing.

Example 2. (Graph 1) favours timber production.  
(Graph 2) compares tree diameter growth over time, for the two examples.

1. Emphasis on Grazing - Graph 1.

The scheme would be initiated by planting 350 radiata pines per hectare in rows about 14 metres apart. There would be about 2 metres between trees in the rows. Chemical spraying would be needed to remove grass competition from a strip about 1½ metres wide along rows before planting the trees.

Fertiliser is applied each year at the rate of 200 kilograms per hectare.

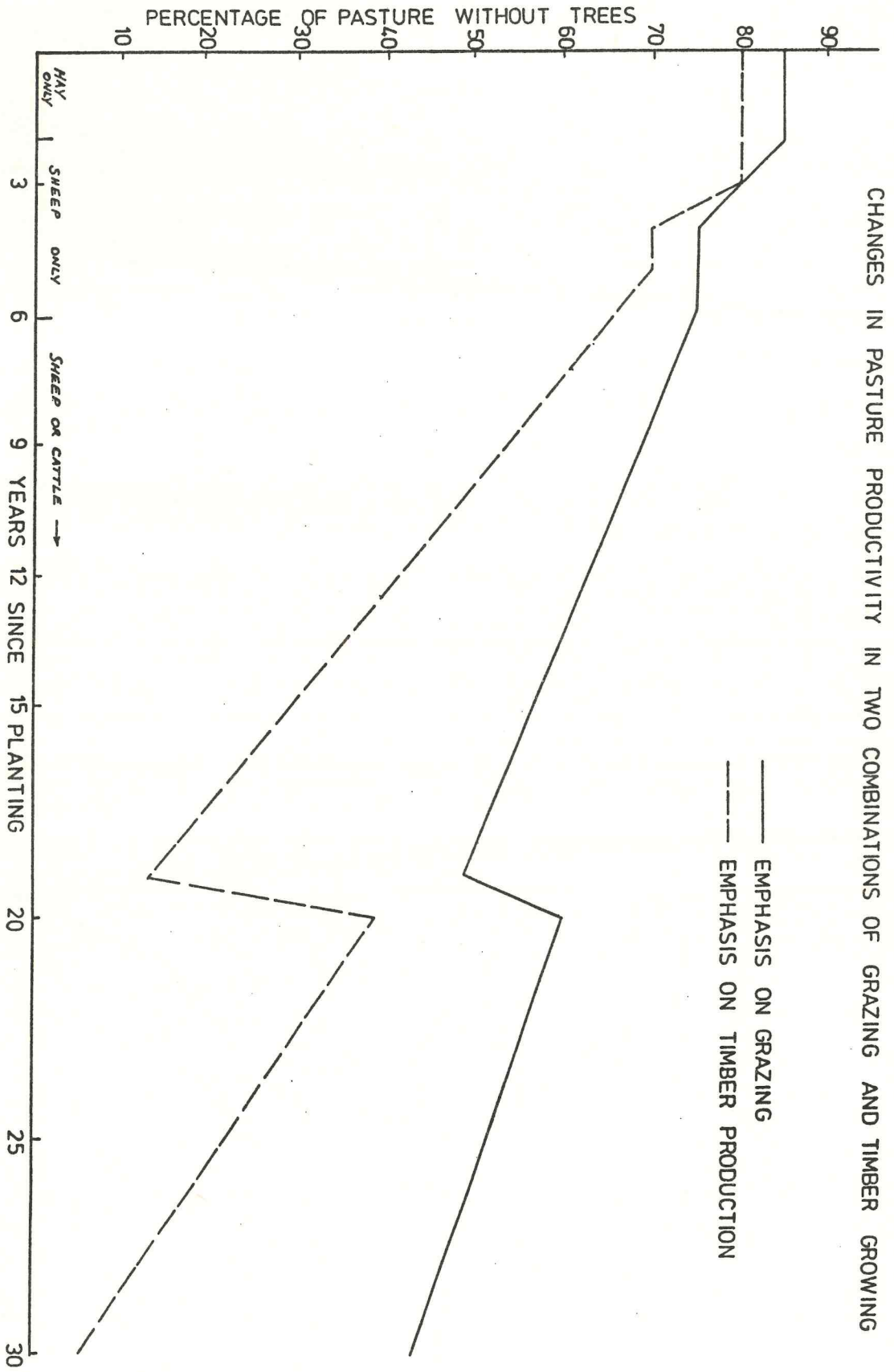
- Year 1 : Yield of hay is 85% of open pasture.
- Year 2 : Yield of hay is 85% of open pasture.
- Year 3 : Sheep grazing capacity 80% of open pasture.  
Cattle would damage trees and are not an alternative till year 7.
- Year 4 : Sheep grazing capacity 70% of open pasture till year 7. Trees are thinned. One hundred per hectare are retained and pruned.
- Year 5 : Sheep grazing capacity 70% of open pasture. Further pruning of the 100 trees per hectare.
- Year 6 : Sheep grazing capacity 70% of open pasture. Trees are thinned. Fifty per hectare are retained. Pruning continues.
- Year 7 : Sheep or cattle grazing capacity 75% of open pasture. Continue pruning.
- Year 7-19 : Sheep and cattle grazing capacity reduces annually by about 2% compared with open pasture down to about 40%. Pruning of trees continues each year to achieve branch free boles of 10 metres.
- Year 20 : Trees are thinned to 35 per hectare giving a rise in grazing capacity to 60% of open pasture. The 15 trees per hectare thinned are sold for sawlogs.

Year 20-29 : Grazing capacity reduces by about 1.5% per hectare annually to about 45% of open pasture.

Year 30 : Harvest trees and sell as sawlogs.



GRAPH 1



2. Emphasis on Timber Production - Graph 2

This scheme would be initiated by planting 700 radiata pines per hectare in rows about 10 metres apart. There would be about 1½ metres between trees in the rows. Chemical spraying would be needed to remove grass competition from a strip about 1½ metres wide along rows before planting the trees.

Fertiliser is applied each year at the rate of 200 kilograms per hectare from Year 1 to 15 and years 20 to 23. Application in other years is not warranted as grazing capacity is too low.

- Year 1 : Yield of hay is 80% of open pasture.
- Year 2 : Yield of hay is 80% of open pasture.
- Year 3 : Sheep grazing capacity is 80% of open pasture. Cattle would damage trees and are not an alternative till year 7.
- Year 4 : Sheep grazing capacity is 70% of open pasture. Trees are thinned. Two hundred per hectare are retained and pruned.
- Year 5 : Sheep grazing capacity is 70% of open pasture. Further pruning of the 200 trees per hectare.
- Year 6 : Sheep grazing capacity 65% of open pasture. Trees are thinned. One hundred per hectare are retained. Pruning continues.
- Year 7 : Sheep or cattle grazing capacity 60% of open pasture. Pruning continues.
- Year 7-19 : Grazing capacity reduces annually by about 4% compared with open pasture, down to about 13%. Pruning of trees continues each year to achieve branch free boles of about 10 metres.

- Year 20 : Trees are thinned to 50 per hectare giving a rise in grazing capacity to about 40% of open pasture. The 50 trees per hectare removed are sold as logs.
- Year 20-29: Grazing capacity reduces by about 3% per hectare annually to about 9% of open pasture.
- Year 30 : Harvest trees and sell as sawlogs.

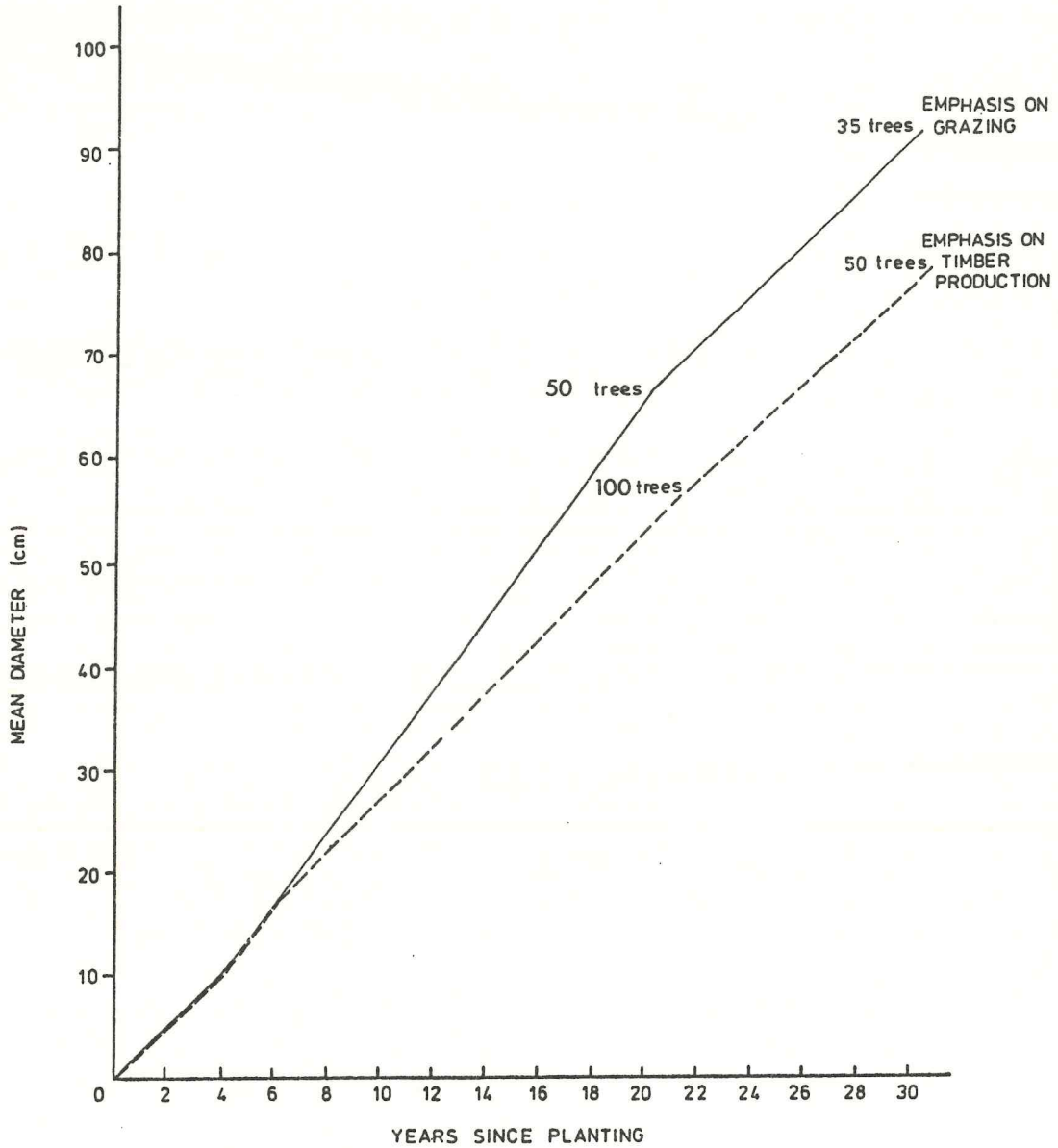
In this programme there will be no grazing income when the grazing potential falls below 30% of open pasture but grazing as a fire prevention measure is still warranted.

In both programmes some heaping of branch litter will be needed to maintain the grazing potential at its highest level. Timing of tree pruning will need to be assessed on a tree-by-tree basis to minimise branch size.

# GRAPH 2

## TWO COMBINATIONS OF GRAZING & TIMBER PRODUCTION

### MEAN DIAMETER VERSUS TREE AGE



The application of the farm management programmes would of course be supported by advice to farmers from competent extension officers from the Government Departments concerned. Although farmers would need to develop some new skills to deal with a more complex farming situation, there are numerous examples, particularly in New Zealand, that demonstrate these problems are readily overcome.

The activities involving commercial thinning and final crop harvesting require specialised equipment and expertise which can be provided by logging contractors or through the Forests Department to ensure these operations are performed efficiently.

The layout chosen for tree planting in these schemes is designed to facilitate the use of normal farm machinery for such work as fertiliser spreading and haymaking. The spacing of trees within rows is quite close to allow selection of those trees with the greatest timber potential and by age six only these trees will remain.

A good experimental basis now exists for combinations of agriculture and trees to be undertaken with some confidence but there has only been limited application of these ideas on a full scale practical farming basis. Economic analysis of the two farm management examples outlined above are currently being undertaken and will be available to the public in the near future.

There is ample scope for developing variations on this theme to suit individual preferences.