



Trees and livestock: a productive co-existence

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Trees, as part of farming, can help to combat land degradation problems and produce a good economic return from timber at the same time.

For example, there is now clear evidence that planting trees can help combat salinity by lowering water-table levels. Trees can also substantially improve overall farm productivity by providing shelter for pastures and livestock.

The challenge is to find practical and economical methods of integrating trees and farming.

A combination of widely-spaced trees and livestock is one promising method. This article describes the benefits of this type of agroforestry to farmers, suitable locations and how to practice such a combination

Agroforestry products

Two products are produced in an agroforest: timber, and pasture or crops. The timber is usually high quality sawlogs, suitable for furniture and panelling. Pasture for grazing is grown between widely-spaced trees. Crops can be grown as an alternative to pasture, especially if trees are planted in widely-spaced rows.

How agroforestry can help farmers

Increased productivity

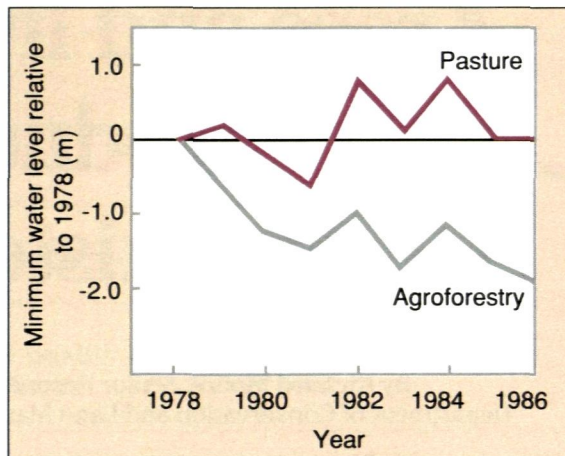
The combination of trees and pasture is more productive than either on its own. This is because trees and pastures together are able to use more of the available water, nutrients and sunlight. For example, tree roots can 'pick-up' water and nutrients which have slipped past the roots of pasture.

In a pine agroforest the combined production of timber and livestock is about 30 per cent more than production from grazing alone (Anderson *et al.*, 1988). Similar increases in total productivity are expected for other tree

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Livestock grazing amongst widely-spaced pine trees in a parkland setting near Busselton.

Figure 1. Changes in level of water-table at Flynn's agroforestry site (adapted, Schofield et al. 1989).

The level under the agroforest declined 1.9 m compared with the level under open pasture.



species. Greater productivity from combinations of trees and pasture is likely to be the main reason why farmers would practise agroforestry in farming areas which do not have serious land degradation.

Improved shelter

Shelter is an important reason for greater productivity from agroforestry. Former CSIRO scientist Geoff Anderson has found that wind-run was 40 per cent less in a five-year-old agroforest than in an area without trees (Anderson *et al.*, 1988).

Reduced wind speeds can lead to increased crop growth (Bird 1984). Shelter also improves livestock performance because stock use less energy to maintain body temperature.

Combating salinity and waterlogging

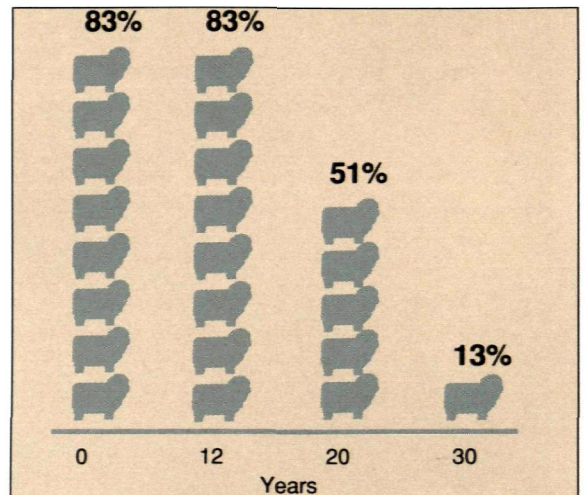
Agroforests can lower water-tables, thereby helping to combat salinity. Measurements of water-tables, by the Water Authority of Western Australia, showed that over an eight-year period the level under an agroforest declined 1.9 m compared with the level under an area without trees (Figure 1, Schofield *et al.*, 1989). The fluctuations in the level of the water-table reflect wet and dry years.

Other stands of widely-spaced trees have had similar effects on the water-table level. For example, the water-table level under an agroforest of eucalypts near Narrogin declined 0.9 m in six years (Schofield *et al.*, 1989). Agroforests can help farmers to combat salinity while enabling them to obtain an income from the land.

Diversifying income

Growing trees for timber is one way for farmers to diversify their income. Trees can be another crop on the farm; a crop which can provide on-

Figure 2. Changes in livestock carrying capacity during a 30 year rotation of 150 pine trees per hectare. Data from experimental agroforestry sites near Mundaring.



going environmental benefits and, finally, a substantial income. The timing of harvesting trees is flexible. It can be carried out, for example, when other farm income is low.

The demand for sawlogs is likely to increase. Australia imports timber worth millions of dollars each year. Furthermore, as additional areas of State forest are set aside for conservation, the traditional source of sawlogs is being reduced. Farmers have an opportunity to help meet the increasing demand for sawlogs.

Providing returns from grazing while trees grow

Although stock carrying capacity is reduced in an agroforest compared with a pasture, the land can still produce a substantial income from grazing while trees are growing.

Geoff Anderson showed that during the first 12 years in a pine agroforest the carrying capacity of sheep under 150 trees per hectare is about 83 per cent of that in an open paddock without trees (Figure 2). From year 12 onwards, the carrying capacity declines steadily as the crowns of trees expand and cut out more light. At 20 years the level is about 51 per cent and by 30 years about 13 per cent.

The density of the trees also affects the amount of grazing; the fewer trees the greater the level of grazing. Once trees reach sawlog size, the stand can be thinned. The felled trees provide income, and pasture growth beneath the stand is boosted.

Pine foliage is also useful as a supplementary feed for sheep. Sheep will eat the pruned green needles, which have more feed value than dry pasture. Trees can be pruned and culled in autumn, when feed is scarce.



Trees must be pruned to produce saleable timber and to enable reasonable growth of pasture beneath. Machines, such as this specially modified 'Squirrel', have been developed.

What to consider before undertaking agroforestry

Rainfall

Growing trees at a wide spacing can be considered in areas with as little as 450 mm of rainfall per year. This is because widely-spaced trees can establish extensive root systems and grow well despite low rainfall. Soil type and position of the agroforest in the landscape also influence the availability of water (CALM, 1987a).

The map on page 123 shows the zone where agroforestry with widely-spaced trees can be practised, assuming suitable soil type and species.

Soil type

Trees generally grow best on well drained soils with good moisture holding capacity. Sandy loams and gravelly loams at least a metre deep are especially suitable.

Agroforests can be grown on poorer soils and slightly saline areas, but it may not be possible to use the most productive timber species. The main benefits in these areas are control of groundwater levels and provision of shelter.

Tree species

The choice of tree species depends on soil type and rainfall. A selection of species with potential to produce high value sawlogs is listed in Table 1. All sites should be individually assessed to determine suitable species.

Table 1. Tree species with potential to produce high value sawlogs

Species	Common name	Comments
<i>Eucalyptus globulus</i>	Tasmanian bluegum	Needs more than 600 mm of rain per year
<i>E. diversicolor</i>	Karri	Prefers sandy loams or gravelly loams
<i>E. saligna</i> <i>E. grandis</i>	Sydney bluegum Flooded gum	
<i>E. maculata</i>	Spotted gum	Suitable for regions with 450 to 600 mm of rain per year
<i>E. sideroxylon</i>	Red ironbark	
<i>Pinus pinaster</i>	Pinaster pine	Suitable for deep grey sands
<i>P. taeda</i>	Loblolly pine	Suitable for waterlogged sites

Distance from a sawmill

The maximum distance a grower should be from a sawmill is about 120 km. The quality of the timber, the feasibility of back-loading, and whether the logs can be sawn into squared-up logs on the farm, will all influence the economics of carting logs to a sawmill.

Milling logs on the farm with a small, portable mill is also a possibility. Contractors with portable mills are operating in many districts. Farm milling has the potential to increase profitability for farmers, especially those a long way from a mill or with limited numbers of logs.

Tree layout across a paddock

The layout of widely-spaced trees is flexible (Moore, 1990). Farmers can select layouts that are appropriate for their practices and objectives.

For example, some farmers are planting several rows of trees in strips 30 to 100 m apart on the contour to help combat salinity. The trees within the strips are widely-spaced. Such a layout allows the farmer to continue to crop the land. It also benefits pasture and livestock productivity by providing shelter. A parkland arrangement of trees is another alternative.

When control of wind erosion is important, a suitable layout is trees in two or three rows 100 to 200 m apart. The tree belts must be fenced to maintain shelter to ground level. Trial areas of several hectares may be a good way to start practising agroforestry.

Main tasks

The busiest time for tending the trees is when they are about 3 to 12 years old. During this time the best tree out of about four trees is

These widely-spaced eucalypts near Darkan are planted in strips, with land left for cropping between the strips.



Cullings and prunings can be pushed out of the way and heaped with a tractor and rake blade.

selected. The rest are culled. Thus, of the 400 to 800 trees planted per hectare, 100 to 200 trees are kept. The lower limbs of retained trees are pruned, leaving a pruned trunk about six to ten metres high.

Pruning is the most costly task, accounting for about 80 per cent of all costs. However, pruning is essential to produce saleable timber and to let in light for the pasture. Farmers can do the work themselves or call in contractors.

There is some flexibility in the timing of tending trees. Therefore the work can be carried out during less busy times of the year.

If trees are in belts 100 to 200 m apart for controlling wind erosion, no trees are culled. About one in five trees is pruned, the remaining unpruned trees provide low shelter.

Correct pruning is essential to the production of high quality timber. Details are in the booklet "Agroforestry - an alternative approach to farming" (CALM 1987b) and Department of Agriculture Bulletin No. 4176 "Agroforestry with widely spaced pine trees" (1991).

Cullings and prunings can be heaped with a tractor and rake blade. Alternatively, the debris can be left to rot away, but it smothers some pasture for several years.

From 12 years old until the trees are harvested at about 20 to 30 years old, they need no further tending.

Costs and returns from trees

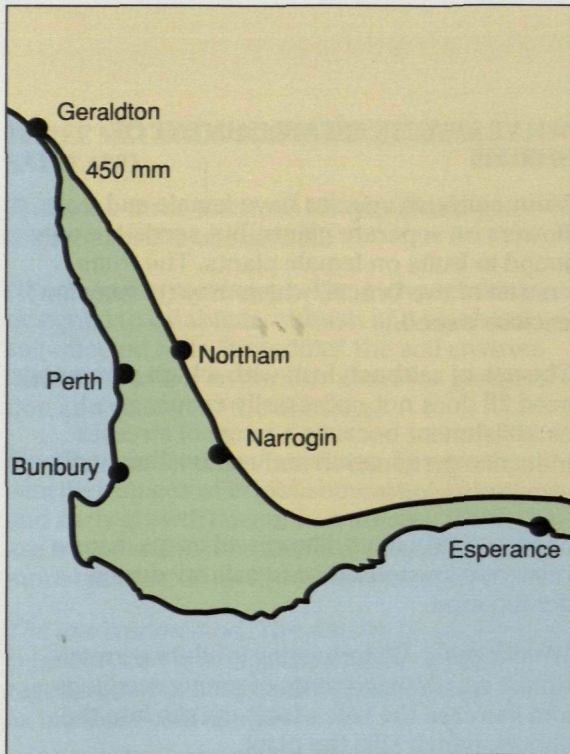
Actual costs and returns vary greatly, depending on soil type, rainfall, tree species and management methods. Data from studies of widely-spaced pine trees give some indication of how costs per tree compare with returns per tree (Table 2). Future costs and returns have not been discounted to present values in these figures; the figures in Table 2 ignore the fact that a dollar in the future is worth less than a dollar today.

Economic studies of agroforestry with widely-spaced trees in southern Australia and New Zealand indicate that agroforestry can be more profitable than a grazing enterprise alone (Malajczuk *et al.*, 1984 and Anderson *et al.*, 1988).

Grazing

As a general rule, trees need to be well above the height of livestock before the area is grazed. Trees should be at least three years old before sheep graze the pastures beneath. For cattle, trees should be at least five years old. However, trees can still be easily damaged. Grazing should be closely monitored in the early years and stock removed once they start stripping bark.

While the trees are small, the land between them can be cropped or used for hay-making. Tree stands can be protected by electric fences.



The green shading shows where it is possible to have agroforestry with widely-spaced trees in the South-West, assuming suitable soils and species.

Conclusion

A combination of widely-spaced trees and grazing can provide farmers with substantial benefits.

Studies show that total production and profit is greater with trees and pasture growing together in well planned and managed agroforests than from either trees or pasture alone. Such arrangements of trees can lower water-table levels, thereby helping to combat salinity and waterlogging.

While correct management of trees is critical to the success of an agroforest, the tasks themselves are not difficult to carry out. With correct management the trees produce saleable timber. Thus, widely-spaced trees provide on-going benefits to the farm environment while growing, and a cash return when mature.

Agroforestry is possible in areas with as little as 450 mm of rainfall per year. Layout of trees is flexible and can be tailored to suit the needs of individual farmers. Areas of just a few hectares are large enough to be viable.

Agroforestry with widely-spaced trees is an important option which farmers should be aware of as they consider how the planting of trees can best meet their needs.

Table 2. Approximate total cost and returns per tree (*Pinus radiata*)

Total costs (\$/tree)	Total returns at 30 years (\$/tree)
\$10 to \$12	\$75 to \$150



When the trees are small the land between them can be cropped or used for haymaking.

Further reading

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