# THE INTEGRATION OF FORESTRY AND AGRICULTURE

## A WESTERN AUSTRALIAN OVERVIEW

by

F.E. Batini

SUMMARY

The history, purpose and some of the benefits and problems of integrating forestry and agriculture are discussed. The current situation in Western Australia is highlighted.

## A BRIEF HISTORY

For many years foresters and agriculturists have been in direct competition for the use of land resources in the south-west of the State, particularly in the greater than 750 mm rainfall belt, where the bulk of the commercial forests are located.

Foresters suffered from the fact that their Department was not formed for almost 100 years after the establishment of the colony, and in that time very large areas of prime forest were cleared and changed to agricultural production. From the time the Department was formed in 1918, it fought a continuous battle to ensure that suitable vacant Crown Land was reserved as State Forest in quantities deemed sufficient for the needs of the population. That it succeeded in eventually reserving an area of $1.8 \times 10^6$ ha (out of an estimated area of $6 \times 10^6$ of forest) was largely due to the high clearing costs and very low fertility of the jarrah (Eucalyptus marginata) forest on lateritic soils.

We had many examples of prime forest being destroyed for agricultural production, in some cases agriculture which eventually failed. Some of the better known were the "Group Settlement Schemes" in the extreme south-west of the State. Schemes that ringbarked and destroyed thousands of hectares of prime karri (E. diversicolor) forest (Hunt, 1958). But even as late as the 1960s, the Department still faced a continuing demand for forest land to be released for agricultural production. Crown Land Tribunals were considering the future of large areas of vacant Crown Land. Farmers were demanding more and more land and many of the Department's officers were involved in land inspections to see whether these alienations should be recommended or not. The State's agricultural development of the 1960s spilled over into what has been described as the "million acre madness"; where a million acres a year of predominantly light lands were bulldozed and cleared to establish marginally economic agriculture. The changes which agriculture has created to the landscape

have been extreme, its effect on native flora and fauna in many areas, has been devastating, and more recently, its insidious and detrimental effects on the water quality of some of the State's major streams have come into prominence.

On the credit side, agricultural products (primarily wheat and sheep) have been key factors in the development and prosperity of this State. Farmers too have felt seriously concerned about the effects of reserves or State Forest adjoining their properties. They saw these as sources of pests (such as rabbits, emus or kangaroos), weeds and also possible source of fire. Others considered that the forester's attitude to alienation restricted their farm size to an "uneconomic" unit. The situation could be likened more to an uneasy truce than to open warfare.

In many cases, the wheel then turned its full circle and land cleared for agriculture was resumed or repurchased and planted again to a tree crop. In water supply catchments (Helena, Collie and Metropolitan catchments) privately owned land was resumed by the Crown to decrease the level of pollutant discharge (e.g. fertilizer, weedicides, faecal matter, salt, etc.). Because of the depressed butterfat markets some farms in the "karri belt" were purchased and replanted to karri (Underwood, 1973). But probably the most interesting phase has been the repurchase of farmland in the Blackwood Valley system. In this area, some 17,000 ha of farmland were repurchased by the Forests Department on the open market, and were subsequently planted to Pinus radiata. Originally, the farmers appeared to welcome our purchase of the poorer sections of their farm (shallow soils on steep slopes, often covered with bracken) while they retained the more fertile bottom land. Some Shire Councils and the remaining farmers now consider that too much land was repurchased and that this has had detrimental effects on the social and service facilities which serve these farming communities (McTaggert, 1977).

More recently, some farmers have strongly opposed the influx of privately managed pine plantations in the Blackwood Valley. These are seen to be primarily a "tax dodge" by absentee landowners (doctors, lawyers etc). Further development is now viewed as a real threat to the survival of the remaining farmers (bush fire control, weed and pest control, loss of social amenities, etc.). However, Councils have been less opposed to private plantations, since these are liable for Shire rates, whereas the Forests Department's are not.

For many years, grazing in parts of the indigenous eucalypt forest has occurred. In many cases, grazing leases predated the dedication of State Forest, and were then allowed to continue. The tuart (Eucalyptus gomphocephala) forest has been grazed intermittently for over 140 years (Skillen, 1977); where it is a useful means of reducing the fuel hazard. In this area, some degree of damage has occurred. In the eastern jarrah and wandoo (E. wandoo) forest considerable grazing has

also occurred, apparently with minimal adverse impact (Walker, 1977). More recently, grazing leases have been encouraged on some of the repurchased farmland in the Blackwood Valley.

## AN UNHOLY ALLIANCE?

Foresters have spoken on many occasions about multiple use of forest resources and it is interesting that this has now been extended to include a mixture of trees and agriculture, both on areas held as State Forest and on areas which are privately owned. A new word, "agroforestry" has been coined to describe this alliance. It is important to differentiate between woodlots, shelterbelts and agro- (or farm) forestry as vastly different means of achieving an integration between forestry and agriculture (McQueen et al, 1976). These all have different objectives and will yield vastly different products (both qualitatively and quantitatively). The other side of agroforestry is the farmer who has only part-cleared his block. To date he has often done this for reasons other than timber production: cost, aesthetics, salt control, shelter, pasture production over a longer period. However, this parkland system could well reduce his total production. Anderson (1977) has reported that dry matter production and clover content increased radially from the tree bole.

Preferably, agroforestry should be viewed as a complete production (not as opportunistic) system (McQueen et al, 1976). However, there is little doubt as to where the major interest of each party lies. Retention of farmer interest in a long term tree crop may well prove a problem. If it wanes and the trees become neglected, considerable investment loss could occur. The concept of agroforestry should also be broadened beyond those trees which merely have a timber value. Other values, e.g. chemical (mallet bark), fodder (mulga), aesthetic, shelter, honey potential, fuel, salt tolerance must also be considered (Glencross, 1977).

We may well ask why the foresters and agriculturalists who last saw each other at first year university, should combine again in agroforestry projects. Obviously, there should be benefits to both parties. From the forester's point of view the returns which some agricultural production ensures in the early part of a pine rotation, are particularly important to increase the profitability of his venture, (Knowles, 1972), particularly at very high discount rates, such as those which are prevailing today. Fire and weed control and provision of access are problems which have faced us for many years. The cost in recent years has escalated sharply and cheaper techniques seem to be available by the use of grazing animals. With the trend to plant less fertile soil types, a greater input of fertilizers is required. This necessitates the optimum use of fertilizer and perhaps the use of clover or similar legume to provide a continuing source of nitrogen. It is possible that trampling by animals will also increase the rate of nutrient recycling. In

South Australia, an apparent second rotation decline with subsequent rotation of pine has been reported (Keeves, 1966). Nutrient recycling, green manuring, leguminous understorey and grazing would appear to have potential of reducing this decline.

The Forests Department's "Donnybrook Sunkland" project aims to establish 60,000 ha of pine in that region within 30 years (Forests Department, 1975). It is anticipated that some 20 per cent of the area could be managed under an agroforestry regime. These would form broad fuel reduction buffers around and within the plantation cells. The additional cost of pasture establishment, fencing, watering points, etc. is considerable. Since Treasury Loan funds are limited, this will place a constraint on the area which can be managed under the joint system.

The farmer too can see some benefits from trees on his farm. In some areas (such as Esperance and the lower south coast), shelter belts have been planted to provide control of wind erosion which, in these districts, can be particularly severe. The effect of shelter belts on crops and animals has been documented for the northern hemisphere. However, while there is considerable theoretical knowledge on the length, shape, orientation and density characteristics of shelterbelts (Brown and Hall, 1968, Hall et al, 1972), I found difficulty in obtaining published experimental data on the actual benefits (or otherwise) of shelterbelts. No evidence of any benefit of shelter was presented in any of the workshop papers. Opinions on the usefulness or otherwise of shelter varies, depending upon the person whose opinion is sought (Richmond, 1977). However, animals are seen to make use of shade and shelter in times of stress and it is probable that some research in these fields would be worthwhile.

For many years, farmers have improved the aesthetic appeal of their homesteads by planting with trees and the Forests Department has, for over 70 years, provided nursery stock at near cost, for farmer use. In more recent years, sales depended largely on farmers' affluence, but quantities around the 150,000 to 200,000 seedlings per year have been sold. Further, the Forests and Agricultural Departments have combined in a programme of arboreta plantings on agricultural research stations, farming properties and Shire land. These now cover the agricultural areas of this State in over 50 arboreta, some of which are exclusively on salt land (Hewett and Edmiston, 1977). In some instances, farmers have looked for longer term investments from trees on their land. Enquiries ranged from as far away as the Kimberleys and the Pilbara (where commercial production is deemed to be unlikely in the near future) to the south-west, where a considerable area of privately owned land (7600 ha) has been planted to Pinus radiata in recent years (Forests Department, 1976).

The community too can see value in re-establishing trees on farmland. This value lies in erosion control, the reduction of flooding, silt in streams and reservoirs, and, more importantly in the control of salt

land, particularly in catchment areas which supply domestic or irrigation requirements. As mentioned previously the major streams of South-Western Australia: the Swan-Avon system, the Murray and the Blackwood are brackish or saline, largely as a result of agricultural clearing (Stoneman, 1976). Other streams in major catchment areas, such as the Collie and the Warren are of marginal quality as the result of agriculture. One of the techniques to avoid increases in salinity has been to resume farmland. This has occurred on the Helena and the Collie Catchments but the cost of resumptions is extreme. If, however, a suitable system of integrating forestry and agriculture could be found, such that the agricultural potential was retained and the trees reduced the flow of water and salt into the streams, then a solution that was economically, socially and politically more acceptable might be achieved.

For example, Williams (1977) calculate that in the Collie catchment an area of 105 $km^2$ would need to be reforested to achieve a salt level of 400 $mgl^{-1}$. This was calculated on the assumption that only 25% of the cleared area would need to be replanted, (which I personally feel is an optimistic value). Using more pessimistic estimates, the area to be reforested could range between 168 and 273 $km^2$ to achieve the 400 $mgl^{-1}$ target. This constitutes a major programme, which could take considerable time to reverse the current salinity trends (15 to 20 years). It should preferably be implemented quickly and hence, inevitably, from a position of considerable ignorance (Williams, 1977).

## TO THE FUTURE - WITH HOPE?

Although agroforestry appears to have considerable potential, research in this field has only just commenced. Many basic questions require answers. What are our needs? Which species should be considered? How long should the testing process take? Research is opening up new fields for investigations; fields requiring the joint expertise of the forester, economist, the agricultural and social scientist. With the benefits of joint studies, there are also some disadvantages (co-ordination of efforts, competition, authorship, etc.).

One of the problems is that trees take many years to express their site potential (perhaps 15 or 20) and many of us, particularly the agriculturists, are not used to waiting such a long time for an answer. I would recommend that the tree screening phase should certainly be longer than the 5-6 (or even 1-2!) years suggested by Biddiscombe et al (1977). In the first 10 years of the inland arboreta trials the outstanding species (survival, growth rate, health) was E. occidentalis (flat-topped yate). Five years later, most of these trees were either blown over or dead.

There is some disagreement as to whether the additional cost of older (2/0)seedlings offsets the gain due to earlier grazing potential in the farm situation (Borough, 1977, McQueen, 1977). In this State, a smaller

(1/0) seedling, given adequate site preparation (weed and vermin control, fertilizer) is preferred. The potential farming loss can be further reduced by inter-row cropping, hay baling or silage during the tree establishment phase.

We must also be aware of the negative interactions between trees and animals. Many grazing animals, particularly goats, horses and cattle, can severely damage or kill trees. The use of repellants, guards, pre-conditioning of grazing animals, mineral licks, etc. have all been employed to counter these effects. However, our basic understanding of why animals graze trees is still poor.

Another example of the interactions which may occur is given by the Phytophthora cinnamomi/tree/animal interaction. Pinus radiata is extremely susceptible to the Phytophthora fungus when grown in shelter belt conditions, especially beyond 20 years of age (Newhook, 1959; Batini, 1968). It appears that susceptibility is increased by compaction and camping of grazing animals and by some extract in cattle urine which stimulates the sporulation of the fungus. At the other end of the scale, there is no recorded damage of Pinus radiata by Phytophthora when the pine is grown in plantation form. Work by Shea (1975) has demonstrated the effects of dense Pinus radiata plantations in depressing soil moisture and soil temperature, to levels which are sub-optional to P. cinnamomi at least for a large part of the year. Where will the balance lie with agroforestry? Will it favour the tree ... or the fungus?

Even if agroforestry was demonstrated to be highly successful in research and operational trials, there is also the problem of extending these data to the farming community. A problem of education, of extension, of communications. The agricultural advisers will be well aware of this. In the forester's experience too, many farmers appear to have little appreciation of the requirements of a tree crop. Do we face an appalling ignorance and conservation on all sides? How will these barriers be broken? Who is going to staff and maintain this service?

Of great importance are the questions relating to the economics of the joint forestry/agricultural venture; questions such as the demand/supply positions for the various products (timber, fibre, meat, cereal, etc.). With timber resources, the time scale between establishing a plantation and a financial return can be quite considerable. The discounted profit may be quite low at the higher rates of discount. In contrast, agriculture, with its annual costs and returns, provides quite a different economic framework. The types of products to be grown in the mixed system (whether they be hardwood or softwood; chipwood, case log, saw log or peeler log quality) will have very great influence on the economics of the venture. Harvesting cost, distance from market or port, quantity and quality of resource will have key bearing on the profitability of the final outcome.

In many cases, it may be necessary and highly desirable for Farmers' Co-operatives to be set up to market their product efficiently. These apparently work quite well in some overseas countries, e.g. U.S.A., U.K. and in Europe. This aspect is currently being considered by private growers in this State. Certainly, the marketing of farm timber could be hindered by the fact that sales would be too large, established, timber firms, who could exercise a monopolistic price policy (Douglas, 1977). Alternatively, other systems of recompensing tree farmers (incentives, contracts, annuity payments) could be considered (Bond, 1977). Should private plantations be encouraged in areas which are in close proximity to State owned plantations? Will the operations in the two systems be integrated to the benefit of both parties or will both compete actively against each other for the available markets?

It is recognised that the increased labour requirements of forest operations provides an avenue for stability (or preferably an increase) in rural population. The provision of grazing leases and of part-time employment are further benefits which are available to the local community (McTaggert, 1977). However, practical aspects such as security of tenure for leases (1, 3 or 5 years?), the actual fees paid (currently $7 to 17/ha) and the timing of grazing (e.g. fire control requirements necessitates that pasture be heavily grazed by late spring) will need to be negotiated with lessees, and periodically reviewed. What will be the effects of agroforestry on a large scale, on regional employment and decentralisation? Will it in fact bring more people into the local community, thus improving services, or will the people who obtain their employment from the forest, live in the larger centres, further draining the farming community of the services which are so necessary to its well being and long-term survival?

## LAND USE PLANNING

It is important also to view the integration between forestry and agriculture in the general land use scheme. How should these two activities be integrated? In what proportion? Which areas favour each? How is the mix best obtained? These are important considerations, not only for social or economic values, but also for other factors, such as the aesthetic quality of the landscape. Computer models (such as TOPAZ-WA) are currently being used to assist the land use planning process (Bennett et al, 1977).

I believe that variety and contrast enhances aesthetic appeal and that some integration between forestry and agriculture (such as has occurred in the Blackwood Valley) can in fact improve the appeal of the area, particularly if the plantations are designed to blend and not intrude into the landscape. The use of landscape planners in the evaluation and management of the visual resource, especially where large scale, long term and highly visible changes to landscape are proposed, is desirable

(Schmidt, 1977). The British Forestry Commission have for some years been advised by a landscape consultant (Crowe, 1966). In this State, landscape proposals have been prepared for the Blackwood Valley (Gobby, 1974) and the Department currently employs a forester with professional training in landscape architecture.

Though much of this discussion has centred on economic aspects of growing trees and agricultural crops, there are other aspects of integration which could be briefly considered. These include facets such as recreation on farms, hunting or wildfires management on private property. These aspects are widely explored overseas, especially in England, Europe and in the U.S.A. In some cases, these alternatives provide a much greater economic benefit to the farmer, than does the agricultural produce from his land. The demand for these services in Western Australia seems to be low at the present time but it is quite likely that this will change. Especially as more and more people choose to live in the industrialised larger cities and their access to the countryside is reduced.

It is also interesting to note an apparent reversal away from a system of agroforestry in some parts of the U.K. and France. In some areas, Normandy and Britanny in particular, hedgerows around fields were once common. These provide shelter to stock and crops and were regularly pruned for firewood. More recent policies have chosen to "improve" agricultural production (large fields, greater use of mechanisation, specialisation etc.). In the process the hedgerows have disappeared. With what long term results?

## CONCLUSION

I believe that a better integration between forestry and agriculture can provide substantial benefits to our society and may lead to better use of the available land resources. The Australian Agricultural Council is to be commended for sponsoring this workshop.

## REFERENCES

ANDERSON, G.W. (1977). Effects of eucalypt canopies on production and composition of annual pasture. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury W.A.

BATINI, F.E. and F.D. PODGER (1968). Shelterbelt mortalities on the Swan Coastal Plain. Aust. For. Res. 3(4), 39-45.

BENNETT, D., F.E. BATINI, R. SHARPE, and J.J. HAVEL (1973). An allocation model for catchment land use planning. Inst. Eng. Hydrology Symposium, Perth, 181-183.

BIDDISCOMBE, E.F., A.L. ROGERS and E.A.N. GREENWOOD (1977). Early growth of species in farm plantations, Hotham Valley. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury W.A.

BOROUGH, G.J. (1977). Experience with tree established in pasture. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury W.A.

BOND, G.E. (1977). The role of contractural arrangements in farm forestry investments. Contributed paper, workshop on the integration of forestry and agriculture, Bunbury W.A.

BROWN, A. and N. HALL, (1968). Growing trees on Australian farms. Forestry and Timber Bureau, Canberra. p. 397.

CROWE, Sylvia (1966). Forestry in the landscape. Forestry Commission booklet No. 18.

DOUGLAS, J.J. (1977). Regional aspects of farm forestry. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury. W.A.

FORESTS DEPARTMENT OF WESTERN AUSTRALIA (1976). Annual Report.

FORESTS DEPARTMENT OF WESTERN AUSTRALIA (1975). Afforestation with pines in the Donnybrook Sunklands. Statement of Intent.

GLENCROSS, R. (1977). Diversification on farms. Invited paper, workshop on the integration of forestry and agriculture. Bunbury. W.A.

GOBBY, R. (1974). Blackwood Valley landscape plan. Forests Department of Western Australia.

HALL, N. (ed.) (1972). The use of trees and shrubs in the dry country of Australia. Forestry and Timber Bureau, Canberra. p558.

HEWETT, P.N. and R.J. EDMISTON (1977). Dry-land agroforestry in Western Australia. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury W.A.

HUNT, I.L. (1958). Group settlement in Western Australia. A criticism. University studies in Western Australian history. 3(2), 5-42.

KEEVES, A. (1966). Some evidence of loss of productivity with successive rotations of Pinus radiata in the south east of South Australia. Aust. For. 30(1) 51-63.

KNOWLES, R.L. (1972). Farming with forestry; multiple land use. Farm Forestry 14(3), 61-70.

McTAGGART, R. (1977). Effect of increasing forestry on a farming community. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury. W.A.

McQUEEN, I.P.M., R.L. KNOWLES and M.F. HAWKE (1976). Evaluating forest farming. Proc. N.Z. Grassland Association 37(2), 203-207.

McQUEEN, I.P.M. (1977). Agroforestry in New Zealand. Invited paper, workshop on the integration of forestry and agriculture. Bunbury W.A.

NEWHOOK, R.J. (1959). The association of Phytophthora spp. with mortality of Pinus radiata and other conifers. N.Z. J. Agric. Res. (2), 808-843.

RICHMOND, P.C. (1977). Review of forestry in the Esperance Agricultural area. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury, W.A.

SCHMIDT, W. (1977). The role of landscape architecture in the planning of agroforestry projects. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury, W.A.

SHEA, S.R. (1975). Environmental factors of the northern jarrah forest in relation to pathogenicity and survival of Phytophthora cinnamomi. Bull. For. Dep. West. Aust. No. 85.

SKILLEN, J. (1977). Grazing in the Ludlow tuart forest. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury, W.A.

STONEMAN, T. (1976). Effects of agriculture on stream salinity. Land management and Water Quality. Department of Environment and Conservation. A seminar, Cottesloe Civic Centre.

UNDERWOOD, R.J. (1973). Muirillup Farms project. Forest Notes 11(3), 26.

WALKER, A.W. (1977). Grazing in jarrah-wandoo forest. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury, W.A.

WILLIAMS, P. (1977). Catchment management aspects of the Wellington Reservoir salinity problem. Contributed paper, workshop on the integration of forestry and agriculture. Bunbury, W.A.