AGROFORESTRY IN WESTERN AUSTRALIA

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by

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INTRODUCTION

In the preparation of this paper some difficulty was experienced in defining what is meant by the term agroforestry. The problem lies in defining the limits to the use of the term, since the name is loosely applied to a range of land management systems which vary greatly depending on the primary purpose of the agroforestry operation. Zones can be identified where forest products, water quality protection and agriculture have varying degrees of emphasis.

In the high rainfall areas above 900mm annual rainfall, wood production agroforestry is the most likely system. In this area a major or at least a significant proportion of the economic return comes from the forestry activity. Salinity control is a secondary benefit, although it could have considerable importance in specific areas.

The 600-900mm intermediate rainfall zone in Western Australia forms the eastern portion of the catchments of many of the major water resources of the south-west region. It is highly susceptible to salinisation of both land and streamflow if native forest vegetation is permanently removed for agricultural development. Consequently, agroforestry may best be pursued for salinity control purposes.

In the low rainfall areas (<600mm), where protection of the water resource is not the primary aim in the forseeable future, but may be a socially desirable goal, agroforestry is likely to be pursued only if it is profitable to the individual farmer. The value of agroforestry lies in potentially beneficial effects on crop and animal production (especially lamb survival) and reduction in wind erosion.

There is thus a continuum of land management systems and all of them are in operation in Western Australia to some degree.

Because it is difficult to assess where the intent of the joint Council's decision lay, we have attempted to cover the whole field as we see it.

CURRENT USE OF THE SYSTEM

High Rainfall Zone

The use of limited grazing of rather poor quality pasture is commonly used in private pine plantations in the Bridgetown area. These plantations have all been established on former farmland and usually carry poor quality run out grass and the grazing is essentially opportunistic. There appears to be no real attempt to manage the pasture and grazing appears to be on an agistment basis.

In Forest Department pine plantations in the Blackwood Valley, and south of Busselton there is a thriving grazing lease system where pines have been established on pastured land. Currently some 4800 ha is leased for grazing and the area grows rapidly each year. There are two distinct situations in these plantations:

(a) young plantations where there is a large amount of pasture still present. These are grazed with sheep or cattle from age 2 or 3, depending on site quality to age 7 - 8, after which the amount of pasture is unattractive to graziers.

(b) fuel reduced buffers within large plantation units. These are strips of plantation about 1 km in width through the plantation where the trees are managed on a special silvicultural regime with extra high pruning of the limbs and very wide spacing, aiming to maintain a high quality pasture throughout most of the life of the tree crop.

There has been a continuous evolution of the way in which these leases were handled. In the mid 70s the emphasis was placed on achieving the highest possible lease rental, on the basis of one-year leases. Later, as it was realised that the benefits of reduced fire hazard of the grazing outweighed the income from the leases, the lease income was not as important as ensuring the leases were all let. Lease rentals declined in the late 1970s, there was a move away from the tender system toward annual renewal of leases subject to good performance by the lessee. More recently, leases have tended to run for larger periods - about three years - and often include a requirement that the lessee apply superphosphate at specified rates in the first and second years. This requirement for fertiliser is due primarily to the recognition of the need to actively manage the pasture in order to achieve the fuel reduction objective (Burrows 1981).

This type of agroforestry system is very successful: there is a highly significant reduction in fire hazard in young plantations; there is an effective system under development (the fuel reduced buffers) which will enable a large plantation fire to be fought; an otherwise wasted resource is utilised; the lessees are able to carry more stock without a large capital investment and local government obtains more rate revenue.

Despite the undoubted advantages, in the long term (Borough and Reilly 1976) to a farmer from such an integrated land management system, especially where there is a sure market in the forseeable future for the pine sawlogs which are the product of such a system (Anon 1977), there has been no instance of a farmer becoming involved on his own land in Western Australia.

Intermediate Rainfall Zone

In Western Australia, at least, there is currently considerable interest in the use of trees to control groundwater levels as a means of reducing the movement of soil-stored salt into streams (Sadler and Williams 1979). On some sites it is possible to grow pines in such a way that an economic return is possible. So far, such plantings have taken place only on farms repurchased by the State, but there is no reason why a farmer could not do so, in order to comply with the State's water quality control objectives, and still retain his own property. It is desirable, both socially and economically, that farmers come to adopt some form of integrated agriculture/silviculture themselves.

There are, however, many sites on which pines do not do well and it is likely only eucalypts would be used. In such situations the lack of an early and assured economic return mitigates against their voluntary use by farmers.

There are still significant areas of uncleared forest on private land in catchment areas where there is a possibility that some partial clearing strategy could satisfy hydrological objectives and still give some degree of agricultural return. So far there are only limited areas of this type in Western Australia.

Low Rainfall Zone

Most farming areas in Western Australia still have some degree of tree cover remaining, although there are localized zones where they have virtually disappeared. There is no doubt, however, that there is a steady decline in the number of trees in rural areas (see Proc. Conference on Trees in the Rural Landscape, Perth October 1981, in press). There is rarely any provision for regeneration of farm trees and the low numbers remaining are subject to an ever increasing intensity of inimical factors such as soil compaction by livestock, insect attack, mistletoe infection, disease and salinity.

The generally negligent attitude of the farming community is surprising in view of the well documented benefits of trees for shelter and erosion control (Lynch and Marshall 1969, Marshall 1967, Anon 1964). In the last few years there has been a resurgence of interest in tree planting on farms, as evidenced by sales of trees in rural areas from Departmental nurseries.

POTENTIAL FOR USE OF AGROFORESTRY IN WESTERN AUSTRALIA

It is expected that the integration of grazing and pine silviculture in Forests Department plantations in Western Australia will continue to increase. The current figure of 4800 ha leased in plantations is expected to climb to at least 12000 ha over the next few years. Although this may not appear to be a large proportion of the agricultural area, the fact that the sites on which it is used are highly productive gives it greater significance.

Furthermore, once the financial benefits of a production forestry sideline become clear to farmers in the lower south-west, it is expected there will be far greater interest in growing pines on farms. The pine utilization industry is still in its infancy in Western Australia but will assume great importance over the next 20 years as pine largely replaces hard-wood in the timber industry (Anon 1977, loc. cit).

On an area basis, there can be no doubt that the greatest potential for the use of some form of agroforestry in Western Australia is in catchment areas either already harnessed for water supply or potentially harnessable, in areas where there is an increase in stream salinity following clearing of native vegetation.

The stream salinity problem is so serious in Western Australia that it has prompted legislative controls on clearing on farms in five major catchments. There has also been some repurchase of farmland by the State in the Wellington catchment for the purpose of reforestation or prevention of clearing. Needless to say there is considerable opposition to this in the agricultural community and it is clear that agroforestry could have great potential for reconciling a social need for agricultural activity and a hydrological need for groundwater control. The importance to the State of developing efficient and workable agroforestry systems for stream salinity control should not be underestimated. If efficient systems are not developed then larger areas will have to be reforested to ensure salinity control and the impact on agriculture and the cost to the State will be greater.

If techniques acceptable to farmers can be devised and there are reasonable economic returns to the individual farmer, there is also the potential for restoring the quality of water in the two largest rivers in the southwest, the Murray and the Blackwood, to the point where they might be considered available for harnessing in the future. An inter-disciplinary land use study of the Murray Valley recently found that the greatest net social benefit from the valley would be obtained by partial reforestation so that the catchment would produce a balance of agriculture, forest products and potable water (Bennett and Thomas, In press).

Wind erosion is a serious threat to soil fertility in some agricultural areas, especially in the low rainfall zone. A suitable system of windbreaks which did not interfere with the operation of farm machinery would greatly reduce wind erosion and at the same time increase crop yields (Anon, 1964). If appropriate tree species are used, such a windbreak system could also provide a useful fodder reserve in times of drought.

RESEARCH IN PROGRESS

Although there has been active research on the problems of agroforestry in high rainfall areas of Western Australia (McKinnell 1974a, 1974b, 1979, McKinnell and Batini 1978, Anderson and Batini 1979), much remains to be done before we have adequate information for use in intermediate and low rainfall agricultural areas.

Agroforestry research in W.A. is coordinated by a Working party of the Research Steering Committee on Land Use and Water Resources. This Committee reports to a high level Research Coordinating Committee which in turn reports direct to State Cabinet.

There are several aspects of research currently being pursued by the Forests Department, CSIRO Division of Land Resources Management, Agriculture Department and Public Works Department (Water Resources Section) either as separate projects or as joint projects where appropriate.

High Rainfall Zone

The variation in livestock carrying capacity under various levels of tree stocking is being studied by the CSIRO and Forests Department at Mundaring, near Perth, and by the Agriculture and Forests Department in the Sunkland, near Busselton. There are further Forests/CSIRO studies on interactions between trees and grass with young pines and eucalypts in a number of planting patterns - dispersed over the landscape, in multi-rows with wide bays of pasture between and in small blocks. A somewhat similar experiment in the Wellington catchment tests the effect of various tree planting strategies on groundwater levels and at the same time is evaluating the practicality of managing a farm with the pasture broken up by belts of trees.

The Forests Department is studying the changes in pine tree growth habit under agroforestry conditions at several sites and is also developing techniques for mechanisation of high pruning (McKinnell 1981). There is also a cooperative experiment with the Agriculture Department at Esperance where agriculture faces two severe problems - wind erosion and salinity and it is hoped an agroforestry system will ameliorate both these factors and also provide timber for fencing and local construction in this isolated area.

Intermediate Rainfall Zone

Partial clearing or "parkland development" strategies are being studied at several sites by Forests, Agriculture and Public Works Department and CSIRO, mainly in southern catchment areas where there is a moratorium on further clearing of native vegetation. The Forests Department is normally involved in monitoring tree growth, health and regeneration and the Public Works Department monitors groundwater levels and precipitation and is developing process models in order to predict the hydrological effect of various land management practices on different sites.

On the agricultural side, there is interest in the use of trees on farms which have forage value or which produce seed or fruit palatable to livestock. In respect of forage value attention is currently focussed on tree lucerne (Cytisus sp.). A field trial near Collie is testing the use of tree lucerne in a "hedge" arrangement to provide green fodder in midsummer with the aim of developing a technique which will minimise groundwater recharge but also provide benefits to the farmer. This would be an alternative strategy to reforestation of whole farms in catchment areas.

The establishment of tree lucerne by direct drilling with a combine for windbreaks and fodder production is also under investigation.

There are a number of eucalypts which have a high content of essential oils such as cineol in their foliage. Although the essential oil market is prone to fluctuations (a situation not unknown in agriculture!) there appears to be a trend for increasing demand, and their culture could well be a profitable sideline for farmers, with some benefit to hydrological values.

Another aspect under study, although at a low level, is the development of alternative crops such as nut trees (Pistachio, Almond). One species which appears attractive is the carob (Ceratonia siliqua) which produces edible foliage as well as seed pods which can be used for stock feed or in industrial processes. The foliage would probably only be used as a drought reserve in the way kurrajong is now sometimes used in pastoral areas. There are other tree species worthy of trial, such as spineless varieties of the mesquite (Prosopis julifera), but no action has yet been taken to evaluate them.

The Forests Department also has an experiment to assess the grazing potential of pasture under young eucalypts at several levels of density in the Wellington catchment area.

FACTORS INHIBITING EXPANSION OF AGROFORESTRY

In the area of lease of Forests Department pine plantations the only factors limiting further expansion of the area devoted to agroforestry are funds for fencing some areas, lack of sufficient plantation area of the right age and some farmer nervousness about the security of their stock in leases in isolated areas.

The partial clearing concept, while appearing attractive both from the agriculture and hydrological point of view, may well have problems in respect of long term viability due to difficulties in regeneration of trees and decline in site quality due to soil compaction by livestock. This is one of many aspects on which we lack sufficient information on which to base land use decisions.

Farmers have been notably slow to see the benefits of agroforestry. While it is easy to blame this situation on the conservatism of a group who are only just emerging from the pioneering stage to a realisation of the need for development of

land use practices which are sustainable in the long term, there is insufficient research to give them viable alternative systems, especially in the wheatbelt.

In the southwest forest zone, that is, roughly all that land inside the 750mm isohyet, there is long experience with growing pines, and an expanding market for pine sawlogs. However there is currently an uncertain market for small pine logs which are the inevitable by product of large sawlog production. Nevertheless, an economically attractive case can be made for agroforestry in this area, particularly within about 100 km of the main wood processing centres. Little has yet been done to sell the idea to farmers, even where there are clear hydrological benefits, as in the Wellington catchment.

One aspect which does concern farmers is the long time delay between planting and some form of direct financial return. It takes at least 10 years to produce fence post size trees and at least 25 years to produce a worthwhile sawlog. Most farmers are unwilling to make a commitment for such a long time span for what they regard as an unproven system.

Whereas there is long experience with growing pines in the southwest and there is a bright future for pine timber, not all sites are suitable for pines. There are many sites inside the 750mm isohyet where pines are quite unsuitable and virtually the only alternative is a eucalypt. In higher rainfall areas there are a number of Eastern States species which grow well and can produce sawlog quality material under forest conditions. There is almost no experience of growing them under wide spacing agroforestry conditions. Further, some of the drier, poorer soils are suitable only for eucalypts such as wandoo (E. wandoo) or marri (E. calophylla) which either grow very slowly or are not commercially saleable.

In areas where there are strong reasons for promoting the planting of such trees, for example, for groundwater control to improve stream salinity, consideration could be given to some form of subsidy, grant or taxation incentives to encourage farmers to use them. Such a policy might need to be combined with a restructuring of farm units to ensure farms remained viable units, although there would be fewer of them.

Where suitable tree species are available for planting on farms there is still insufficient information on the best planting arrangements for groundwater control and we cannot yet estimate with any precision how long a given tree stocking will take to lower water table levels to the point where land or stream salinity is significantly affected. While it has been shown (Anderson and Batini, loc cit) that cropping between trees is technically feasible, it has not been demonstrated on a farm scale that this practice is viable. There is thus a deficiency in both basic and applied research fields.

Another gap in research which is hindering the expansion of agroforestry is the possibilities for use of fruit or nut trees in an open formation in, say, the 400-900mm rainfall zone, or the use of trees with fodder potential such as carob bean or mesquite. In the case of mesquite we have a species which appears, on paper, to have many qualities highly desirable for wheatbelt planting, but it is a prohibited import due to its

former status as a weed in the northwest pastoral areas. This is a situation where a rethink by agriculture protection authorities is justified. Only spineless varieties are of interest to us and there is not the scope for uncontrolled spread of the species which once existed in the northwest. In the wheatbelt, any undesirable expansion of the species which was not held in check by the much greater grazing pressure there would be readily controlled by chemical herbicides.

Another major factor inhibiting the expansion of agroforestry is the lack of suitable extension services, especially in the intermediate and low rainfall zones.

Many farmers do not possess the necessary knowledge to enable them to carry out a successful tree planting programme. There have been many instances, especially in the wheatbelt, of initial enthusiasm being blunted by failure to establish trees. The Forests Department is attempting to remedy this situation by the production of a series of tree care leaflets and it also maintains some 60 arboreta in wheatbelt areas to demonstrate the best species for planting in the various soil and climatic zones. This action is clearly not enough and there is a need for greater cooperation by forestry and agricultural personnel in the extension field. For largely historical reasons this cooperation has been lacking in the past but there are encouraging signs that a more enlightened attitude is emerging on both sides.

It would be of great assistance in the promotion of agroforestry if there were some financial incentives. After all, it does cost money to buy suitable planting stock and protective fencing and competition control is expensive. Low interest loans, or even grants in catchment areas could be considered. The idea of direct grants is surely justifiable where the remainder of society stands to benefit from a long term improvement in stream salinity. The most acceptable financial incentive, on a national basis, is probably the allowance as taxation deductions all expenditure for reforestation in the year in which it is incurred.

CONCLUSIONS

Although agroforestry land management systems show much promise in Western Australia - perhaps more so than in other parts of Australia - and it has made a promising start in the last 10 years, there are still major research gaps which are stifling development.

There are deficiencies in our knowledge of the hydrological implications of agroforestry under various conditions, in the use and value of eucalypts under a wide range of conditions and especially of the possible use of fodder or nut trees on farms. We need to be more flexible and imaginative in our choice of species for research and we need to spread our research wider since there is likely to be a whole range of agroforestry systems required.

We lack economic data on the potential of fodder trees such as carob or tree lucerne to improve stock carrying capacity as well as ameliorate soil groundwater conditions and above all we need to study the social aspects of agroforestry. We have to be able to show farmers there are direct economic benefits to them from the adoption of some form of agroforestry where it is appropriate to do so, as well as general benefits to society as a whole.

What we need is an expansion of the research effort and a desire on the extension front to demonstrate the benefits of agroforestry to the farmer. Both on the research and the extension aspects there needs to be much closer cooperation between agricultural and forest services.

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