Agroforestry Update

Newsletter for Agroforestry Researchers and Practitioners

Department of Conservation and Land Management

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Contents

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EDITORIAL

Thanks to all those who have contributed to this edition. We remind readers that we need your contributions, small or large, on any aspect of the integration of trees and farming. With the "Year and Decade of Land Care" coming up, agroforestry looks set to take a firmer place in developing more sustainable methods of farming. "Agroforestry Update" can help in the transfer of new ideas and information.

Thanks to the Department of Agriculture's Word Processing Centre and Information Branch for their help in preparing this newsletter.

VICTORIA'S THIRD AGROFORESTRY CONFERENCE

by Rob Youl

After one year in the planning, Victoria's Third Agroforestry Conference, held at Morwell on April 27-28, proved a great success with 280 participants.

The number of agroforesters was swelled by the device of holding the annual meeting of the farm tree groups movement at the same venue. Nevertheless there were numerous keen people at all sessions, especially landowners, and the proportion of public servants was low.

Other associated events were an occasional meeting of the Australian Agroforestry Working Group at Creswick beforehand and a series of pruning clinics run afterwards throughout Victoria by Neil Barr and Harry Bunn, the famous NZ foresters. Futhermore APM used the opportunity to announce its campaign to encourage the growing of eucalypts on private land in Gippsland through technical assistance and higher royalties.

A wide variety of papers was presented. Transcripts of all are available in the conference proceedings - $8 from Lex Aitken, Land Protection Division, 250 Victoria Parade, East Melbourne 3002. The book includes good reviews of all Victorian agroforestry species.

The conference dinner saw the award of the AFDI - Stihl Treefarmer of the Year to Harry Baess whose 25 ha property at Foster carries up to 300 sheep grazing on beautiful pasture amongst pine plantations and groves of walnuts, hazelnuts, chestnuts and tagasaste.

Second and third prizes were awarded to Noel Fox of Boolarra and Kevin and Janet Blake of Shelford.

Bill Loane and his competition subcommittee neatly blended the judging process with Bill's computer modelling activities on farm treegrowing.

The second day of the conference saw five excursions throughout South and Central Gippsland that still did not fully demonstrate the great range of treegrowing activities underway in those districts.

After a summing-up by Andrew Campbell, most participants headed home, but a few stayed to go to the first of the Bunn-Barr pruning clinics at Flynn Creek.

Undoubtedly many landowners are intrigued by the possibilities of agroforestry and will experiment with species and pruning on their properties. This is the best way we will learn how Australians can make use of the ancient craft of agroforestry - from the experiences of farmers.

"FARM TREES FOR PRODUCTIVITY AND PROFIT"
THE THIRD AGROFORESTRY CONFERENCE, MORWELL, VICTORIA APRIL 1989

by David Bicknell
Department of Conservation and Land Management
Esperance, Western Australia

This conference demonstrated not only the groundswell acceptance of the role of trees on farms, but also the move by relevant government departments and farmer bodies.

Many informative papers were given, and several encouraging case histories given by landowners. In general, I thought the willingness to use trees for productivity and profit has outstripped the quantitative information available from reliable sources. It is up to the relevant advisers and researchers to make this information accessible or to start collecting the data.

When the first tide of tree planting enthusiasm ebbs, information will be needed to calculate profitability or productivity gains. Many landowners are waiting and willing to be convinced.

Keynote Papers

"Agroforestry for productivity" was given by Geoff Anderson of CSIRO, Floreat Western Australia. The following is a summary of the paper.

Agroforestry has been defined as the management of land for increased nett social benefit by the simultaneous production of farm and forest products. This includes direct products (such as timber and fodder) and indirect products (such as shelter and lowering of watertables).

In effect, agroforestry is an umbrella definition that can include:

1. Integrating timber and livestock production.

2. Growing tree plantations on farms to reduce waterlogging, lower groundwater levels and/or produce timber for sale or on-farm use.

3. Tree shelterbelts.

4. Fodder trees and other uses.

Integrating Timber and Livestock

Advanced, wide-spaced pine agroforestry trials in Western Australia have shown a nett productivity increase.

Extrapolation of the available data gives combined production of between 118 per cent to 135 per cent of pure agriculture or pure forestry situations. This productivity gain is because the two components are not totally in competition. Extra benefits from the pines are the feed value of pine foliage, and some evidence of better livestock health and performance from consuming pine foliage.

Trees for Waterlogging and Salinity Control

The Western Australian Water Authority has been monitoring piezometers on reforested and agroforestry sites in Western Australia and have data to indicate the extent and rate of drawdown of groundwaters relative to the area planted to trees. (The relationship between actual crown cover and drawdown is a good fit - DB.)

On the sites cited, substantial drawdown was achieved within 10 years with 40 per cent of the landscape replanted.

Dense plantations occupying 70 per cent of the slope reduced groundwater by 2.0 m in eight years, compared to pine agroforestry (averaging 150 trees per hectare) occupying 85 per cent of the cleared slope giving 1.2 m drawdown. There appears to be some flexibility in the positioning of trees, density and species to give a desired result. Having pasture only led to a rise in the watertable.

Growing Trees for Shelter

Shelter benefits are available directly to livestock, crops and pastures, and to reduce soil erosion. Livestock can benefit from a more equable temperature (removal of wind chill factors) in energy requirements and survival during adverse conditions (lambing and shearing).

Crops and pastures are protected from sandblasting and desiccating winds.

Nett gains from shelter are possible only if the shelter is well designed and managed.

Three shelter programmes are worthy of note:

- NSCP Shelterbelt Project in Esperance, Western Australia (see article in this Agroforestry Update).
- Victorian 'Sheephaven' programme, and
- Chinese 'Forest-net' technique.

Trees and Shrubs for Fodder

Many trees and shrubs have fodder potential, although few have been investigated in Australia. The available trees cover a wide range of soil and climatic requirements.

Tagasaste (in Southern Australia) is the best known and most widely planted fodder shrub. Management is still being investigated by farmers and researchers.

Conclusion

Trees are not totally competitive with crops and pastures - there is a degree of complementarity which is exploited in agroforestry.

Perhaps the greatest value of agroforestry, is that without trees, there must be serious doubts about the long term sustainability of agriculture.

"Agroforestry for profit" was given by Richard Moore of the Department of Conservation and Land Management, Busselton Western Australia. The following is a summary of the paper.

Economic analyses of agroforestry options have not been readily available until recently because reliable data from actual systems had not been collected. This paper examines the economics of widely spaced pines with livestock in the 500 to 700 mm rainfall zone; plantations of Eucalyptus globulus for producing chipwood and reducing land degradation; and timber from managed pine shelterbelts.

All these options have been shown to be profitable.

Widely Spaced Pine

This system is being considered in catchment areas for potable water. The benefits are from timber, improved agriculture, lowering of the watertable, and lessening of the salt load in public water supplies.

The analysis given only considered timber and agricultural returns and therefore understated the value.

Nett present values (NPVs) were strongly affected by the discount rate used - to be expected over a 30 year programme.

The analysis showed all the proposed agroforestry regimes having positive NPVs at discount rates up to 10 per cent.

Nett present values were greater with lower tree density (i.e. higher annual agricultural returns) at high discount rates (15%). At lower discount rates (5%), tree density has relatively little effect on nett present values.

Previous analyses have shown agroforestry to be at least as profitable as a pure agricultural system.

Plantations of Eucalyptus globulus

This system is also being encouraged on catchment areas. The Western Australian government is offering it as a sharefarming scheme, and paying annuities for use of the farmers' land.

Within the targeted areas, annuities range from $65 to $110 per hectare in 900 mm rainfall and poorer soils; $95 to $125 per hectare in 650-800 mm rainfall and sandy loams; $175 to $210 per hectare in the 1,100 mm rainfall and good quality loams.

These annuities compare well with grazing enterprises on the same sites. The annuities are CPI indexed, and there is a residual amount paid to the landowner after harvesting.

Factors favouring Eucalyptus globulus schemes are:

- little management needed after establishment;
- coppicing ability after harvesting;
- fairly secure market for hardwood chipping material;
- rapid initial growth and higher water use of this species.

Pine Shelterbelts

Analysis showed good NPVs over a range of discount rates and other likely values in a managed pine windbreak in the Esperance region of Western Australia.

The assumptions and values presented in the paper have been derived from measurement of mature unmanaged trees, and experience from other pine stands in Western Australia.

Nett present values were derived from timber returns and maximum shelter benefits of 10 per cent (potential increase in stocking rate).

The NPV was strongly affected by the timber yield of pruned trees, and by the amount spent on fencing.

(However, the same pine windbreaks used in permanent cropping systems give higher shelter benefits and do not require fencing. NPVs would be much higher for this system - DB).

Conclusion

Properly managed agroforestry is profitable. Farmers, as businessmen, need to have information on the financial effects of planting trees for the expected range of benefits.

CAROB PROJECT OF THE INTERNATIONAL TREE CROPS INSTITUTE

by Henry Esbenshade

This drought-resisting, dry country tree crop was first established in this country over one hundred years ago, primaraily for stock fodder, shade and shelter in rainfall zones as low as 250 mm. Twelve high yielding cultivars from Europe, North Africa and America were introduced into four States in 1981 to start the first phase of a variety trial programme. At this time, a co-operative project with CSIRO and the Agricultural Chemistry Centre (Western Australia) is analysing pod and seed gum contents of 29 promising new selections from Western Australia, South Australia and Victoria. The National Carob Gene Pool Programme intends to expand this work in the coming year, as well as start State Registers of carob locations much like in Western Australia where over 350 locations have been recorded to date.

AGROFORESTS VULNERABLE TO WINDTHROW

by K.W. Cremer,
Division of Forestry and Forest Products, Canberra

High-pruning of radiata pine grown at wide spacings caused more trees to be uprooted by wind.

About June 1, 1988 following much rain and two days of heavy winds, many radiata pines were uprooted or seriously tilted at Francis Clarke's property "Pinebark" near Tarago in New South Wales. The widely scattered distribution of uprooted trees in this agroforestry trial and the heavy abrasion of the sinker roots showed that uprooting was due to prolonged swaying, not one or two extreme gusts. As the storm was not so extreme to make uprooting inevitable, large differences were noted betweeen pruned and unpruned trees, and some preliminary observations on this are recorded here.

The damage to high-pruned trees was found to be nine times greater than that in the surrounding unpruned trees grown at the same spacings (200, 300 and 500 trees/ha). In the high-pruned trees, 8.9% of stems were uprooted or tilted so seriously (over 10°) that they probably would not be retained as crop trees. The uprooting was about as common as the serious tilting. The above assessment was based on counts of 4,340 high-pruned trees and 3,169 unpruned trees (including the undamaged trees).

Damage to pruned trees varied from 4% to 18% on different plots, apparently mainly due to different degrees of exposure to the wind. Damage tended also to be higher on the wetter sites (despite their sheltered situations). Bigger trees were more frequently damaged than the smaller trees. There was no clear effect due to tree spacing (200-500 trees/ha). Neither the roots nor the soils were obviously at fault. The soils did not become liquid. The roots looked sound and were well distributed around the trees; but they were shallow (over 90% of the major roots were in the top 15 cm of soil).

The trees had been planted in 1978 and were about 10-11 m tall in 1988. Annual prunings to a stem diamter of 8 cm had lifted the pruned length to the desired maximum height of 6 m in 1986. After two years of further growth, the crowns were still quite small: only about 4 m long. The foliage present in these 4 m was, however, 3 to 4 times as abundant as on the top 4 m of unpruned trees. The unpruned trees were in the surrounds of each plot, grown at the same spacings, but containing also a few naturally regenerated wattles which further added to the canopy.

The peculiar vulnerability of these high-pruned trees grown at wide spacings was not expected. Unpruned trees are normally very stable when grown at wide spacings. One might also expect pruning to reduce the likelihood of wind damage by reducing the drag on the tree. The contrary result seems to be due to two factors:

(a) Increased exposure to wind: High-pruning clearly allowed far more wind to enter these extremely open pruned stands. The unpruned stands had perhaps ten times as much foliage - enough to lift the wind significantly above the ground.

(b) Adverse changes in tree shape:

- Concentration of mass and drag at the top of the tree (pendulum/cantilever).
- Loss of stabilizing effect possibly afforded by lower limbs because of their inertia and their tendency to sway at random, not in concert with the top of the tree.
- Probably reduced stem diameter growth at breast height.
- Probably less stem taper in the pruned portion of the stem.
- Probably reduced root growth while the tree is tending to restore a proper root:shoot ratio.

Note that the last three effects are known from the literature, and that the high-pruned trees have some resemblance in form to suppressed trees, which are known to be vulnerable to wind when they become exposed.

It was noted during a gusty day that the pruned tree's tops swayed through much greater arcs, that their stems seemed stiffer (at the top) and that (as a consequence) the swaying of the stems was much more noticeable just above ground level than was the case with unpruned trees. This presumably would put the roots under greater stress.

It seems from nearby older stands grown at similar spacings but pruned in earlier years, that high-pruned trees do eventually regain good stability, but may take ten or more years to do so.

It may well be that high-pruning also make the stems more vulnerable to bending or breakage by heavy loads of snow or by extreme winds that occur while the soils are dry.

The above indication of increased vulnerability of high-pruned trees is significant for agroforestry and needs careful investigation. If you have relevant evidence, please write to Dr Mike Slee (Forestry Department, ANU, Canberra) who plans to look further into the problem.

PROGRESS REPORT - TARAGO AGROFORESTRY TRIAL

by Peter Snowdon

In 1978 the Division of Forestry and Forest Products, CSIRO, and landholder, Mr Francis Clarke, established an agroforestry trial testing Pinus radiata at various stockings in improved pasture near Tarago on the Southern Tablelands of New South Wales. At three years of age the pines were thinned to their final stockings. Stands at 200, 300 and 500 stems per hectare were pruned annually from 1982 to an 8 cm diameter limit. These can be compared with stands at 500 and 1,000 stems per hectare pruned only to 1.5 m above ground level. Eight years after establishment regular heavy pruning had resulted in reduced height and diameter growth. The mean diamter over branch stubs resulting from pruning was about 15 cm while maximum branch diameter was about 4 cm. A report on results obtained during the first ten years is being prepared.

NATIONAL AGROFORESTRY WORKING GROUP BACKS DECADE OF SOIL CONSERVATION

by Richard Moore

The National Agroforestry Working Group recently considered its role in connection with the 1990s being a "Decade of Soil Conservation". The Australian Forestry Council had asked the Group to develop a strategy to promote trees on farms as an integral part of the soil conservation initiative. "Trees on farms" are recognized to be a vital element in soil conservation, particularly in the prevention of soil erosion and the control of salinity.

In its report to the Standing Committees on Agriculture, Forestry and Soil Conservation the Group strongly supports the soil conservation initiative. The report also outlines ways in which the Group considers it can assist the Department of Primary Industries and Energy in implementing the initiative. They include:

(i) having agroforestry representation on State steering committees set up to co-ordinate the initiative;

(ii) incorporating expert agroforestry advice into the whole-farm planning process when developing strategies with farmers to tackle soil conservation problems;

(iii) establishing on-farm agroforestry demonstrations directed at the particular concerns of the regional community;

(iv) holding a National Agroforestry Conference in 1992 to provide a focus for those interested in technical developments which support the soil conservation initiative;

(v) strengthening the advisory services by formal in-service training on agroforestry for advisers in agricultural and forestry organizations;

(vi) encouraging States to set up a committee (where this has not already been done) to co-ordinate State and private agencies involved with agroforestry development;

(vii) assisting with publicity for the initiative; and

(viii) by encouraging tertiary institutions with agricultural and forestry programmes to introduce agroforestry courses.

As a first step, the Working Group has provided the Department of Primary Industries and Energy with a list of agroforestry case studies which could be used in publicising aspects of the initiative.

The involvement of agroforestry in the Decade of Soil Conservation highlights the importance of "trees on farms" in the development of strategies to control land degradation.

MILLIONS PLEDGED TO SOIL CONSERVATION

by Countryman, April 26, 1989

Australia's first ever National Soil Conservation Strategy, aimed at combatting land degradation and educating the public on the importance of soil conservation, was jointly launched last week by the Federal Minister for Resources, Mr Peter Cook, and his State Ministerial counterparts.

The $45 million package on initiatives was considered so important that the Ministers announced the strategy via a national live television hook-up.

Senator Cook said the strategy was historic and exciting because it reflected a major commitment by both Federal and State governments to tackle Australia's leading environmental problem.

The principles of the programme affirm the need to:

- Integrate conservation and development, and emphasize their interdependence and common ground.
- Retain options for future use.
- Focus on causes as well as symptoms.
- Accumulate knowledge for future applications.
- Educate the community about sustainable development and conservation.

The injection of funds meant that the National Soil Conservation Programme, which allocates funding for various land projects around the country, would in 1989-90 alone have a budget of $13.5 million to work with, Senator Cook explained, an increase of nearly $3 million from this year.

Senator Cook also announced that Western Australia had received the lion's share of funding for the latest round of National Soil Conservation Programme grants.

Around $945,000 has been allocated to various soil projects in the State, with nearly a third of that sum going to technical support for land conservation districts.

Welcoming the package, Western Australia's Miniter for Agriculture, Mr Ernie Bridge, said the strategy further reflected the genuine commitment to soil conservation among farmers and conservationists.

"The strategy complements the work of Western Australian farmers and the resources management staff of the State's Department of Agriculture", he said.

Western Australia was already leading the nation in terms of developing greater community involvement in soil conservation through a network of land care groups, he claimed.

The State Government would also double its contribution to the many district committees around Western Australia with an allocation of $500,000 this year.

Mr Bridge pointed out that Western Australia already had in place its Land and Water Care Plan, aimed at arresting the problems of land degradation and salinity by the turn of the century.

NATIONAL SOIL CONSERVATION PROGRAM - TREES IN ESPERANCE, WESTERN AUSTRALIA

by David Bicknell,
Department of Conservation and Land Management, Esperance

Esperance

Managing trees for land degradation control and a possible commercial product has been investigated several times on the Esperance sandplain.

Esperance is about 600 km ESE of Perth and on the coast. The sandplain is a strip along the coast, with some interruptions, that extends from Albany to East of Esperance; a distance of about 600 kms. It stretches inland between 35 km and 80 km, and is bounded by mallee country to the North and the Southern Ocean on the South.

The region is well known for its fine sand soils, and highly erosive wind. Two thirds of the 400 to 600 mm rainfall falls in the autumn to spring period; one third falls over summer. The Esperance region sandplain covers about 1.1 million hectares.

Tree History

The style of clearing used in the main period of development (1950s) meant that large tracts of land were exposed to wind erosion following cropping and clover harvesting. Pinus pinaster (Maritime Pine) and Eucalyptus gomphocephala (Tuart) were planted in single and double row windbreaks along many road verges to help prevent sand drift from farms.

Observations by farmers of the soil erosion control and increases in agricultural productivity behind the windbreaks has led to more tree planting, especially since the early 1980s. Richard Moore, of CALM Busselton, Western Australia, surveyed pine timber potential in the Esperance region in 1986 in the light of new management techniques for pine shelterbelts. The outcome was promising, and Richard applied for National Soil Conservation Program (NSCP) funding to investigate and encourage the use of managed shelterbelts to reduce land degradation and increase agricultural productivity. Timber products were seen as a possibility with pines on suitable soils.

NSCP Landcare Project Objectives

1. Plan and encourage establishment of tree planting with a relevant management package to treat or prevent land degradation.

2. Document and demonstrate a management package using trees on farms that will provide landscape stability. That is, control wind erosion and reduce salinity.

3. Measure the effects of shelterbelts on agricultural production.

4. Extend the tree landcare package to farmers and the Esperance District Land Conservation Committee.

Progress and Directions to June 1989

The project started in March 1988.

Farm planning was seen as a requirement for sensible tree planting on most sites. In co-operation with two other NSCP projects in Esperance (Department of Agriculture), joint project sites have been established on private farms for future demonstration. Measurements of pine growth rates, watertable under windbreaks, eucalypt coppice growth, and crop production in relation to windbreaks are all being done.

The easiest to measure and most gratifying data has come from lupin and oat yields between young pine windbreaks. Parallel, five year old windbreaks are about 200 m apart. The yields between showed a small area of competition and a large area of yield gain. More crop areas will be measured in 1989/90.

Pasture measurements in the lee of mature tree windbreaks have been more complicated to interpret. The presence of a windbreak changes pasture growth directly (by shelter effects) and indirectly (by influencing grazing behaviour and the farmer's fertilizing practise). On the sandplain, this can lead to the development of non-wetting sands and large grazing pressure gradients behind the windbreak.

Extension

Trees, and their role in treatment and prevention of land degradation, have become a national issue over the last five years. This, combined with a few years of good seasons, higher wool prices, and the spectre of rising saline watertables in the region, have made many farmers very keen to learn about tree planting.

At a recent tree planting machinery field day, more than 120 people stood in a continuous downpour to view machinery from four companies.

Farm planning workshops with vegetation planning are being requested by local catchment groups.

Newspapers and radio stations are accepting nearly all news items concerned with trees.

As an indication of the interest, about 350,000 seedlings were planted in the Esperance region this year. 'Home grown' plants, direct seeding, and areas of natural regeneration are extra to this figure.

Direction

The last serious regional wind erosion was in 1981. Waterlogging and salinity have been of increasing concern over the last few years. Watertable monitoring has shown some areas with 30 to 60 cm rises per year.

Winter waterlogging and summer recharge is leading to interest in perennial pastures, drainage and trees. Although technically little understood, trees for drying salt areas are being tried on many sites. Bore holes for monitoring the watertable have been put in by the Department of Agriculture.

In summary, the concerns of Esperance farmers centre on land degradation from rising salt/watertables, wind erosion/exposure, and non wetting sands.

Trees are a useful tool in treating the first two problems.

This NSCP project is well on the way to demonstrating some quantitative gains from managed tree belts, and encouraging the planned use of vegetation on farms.

SUMMARY OF STAG

by David Cameron

Project STAG was commenced in 1983 to examine the competition between a tree (Eucalyptus grandis) and a pasture (dominated by Setaria sphacelata) for water, nutrients and light. A competition ring design was used which provided a range of tree densities from 22 to 3,580 stems ha^{-1}. The experiment is located at Samford (23 km west-north-west of Brisbane) and researchers from four CSIRO Divisions, both Brisbane Universities and the Queensland Institute of Technology were involved in various aspects of its installation and monitoring.

The major findings after three years of intensive measurements of pasture and tree production and soil water content are as follows:

1. Pasture production was not lowered by the presence of trees up to a stand density of about 300 stems ha^{-1}. The trees were then about 9 m in height.

2. Pasture nitrogen and potassium contents were higher under shade than in the open.

3. Individual tree biomass production was highest at about 300 stems ha^{-1} and decreased to both higher and lower densities.

4. At high stand densities (2,150 stems ha^{-1}), trees exploited soil water very effectively, removing it to wilting point to a depth of about 1.5 m after 1 year, 4 m after 2 years and to deeper than 5.6 m after 3 years.

5. Trees seemed to benefit from a "mutual protection effect" at all stand densities. This was of most benefit to the trees at the highest stand density in the first year. As the trees grew and competition affected growth, the optimum stand density became progressively lower to 1,000 stems ha^{-1} at age 2 and 300 stems ha^{-1} at age 3.

PROSOPIS - AN INTERESTING GENUS

by Geoff Anderson

Introduction

The genus Prosopis (Mesquite) is widely distributed in arid and semi-arid regions of Latin America, Africa, Asia and Southern United States of America. Forty-four species are recognized and seven of these have been extensively studied. These species are P. juliflora, P. pallida, P. chilensis, P. alba, P. nigra, P. tamurugo and P. flexuosa. There is considerable variation between and within species and natural hybridization is common.

Prosopis is a deep-rooting leguminous, multi-purpose tree or shrub. It is cultivated for timber, food for humans and livestock, fuel and for reclamation of degraded lands. Some species tolerate very low rainfall (< 100 mm) and others are extremely salt tolerant. At least one produces timber with exceptional physical properties. Prosopis will grow on a wide range of soil types. It will tolerate extremes of temperature from desert heat to areas with upwards of 100 days of frost per year.

Prosopis trees range in size from single stemmed trees of 60 cm diameter and 15 m height to low multi-stemmed shrubs. The more arboreal types may still require reduction of stems from perhaps three to one if timber production is an objective, and pruning of pendulous branchlets for livestock access to the fallen pods.

Wood Values

Dewayne Weldon of the Texas Forest Service has studied the properties of 'mesquite' wood and this abstract of one of his papers is worth quoting:

"Weldon, D., 1986. Exceptional physical properties of Texas mesquite wood. For. Ecol. Manage., 16: 149-153.

The mesquite tree has long been considered a pest tree in the south western United States. Only in recent years have the exceptional physical properties of the wood gained the widespread recognition that it deserves in this country. The natural colour, grain pattern and texture of mesquite wood can equal that of the finest hardwoods. High strength values give mesquite wood advantages over many other hardwoods. Mesquite wood has no peers when it comes to dimensional stability. Mesquite wood also excels in its ability to resist degradation by decay organisms. Although some obstacles remain, the future for mesquite wood appears bright."

Another attribute of the wood is its high calorific value (1,720 J kg^{-1}) which makes it prized as firewood and excellent for conversion to charcoal. The wood is popular for barbecuing because it imparts an attractive flavour to the meat. Biomass production from stands grown for fuel can be as high as 50-60 tonnes ha^{-1} in ten year rotations.

Food Values

The fruit of Prosopis have numerous food values. Whole pods are 11-17% protein and 13-34% sugar with most of the protein contained in the seed and most of the sugar in the pod pericarp. The seed also contains a galactomannan gum which can be used as a food thickening agent and in oil drilling

operations. Pods are dried and ground to make a flour which can be used to replace some of the wheat flour in various products e.g. biscuits, extruded products and drum-dried flakes. Roasted ground pods can be used as an additive to coffee. Up to 70% substitution does not significantly alter the coffee flavour. "Mesquite syrup" can be used as a sweetener.

For livestock, pods are fed to sheep, cattle, goats and pigs. A figure of 35% of "mesquite flour" is quoted as being used in rations for pigs and lot-fed cattle. The addition of mesquite flour at up to 50% substitution rate in wheat based diets for animals increased digestibility, energy value, protein value and improved the balance of amino acids.

The leaves of Prosopis contain 10-15% protein and are grazed by livestock. High phenolic content in some species reduces palatability and digestibility of the leaves. Yield of pods has been variously quoted. For example, a 5-year old plantation in southern California (370 mm rainfall) yielded 3-4,000 kg ha^{-1}, while in Brazil a similar aged plantation yielded 6,000 kg ha^{-1} per year. A third yield of 14.5 tonnes has been quoted. Older trees can produce more than 100 kg of pods per yer. Prosopis flowers prodigiously in springtime producing considerable amounts of nectar. This yields a good quality honey.

Land Management Values

Prosopis has qualities particularly suited to the improvement of degraded, saline sites in low rainfall areas of Australia. It can withstand the extremes of temperature and low, sporadic rainfall and can produce quite well on sites with salinity levels similar to those generally used for Atriplex species (5-10,000 ppm T.T.S.). The deep rooting habit of Prosopis should allow it to tap into and lower saline groundwaters.

Problems with Prosopis

Management problems include the need for pruning to improve form and below tree access for livestock. Harvesting of pods for human foods or for feeding to livestock elsewhere could also be laborious.

The thorns can cause eye and foot injuries in livestock, especially if the pendulous branchlets are not removed. If pruning is not done, the thorniest species (e.g. P. juliflora) are avoided by livestock and hence gradually develop into impenetrable thickets.

A number of insects are predators on Prosopis. One, Oncideres limpida, constitutes a serious threat in Brazil because the female, after laying eggs on a branch, then severs the branch at the base. Use of insecticides on this pest is being studied.

A major problem with Prosopis is the degree of hybridization which occurs coupled with the fact that one parent may carry the thorn gene. Offspring would then vary in thorniness. Roguing out thorned individuals in a plantation and using asexual propagation are techniques which could be used to minimize this problem.

The last problem to mention is that no single species combines all the good qualities of the genus. Careful selection would be essential for particular objectives.

The Australian Situation

Currently, through unfortunate experiences with P. juliflora in tropical Australia, the genus Prosopis is a prohibited import and a declared weed. In fact, there is some work being done on lines of biological control.

However, there are some who recognize the very real values of some species for our degraded and saline, low rainfall agricultural and pastoral lands. In 1987, in Western Australia, a Prosopis Introduction Committee was formed with Dr F. McKinnell of CALM as Chairman. The Committee wishes to import Prosopis material so that the potential can be evaluated under our conditions. At present the Commonwealth Plant Introduction people are standing by the status-quo, mainly because of the risk that thorniness may develop by back-crossing or other mechanisms.

I strongly support a relaxing of the prohibition, not only because the genus has so much to offer, but also because evaluation of a limited amount of material under properly supervised conditions is extremely unlikely to cause problems. Techniques for eradication are now well developed in the United States of America. The genus can be managed.

On a visit to Texas I spoke with Peter Felker and asked him to recommend lines with minimal thorn development, tree form, high pod production, salinity tolerance and high transpiration. He has suggested three accessions of P. alba which have those attributes and of which seed is available. If we are allowed to bring these in an evaluation project will be quickly established.

I would be pleased to receive correspondence from others similarly interested or with constructive criticisms to offer.

Finally, I must confess that in the preparation of this article, I have extracted material from a number of authors. I particularly wish to acknowledge the report by Ray Fremlin, of CALM, on the II International Prosopis Conference, Recife 1986; Felker et al.; Nelson, Robertson, Almanza and Moya, and Meyer et al. I have reprints of their papers available.

"GREENHOUSE" MEANS TOLERANT TREES

by The Weekly Times, May 3, 1989

Farmers planting trees from now on must choose species with the widest possible tolerance to climate changes.

Mr Arthur Lyons, convenor of the Victorian Government's Agroforestry Committee told the Third Agroforestry Conference, at Morwell last week, that until the effects of the "Greenhouse Effect" were known, trees grown should have the widest possible climatic tolerance and farm woodlots should consist of a number of tree species to play safe.

Mr Lyons, an officer of the Department of Conservation, Forests and Lands, said the influence of the "Greenhouse Effect" on trees was now being seriously examined by scientists.

It also would affect pastures grown by farmers.

The warming of the global climate is predicted to increase the average surface temperature by 1.5 to 4.5 degrees within 40 years.

Rainfall Patterns

"Changes in rainfall, rainfall patterns and soil moisture may be more dramatic than the increase in temperature."

"It is likely that summer rainfall will increase. How winter rainfall will change is uncertain."

Mr Lyons said within five years CSIRO research should be able to provide reliable predictions on changes in climate.

Mr Lyons comments triggered private discussion about the new potential of poplars and Paulownias in agroforestry.

Both species have a wide climate tolerance, and appear to have excellent market prospects once a volume of wood can be developed.

Poplar agroforestry is known to be able to increase grazing profitability by about 20 per cent in a 15 year rotation and then give a return of $7,000 to $8,000 a hectare in wood sales.

Paulownia's commercial viability has yet to be established, but three cheese companies are studying the prospect of using Paulownia wood for specialty cheese packaging - with the wood being grown by their dairy farmer suppliers.

Other private discussions focused on the wide climate tolerance of pines of various species, plus the Australian red gum - which grows from Australia's tropics to the cold plains of central Tasmania.

Thoughtful Response

Other eucalypt species also have wide climate tolerances.

These discussions at the conference indicated that the "Greenhouse Effect" publicity has already triggered thoughtful responses among agroforesters.

CALL FOR MEMBERSHIP: IUFRO PROJECT GROUP ON AGROFORESTRY

IUFRO News, March 1988

The International Union of Forest Research Organizations (IUFRO) established a Project Group on Agroforestry at its 18th World Congress in Ljubljana (Yugoslavia) in September 1986. Since then, there has been no formal call for membership in the Project Group, although several people have expressed an interest in joining.

The Project Group is concerned primarily with the potential contribution of forestry specialists to the multidisciplinary focus of agroforestry, including questions on the establishment, management and improvement of multipurpose trees in croplands and pastures, and economic and other issues related to the use of multipurpose trees for fuelwood, fodder, building poles and other products. The Group will also address the institutional question of how foresters can best integrate their efforts with those of agriculturalists, economists and social scientists to develop improved agroforestry practices and systems.

All researchers with an active interest in any aspect of agroforestry who are staff members of an organization affiliated with IUFRO can become members of the Project Group on Agroforestry. Those interested in joining are invited to write to the IUFRO office holder from their region listed below. Ideas and proposals for possible activities for the Project Group will also be appreciated. Following replies to this call for members, a tentative membership list will be circulated as well as proposed activities for the period up to the 19th IUFRO World Congress, to be held in Montreal (Canada) in 1990.

Dr Bjorn Lundgren
Director General
ICRAF
PO Box 30677
Nairobi, Kenya

Chairman and overall co-ordinator responsible for membership and activities in Africa and Europe.

Prof P.K. Khosla
College of Forestry
University of Horticulture and Forestry
Solan 173 230, India

Co-chairman responsible for membership and activities in Asia and the Pacific region.

Prof G. Budowski
Head, Programme of Natural Resources and Quality of Life
University of Peace
San Jose, Costa Rica

Co-chairman responsible for membership and activities in South, Central and North America.

ASSESSMENT OF RECHARGE REDUCTION BY MANAGING TREES FOR OIL AND FODDER PRODUCTION

by Phil Scott,
Division of Resource Management,
Department of Agriculture, Perth Western Australia

A trial to assess the ability of different tree species and shrubs to reduce groundwater recharge was commenced on the Wongan Hills Research Station (140 km NE of Perth) in 1986.

The trees have been selected, and will be managed, for oil production. The shrubs have been selected for their fodder potential. Oil and fodder production of these species will be assessed.

Rainfall at the site averages 380 mm annually, with a distinct cool wet winter and warm dry summer distribution. The soil is a deep yellow sandy loam (6 metres deep) of aeolian origin, with occasional unconsolidated iron nodules and clay lenses.

Nine species of eucalypts are being assessed for oil production, and one (E. camaldulensis) is being used as a "tree control". Two species are being assessed for fodder production, and conventional pasture is being used as a grazing control.

Seed for the eucalypts was collected by CSIRO and raised to seedlings by ALCOA of Australia.

Establishment

One metre wide strips were sprayed with 1 litre per hectare of Roundup® and deep ripped. Seedlings were planted out in July 1986 on a 2 x 1 metre spacing (5,000 stems per hectare) except for E. camaldulensis (2,500 stems per hectare). All seedlings were drip irrigated over the first summer. Establishment was generally good, but dead seedlings were replaced in June 1987.

The thirteen treatments are replicated four times in plots 25 by 25 metres. Each plot has a centrally located neutron moisture meter access tube to a depth of 5 metres to measure soil moisture on a monthly basis. Boreholes are located at the extremities and the middle of the trial block.

Early indications are that the trees removed between 50 and 110 millimetres of extra water from the soil profile than did pasture between March 1987 and March 1988.

The bulk of the plots were harvested using a modified forage harvester with reinforced cutter bar and fingers. Some plots having trees with larger stems were cut by chainsaw. The 2 x 1 metre spacing proved to be difficult for harvesting because the tractor had to straddle the freshly cut row to get to the next one.

Large differences in biomass production within species were found to be related to the presence of a perched water table in the lower lying corner of the trial. A five-fold variation was noted within some species. Acacia blakelyi and tagasaste (Chamaecytisus proliferus) both yielded well. Of the oil producing species, the dry matter yields of E. loxophleba, E. kochii and E. spathulata were impressive.

The next harvest is scheduled for August 1989, when an assessment of oil yield will be carried out by Murdoch University.

Species	Establishment	DM yield (t/ha)
E. angustissima	good	0.68
E. borealis	good	1.07
E. calycogona	good	0.68
E. dives	poor	0.98
E. kochii	variable	1.52
E. loxophleba	very good	2.16
E. plenissima	good	0.68
E. radiata	variable	1.05
E. spathulata	good	1.26
A. blakelyi	poor	2.96
C. proliferus	variable	3.66
E. camaldulensis	variable	uncut

"TREES ON FARMS" BOOK IN PRESS

The book, "Growing Trees on Australian Farms". has been revised and is with the publishers. According to Alan Brown, CSIRO, Division of Forestry and Forest Products, Canberra, the book has been largely rewritten. It should be available by Christmas 1989.

There are no plans at this stage to reprint "Trees and Shrubs for the Dry Country". The book, which was also produced by the CSIRO, is considered to have a small market.

MORE MONEY IN PINES THAN GRAZING

by Weekly Times - May 3, 1989

Agroforestry with wide-spaced pines in the 500 to 700 mm rainfall zone is more profitable than a purely grazing enterprise.

This is the conclusion that Mr Richard Moore, one of Australia's leading agroforestry research scientists, presented to the third agroforestry conference at Morwell last Thursday.

It is the first time such a conclusion has been presented by an Australian agroforestry researcher, and his practical research results now underpin Victorian research observations.

Mr Moore is employed by the Western Australian Department of Conservation and Land Management (CALM).

He told the conference that there was mounting evidence that agroforestry in which widespaced trees were grown for timber and grazed between them with livestock, was more profitable than either forestry by itself or grazing by itself.

But he emphasized that management was critical in agroforestry.

Results of West Australian agroforestry research had shown that it could overcome many land degradation problems on farms besides giving another source of income - from timber.

His studies had also concluded that dryland salinity problems could be overcome in many areas by using agroforestry regimes on key farming areas.

Mr Moore told the conference about West Australian tree farming of southern blue gum (Eucalyptus globulus).

These plantations for pulpwood were providing farmers with another farm enterprise to consider. Through a system of annuity payments, farmers who committed land to eucalypt crops could still have an annual income from their land in the same way as other agricultural enterprises.

The annuities were now comparable to returns from other enterprises. They varied from $65 to $210 a hectare depending on soil type.

Twenty to 40 hectares was the minimum eucalyptus planting commitment, depending on soil type, and the growing cycle was eight to 12 years.

Under this government sponsored scheme, a farmer did not have to commit large tracts of land, and the landscape benefited by having a mosaic of trees and farming.

"FOREST-NETS" CAN BOOST GRAIN CROPS

by Weekly Times, May 3, 1989

Australian cereal growers should consider the Chinese system of forest net agroforestry.

Mr Geoff Anderson, an agroforestry scientist with CSIRO in Western Australia told last week's agroforestry conference at Morwell, that grain yields in China had been increased from 10 per cent to 40 per cent using the forest-net system.

The increase depended on the crop species and the climate.

Under the forest-net system a good perimeter shelter belt is grown to slow and elevate the wind as it sweeps across a cereal-growing plain. Trees scattered within the paddock (40 hectare paddocks being recommended) help keep the wind above crops (or livestock grazing stubble or pasture).

Australian cereal growers should consider the Chinese system of forest net agroforestry.

"I believe we can adapt this idea to suit cereal growing in light soil, high wind areas of Australia," he said.

Mr Anderson said internal trees on cereal farm paddocks could be in rows to make harvesting easy. He saw rectangular paddocks with perimeters of permeable windbreaks as the best.

Benefits

"The reduction of area planted to cereals and the increased time to sow and harvest (due to long, narrow strips) could well be compensated for by increased yield," he said.

"The other benefits of retained topsoil and moderate effects on salinity and water-logging problems, and timber production, could in the long term offset the establishment costs."

He said farmers prepared to undertake such innovative projects did a great service for their colleagues.

They also helped themselves to sustained yield from land, and sustained profit.

"Matching the system to the site, then managing it astutely are the keys to high productivity of agroforestry systems.

"Trees are not totally competitive with crops and pastures - there is a degree of complementarity, which is exploited in agroforestry," he said.

"Furthermore, the presence of trees can be important in animal production in soil conservation and for water quality. When these multi-purpose values of trees are taken into account the productivity of agroforestry systems can be high indeed.

"Perhaps the greatest productive value of agroforestry is that without trees, there must be serious doubts about the long-term sustainability of agriculture," he concluded.

CHANGING ATTITUDES TO TREES

by Andrew Davies,
Farming News, Newbury Hampshire, October 6, 1988

Editor's note: "This item has been included here because of its novelty value, and as a basis for discussing related proposals in Australia. Most of Australia's tree schemes are now based on commercial enterprises or land conservation."

Should trees be planted all over England's green and pleasant land? The vast majority of the timber used in this country is imported and there seems little prospect of home production ever exceeding 20 per cent. In the context of surplus food stocks, there is considerable scope for an increased area of woodland, and the Government is committed to encouragement. The growing of timber, however, has little commercial viability and the reasons for planting woodland are rarely financial. Established woods and hedgerows have suffered over recent decades from natural disasters such as Dutch Elm Disease and the hurricane last October, and from clearing by some landowners and apathy in others. Attitudes are changing, the impetus coming perhaps from those very forces which caused the destruction and there has been an upsurge in enthusiasm largely due to pressure in the media and to Government initiatives.

There has been considerable publicity concerning the tax changes in the last Budget. Until last March, any costs of planting and maintaining woodland could be offset for tax purposes against income from whatever source. This resulted in sporting and show business figures like Steve Davis and Terry Wogan owning great tracts of forest. In the Budget, forestry has been removed from taxation altogether, there are no tax concessions on planting nor any tax payable on the income from felling. The changes are not so dramatic as they seem due to the reduction in the top rate of income tax to 40 per cent and to increased grants from the Government. I wonder whether any benefit to the countryside came from woodlands owned by those only concerned with their tax position and how soon they will sell now that the concessions have been abolished?

On poorer, cheaper land big forests with economies of scale may be viable, although vast conifer plantations in Scotland raise environmental issues which cannot be considered here. Small woodlands in the south cannot be commercial and the main reasons for planting trees here are for recreation and amenity. Many landowners are concerned to maintain and improve the beauty of the countryside and the value of their estates, but shooting is perhaps the biggest single factor. More and more days shooting are being sold and the sporting rights on many farms are increasingly being considered as assets to be exploited. The proceeds contribute to farm income and the grants now available make woodland management more attractive.

There are two main Government grant programmes, the Woodland Grant Scheme, which covers the management and improvements of existing woodland, and the Farm Woodland Scheme to encourage the planting of new woodland on agricultural land. The Woodland Grant Scheme, coming into effect on April 1 this year, provides planting grants which vary from £240 per hectare for areas of conifers over 10 hectares to £1,375 per hectare for areas of broadleaved species between one and three hectares. The grant is paid in three instalments, 70 per cent on completion of planting, 20 per cent after five years, and 10 per cent after 10 years, subject to satisfactory establishment and maintenance. The cost of planting varies enormously depending upon any drainage and fencing required, but the grant should represent at least 50 per cent.

The Farm Woodland Scheme offers a loss of income payments in addition to the same planting grants described above. In order to be eligible, planting must be carried out on arable land or grassland which has been cultivated and reseeded within 10 years. At least three hectares must be planted, one hectare in any one block, and there is a maximum of 40 hectares. The annual grant is £190 per hectare and the length of payment depends upon the species grown, 40 years for oak and beech alone, 30 years for mixed species with at least 50 per cent broadleaved, and 20 years where the broadleaved trees make up less than 50 per cent. The level of grant will be reviewed in 1991 and at intervals of not more than five years thereafter, but it may go up or down.

This scheme has obvious parallels with the set-aside programme and, indeed, new woodland planting may form part of any set-aside plan. The area planted with trees would count towards the minimum of 20 per cent of arable land and the grant would be that of the Farm Woodland Scheme payable over the longer period rather than five years. It is the Government's hope that 36,000 hectares of existing farmland will be planted with trees during the initial three years of the scheme.

For small amenity areas and for new hedgerows there are a variety of grants available from the Countryside Commission and country councils. Payment is normally a percentage of the gross costs, including fencing, from 33 to 50 per cent depending on the merit of the scheme and the amount of money available.

Most farms have areas of marginal land which produce poor crops, and it is likely that the loss of income payment will exceed that from farming. There is no advantage in having arable fields larger than 20 hectares, and a hedge round each field would improve the wildlife habitat as well as the beauty of the farm. There is advice available from national firms and smaller, local ones such as Wessex Woodland Management, and the initial consultation is likely to be free of charge or obligation. This Government initiative deserves success and I fervently hope that the volume of tree and hedge planting will continue to increase.

The following additions have come in since 'Agroforestry Update No. 7'.

Peter Swain
Telephone (062) 72 4266
Forestry Branch
Department of Primary Industries and Energy
CANBERRA ACT 2600

Interests: Integrated land-use on farmland including farm forestry and environmental conservation.

Current projects: On two-year attachment to DPIE from UK Agricultural Extension Service ADAS.

Peter Bradshaw
Telephone (053) 41 3321
2105 Geelong Road
MT HELEN VICTORIA 3350

Interests: Would like to provide consultancy service in agroforestry. Interested in group marketing of farm timbers.