



Sub-Program 2.2

Agroforestry and Farm Forestry

JVAP Completed Projects in 1999-2000 and
Research in Progress as at June 2000

**RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry
Program**

with support from the Natural Heritage Trust and the Murray Darling
Basin Commission

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*"RIRDC Completed Projects in 1999-2000 and Research in Progress as at June 2000 - 2.2 Agroforestry and Farm Forestry
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Foreword

This year RIRDC has produced *Research in Progress, June '00*, which contains short summaries of continuing projects as well as those that were completed during 1999-2000 for all of the Corporation's 20 program areas.

The complete report on all the programs is only available in electronic format on our website at <http://www.rirdc.gov.au>

The following report is a hardcopy extract covering Sub-program 2.2. It contains all entries from continuing and completed Agroforestry and Farm Forestry research projects funded by the RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program. This program aims to integrate sustainable and productive agroforestry within Australian farming systems.

This report is the newest addition to our extensive catalogue of almost 600 research reports, videos and CD-Roms of projects supported by RIRDC. Please contact us for the latest publications catalogue or view it on our website.

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Peter Core

Managing Director

Rural Industries Research and Development Corporation

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2.2 Agroforestry and Farm Forestry

Completed Projects

Targeted Strategies for Implementation of Farm Forestry

Project Title	ANU Forestry Market Report
RIRDC Project No.:	ANU-38A
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Email:	un.bhati@anu.edu.au
Internet:	www.anu.edu.au/Forestry/info/marketreport/index.html
Objective	To prepare and disseminate nationally a quarterly market report on forest products and inputs for Australian forest growers, with a primary focus on small scale growers.
Background	Native forests and planted trees on farms have the potential to increase both wood and agricultural production and to provide a variety of environmental benefits. However, the lack of reliable and readily available market information is a major impediment to the full development of farm forestry in Australia. To address the impediment, ANU Forestry held consultations with Australian Forest Growers and others. Following their endorsement, the project commenced in June 1997.
Research	Since its commencements, the project has produced a total of 11 reports. Of the 11 reports, three were produced in the first nine months of 1999–2000. Besides dealing with a range of important farm forestry market issues, the reports also provide actual stumpage prices received by small scale growers in various regions of Australia. The project disseminates the reports through industry newsletters and magazines, the internet, and presentations at national, regional and local meetings, workshops and conferences.
Outcomes	Feedback from readers of the reports shows that the project is providing an impartial and useful market information. The project is thus contributing towards creating more informed forest product and input markets in Australia for small scale growers.
Implications	While the project is helping to create more informed markets, the feedback also shows that market information needs of farm forest growers are vast and changing. The implication is that this important work is far from finished.
Publications	Titles of the three reports produced in the first nine months of 1999–2000 are: Trends in sawnwood market, September 1999; Market for forest products in South Korea, December 1999; and Market Trends in the 1990s, March 2000. They were published in industry outlets such as: <i>Agroforestry News</i> , <i>Australian Forest Grower</i> , <i>NAFI News</i> , <i>Australian Farm Journal</i> , <i>Shaping the Future with Farm Forestry</i> (The JVAP Newsletter), and <i>Branching Out!</i> . The reports are also published on the internet web sites of ANU Forestry, Farmwide, and others.

Project Title	Developing effective and efficient extension and advisory strategies for agroforestry
RIRDC Project No.:	ECU-2A
Researcher:	Prof. Alan Black
Organisation:	Centre for Social Research Edith Cowan University JOONDALUP WA 6027
Phone:	08 9400 5844
Fax:	08 9400 5866
Email:	a.black@ecu.edu.au
Internet:	www.ecu.edu.au
Objectives	▪ To produce a comprehensive inventory and assessment of current extension and communication systems for agroforestry in each State of Australia. ▪ To identify those systems and activities that are perceived by the various stakeholders to have been most successful in fostering the development of agroforestry, and to analyse their strengths, limitations, potential for improvement and potential for wider application. ▪ To recommend information exchange and advisory strategies that can most effectively and efficiently assist agroforestry to become more widely adopted, profitable and sustainable. ▪ To publicise the findings and recommendations among policy makers, extension and advisory staff, education providers and other stakeholders.
Background	Despite the potential benefits of agroforestry and the emergence of several Commonwealth and State tree planting programs during the 1990s, the uptake of agroforestry in Australia has been much slower than would be required if the commercial and conservation benefits are to be optimised.
Research	The research involved a study of relevant literature, as well as interviews and focus group discussions with stakeholders or potential stakeholders in farm forestry.
Outcomes	Chapter 1 of the final report examines literature on possible reasons for the non-adoption of innovative agricultural technologies or integrated management practices such as agroforestry. Chapter 2 reviews general models of agricultural extension under four main headings: linear ‘top-down’ transfer of technology; participatory ‘bottom-up’ approaches (also termed ‘group empowerment’); one-to-one advice or information exchange; and formal or structured education and training. Attention is then given to the effectiveness of various media and methods, including the present and potential use of new information technology, particularly the Internet, as a medium for extension. This is followed by an examination of criteria to be used in evaluating extension and advisory strategies for agroforestry. Chapter 3 reviews the agroforestry extension approaches that have been developed by government agencies and other organisations throughout Australia. As far as possible, the goals and vision of each agency’s various extension strategies are identified. The extension models in use are discussed in relation to the models outlined in Chapter 2. Where information is available, salient points from stakeholder perceptions of the outcomes of these strategies are reported. The degree of coordination between agencies is also examined. Chapter 4 summarises the conclusions of the study and makes recommendations. These recommendations deal with general principles that should apply throughout Australia. Where appropriate, the accompanying text provides evidence or examples from around Australia. The more detailed evidence for these recommendations is contained in earlier chapters of the report.

Implications	No one model of extension is adequate by itself. The strengths and limitations of various approaches should be borne in mind in planning and evaluating extension and advisory programs.
Publications	<i>Extension and advisory strategies for agroforestry</i> (RIRDC)

Project Title	Practical farm forestry: whole farm case studies
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email: Internet:	ECU-3A Prof. Alan Black Centre for Social Research, Edith Cowan University JOONDALUP WA 6027 08 9400 5844 08 9400 5866 a.black@ecu.edu.au www.ecu.edu.au
Objective	To evaluate and document the economic, environmental and social impacts of the adoption of farm forestry on ten case study farms across Australia.
Background	The potential benefits of farm forestry are as varied as the ways in which it is practised. However, attempts to measure and document the benefits (and costs) of implementing farm forestry at the whole farm level are relatively rare. This information is useful to farmers, extension staff and policy makers as a means of reducing the economic uncertainties associated with what can be a significant long term investment for the farm business.
Research	There were three major stages to the research. Firstly, the case study sites were selected with a view to providing a diverse range of systems, rainfalls, species and finance arrangements. The second stage of each evaluation was a visit to each site to collect all available data and conduct interviews with the landholders. The final stage involved economic modelling of each project and the preparation of a report with the results of these analyses and descriptions of the project and the landholder's account of environmental and social impacts. The financial modelling used a purpose-built financial evaluation model to provide a whole farm discounted cashflow analysis over the project cycle.
Outcomes	All of the case study farmers considered the long-term viability (both economic and environmental) of their farming businesses to be the key motivating force to adopting farm forestry. In most of the case study properties, trees were actively employed to address economic and environmental issues simultaneously. The degree to which these individual objectives for the planting were important often dictated the layout and species selection for the project. The results of the financial modelling show that 8 of the 10 farms can expect direct positive returns of varying significance to accrue from the farm forestry enterprise. The two cases where the forestry projects yielded negative results both suffered from an inability of the trees to generate a large enough income at the end of the rotation to compensate for the loss of agricultural income over the length of the rotation. Environmental impacts of the trees included: increased groundwater use; soil stabilization through root systems; provision of stock shelter; provision of habitat for birds, beneficial insects and other animals; and aesthetic benefits. For all case study properties, there was a positive social impact at the personal and family

Implications	level. The most common community level impact came through increased involvement with the community, but in several instances farm forestry was producing a demonstrable positive economic flow-on effect to the community as well. The farm forestry industry is dynamic, keen to promote its work and objectives, and receptive to any information that will help it make management decisions. Results of the modelling work indicate that there are profitable farm forestry systems for a wide range of farming systems and rainfalls. At a broader level market information and development is necessary to reduce uncertainty. At the farm level, it is important that skilled analysis and land use planning are used to effectively match land capability and land use to avoid additional high costs to the project though foregone agricultural income on land occupied by trees.
Publications	<i>Practical farm forestry: whole farm case studies</i> (RIRDC). RIRDC publication number R99/099

Project Title	Developing policies to encourage small scale forestry
RIRDC Project No.:	PN99.2012
Start Date:	October 1999
Finish Date:	June 2000
Researcher:	John Herbohn
Organisation:	James Cook University Townsville, Qld, 4811
Phone:	07 4781 4250
Fax:	07 4781 4019
Email:	
Objective	To publish the proceedings from an international symposium dealing with policy measures to encourage small scale forestry.
Outcomes	The JVAP sponsored an international conference examining the issues associated with, "Developing policies to encourage small scale farm forestry". The conference report and papers are available at the web site, www.jcu.edu.au/school/cea/crc/trem .

This project was supported by the **Natural Heritage Trust**

Sustainable use of natural resources

Project Title	Assessing the risk of genetic pollution from farm forestry using eucalypt species and hybrids
RIRDC Project No.:	CPF-3A
Researcher:	Dr Bradley Potts
Organisation:	School of Plant Sciences University of Tasmania GPO Box 252-55 Hobart TAS 7001
Phone:	03 6226 2604
Fax:	03 6226 2698
Email:	B.M.Potts@utas.edu.au
Objective	Review the risks of genetic pollution from farm forestry plantings of eucalypt species and hybrids and develop a framework for risk management.

Background	Plant invasions arising from agricultural, forestry and other activities are becoming of increasing concern worldwide and in the last decade this has focused on genetic invasion by pollen dispersal and hybridisation. In the case of eucalypts, the contamination of local, native gene pools via exotic pollen is of relevance as: (i) pollen dispersal is much more widespread than seed dispersal; (ii) reproductive barriers are often weak between closely related species; (iii) European settlement has already had a major impact on Australia's eucalypt woodlands and mallee; (iv) there has been a rapid expansion of eucalypt plantations and restoration plantings in Australia; and (v) Australia is the custodian of an internationally important genetic resource.
Research	Review the risks of genetic pollution of native eucalypt gene pools.
Outcomes	A report on the risks of genetic pollution associated with the use of exotic species and provenances, selected material, hybrids and genetically modified plants are identified along with potential impacts on other components of biodiversity was produced. This information is used to develop a framework for risk assessment and management.
Implications	- Gene pool management strategies should be developed for the major plantation species in Australia. - The risk and impacts of genetic pollution or other effects on local biodiversity should be considered as part of environmental impact assessments of eucalypt plantations and farm forestry. - Even where the risk or impact of genetic pollution is assessed to be high, many opportunities have been identified to minimise this risk.
Publications	Potts, B.M., Barbour, R. and Hingston, A. (2000). Assessing the risk of genetic pollution from farm forestry using eucalypt species and hybrids. A report for Rural Industries Research and Development, Joint Venture Agroforestry Program

Project Title	Sustaining the productivity of trees crops on agricultural land in south-western Australia
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	CSF – 53A Dr Tim Grove and Dr Tony O'Connell CSIRO Forestry and Forest Products PO Box 5 Wembley WA 6913 08 9333 6000 08 9387 8991 t.grove@ccmar.csiro.au or t.oconnell@ccmar.csiro.au
Objectives	▪ To investigate and quantify changes to fertility of soils on farmland planted to eucalypts. ▪ To Evaluate strategies to maintain soil fertility and sustain long-term high productivity of trees planted on farmland. ▪ To relate measures of nutrient uptake and nutritional constraints to growth to measures of soil nutrient supply.
Background	Plantations of <i>Eucalyptus globulus</i> currently occupy about 150,000 ha of land in south western Australia. Most of the area planted is on farmland where soil fertility has been improved by annual application of P fertilizers and nutrient rich residues from legume pastures. Agricultural experience has shown that continuous cropping or reduces fertilizer application can lead to a decline in crop yields. Conversion of agricultural land to eucalypt

	plantations results in reduced input of fertilisers and changes to the quantity and quality of organic residues to soil. It is important therefore to investigate the impact this change in land use will have on soil fertility and the productivity of later rotations. This project has examined the changes to soil chemical properties under plantations relative to soil under pasture, and evaluated site management options to maintain soil fertility.
Research	The approach used was to measure changes to properties of surface soils, particularly to forms and flux rates of carbon (C), nitrogen (N)- - paired pasture- plantation sites: properties of surface soils under later- age eucalypt stands were compared to those under adjacent pasture land at up to 31 sites throughout south-western Australia: pasture and plantation areas had a common land use history prior to the planting of trees - designed experiments on inter-rotation site management at two sites: the impact of tree harvest residue treatments (residues burnt or residues removed, retained or increased) on soil fertility is being evaluated; N mineralization rates have been measured every 4 weeks and other properties measured in soils sampled annually over 4 years from the time treatments were established.
Outcomes	Conversion of land from traditional farming systems to continuous tree cropping has resulted in lower concentrations of some forms of N and P in surface soils. Concentrations of exchangeable calcium were also lower, but exchangeable magnesium and potassium higher, in plantation soils than pasture soils. Factors contributing to these changes are reduced input of fertilisers to plantation soils, transformations in soil that render nutrients less available to plants with time, and differences in the nature of organic matter residues. While changes to some properties have appears across the range of sites, others (eg. total N, desorbable P) are becoming evident only on sandy soils. There were no detectable effects of land-use change on soil acidity, on carious measures of soil C. The experiments in second rotation establishment have shown that retention of harvest residues has beneficial effects on mineral N dynamics and on concentrations of Ca, Mg and K in surface soils. For example, retaining harvest residues on a red earth soil reduced the potential for N loss after clearfelling but increased N mineralisation rates and therefore soil N supply to trees 3-4 years after establishment of a second rotation crop.
Implications	The observed differences between pasture and plantation soils have emerged within a relatively short time frame and were detectable despite being measured against a relatively high initial fertility level. They are consistent with our initial hypothesis that soil N and P supply for plant growth are likely to decline with changes in land management involving reduced input to soils of both P fertiliser and nutrient rich organic residues. If the observed trends continue, increased incidence of nutrient limitations to growth can be expected to impact on productivity unless corrective measures are taken. Implementing practices which offset declining soil nutrient status will be critical to maintaining site fertility and productivity in the long-term, even though benefits to tree growth on some sites may not be apparent immediately.

Project Title	Agroforestry design guidelines to balance catchment health with primary production
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	CSM-4A Dr Richard Stirzaker and Dr Rob Vertessy (Principal Investigators) CSIRO Land & Water PO Box 1666, Canberra ACT (in conjunction with CSIRO Forestry and Forest Products) 02 6246 5570 and 02 6246 5790 02 6246 5965 Richard.stirzaker@cbr.clw.csiro.au and Rob.vertessy@cbr.clw.csiro.au
Objectives	▪ To measure and predict tree water use under optimal conditions. ▪ To review and measure tree water use under stressed conditions. ▪ To measure and predict the competition between trees and crops for water in different agroforestry systems. ▪ To apply a catchment model to key sites and run model scenarios to optimise catchment health with tree productivity. ▪ To produce a booklet of guidelines to support land managers to optimise tree productivity with crop/pasture productivity and catchment health.
Background	This project arose from the 1996 JVAP workshop “Agroforestry and Hydrology – what do we need to know”. One of three outcomes of this meeting was that guidelines were required that brought together agroforestry and hydrology at paddock, hillslope and catchment scales.
Research	The project started with 9 scientists from CSIRO Land & Water and CSIRO Forestry and Forest products and a total of 16 scientist are authors and co-authors in the book. Experiments were carried out in Wellington (trees over saline watertables), Moora (alley cropping), Wagga (tree spacing), Warrenbayne (break of slope) and Kattaning (tree belts). Based on the above field studies, laboratory studies and a range of computer models, the guidelines were formulated for the book (objective 5).
Outcomes	The first four objectives above all feed into the major outcome of this project –. The working title is “TREES, WATER & SALT –How to use trees to manage watertables and salinity for sustainable agriculture in Australia.” The book summarises the state of the art knowledge in the field, and is being written in such a way that it is accessible to practitioners.
Implications	Understanding of salinity and a sensible management approach is hampered because the subject matter crosses disciplinary boundaries, including groundwater hydrology, agronomy, forestry, physiology and soil physics. The book has been written with input from each of these disciplines and sets out for practitioners what opportunities and limits for using trees for salinity management.
Publications	The major publication from the project will be the book, although a number of journal papers are currently submitted or in press.

Project Title	Establishment of trees on non- arable land to replace weeds
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	DAN-126A Dr M H Campbell NSW Agriculture Locked Bag 21 ORANGE NSW 2800 02 6391 3828 02 6391 3899 malcolmcampbell@smtpgwy.agric.gov.au
Objective	To investigate methods of establishing trees on non- arable land to replace weeds.
Background	Large areas of infertile hill country in Australia infested with weeds cannot be reclaimed by sowing pastures because the pastures will not control the weeds and the process is unprofitable. One solution to this problem is to sow trees to control the weeds.
Research	This project investigated low cost and rapid methods of establishing trees on non-arable land to control serrated tussock. The methods of establishment investigated were aerial sowing and direct drilling in contrast to the normal practice of planting tree seedlings by manual labour. Ten experiments were conducted over five years.
Outcomes	Establishment for at least one species per experiment (5 to 14 species sown per experiment) was successful from 70% of aerial sowings, 90% of direct drillings and 88% of seedling plantings. The respective figure for the two most successful species was 37%, 75% and 50% for <i>Pinus radiata</i> and 50%, 87% and 12% for <i>Eucalyptus viminalis</i>. For aerial sowing and direct drilling successful establishment was defined as >1 tree per 10 m² and for planted seedlings was defined as >80% establishment. ▪ The major factor limiting establishment of aerial sown or direct drilled tree seedlings was competition from weeds in the first spring and summer after planting. Whereas herbicide treatments could control the weeds up to the time the young trees seedlings were 2 to 5 cm high, post emergence herbicides damaged tree seedlings too much to allow selective control of the weeds in spring. ▪ The best time of sowing was late winter because this allowed the best control of weeds prior to sowing. ▪ Eucalypts (<i>E. viminalis</i>, <i>E. polyanthemos</i>, <i>E. melliodora</i>, <i>E. blakelyii</i>, <i>E. albens</i>) were the best adapted species for establishment from aerial sowing and <i>P. radiata</i> and <i>Arcacia</i> spp. the best from direct drilling. ▪ Serrated tussock was successfully controlled by volunteer pasture species that dominated the sown areas once they had been fenced and burning stopped. Further research should be undertaken into the control of weeds in the first spring and summer to improve establishment from direct drilling and in particular from aerial sowing. Also, further research should be undertaken into establishing tree seedlings by sowing them in canisters distributed by aircraft as investigated in USA.
Implications	This project showed that weeds can be controlled, by sowing trees on non-arable land provided the area sown is fenced off from stock and not burnt. Further research is needed to define reliable techniques for using aerial sowing but direct drilling and planting seedlings will give acceptable levels of establishment that will control weeds. Large scale demonstrations of reliable techniques are necessary to inform producers of what methods of tree establishment to use. Financial assistance will be necessary for landholders to retire land from agricultural production for the sowing of trees.
Publications	Campbell, M. H. (1999). Establishment of trees on non-arable land to replace weeds. Final

Report, RIRDC

Campbell, M. H. and Dowling, P. M. (1999). Establishment of trees to control serrated tussock. Proceedings 12th Australian Weeds Conference, Hobart. pp. 20-24.

Campbell, M. H. and Nicol, H. I. (1998). Establishing weeds on non-arable land to control weeds. Proceedings 11th Australian Weeds Conference, Melbourne. 1, pp. 493-6.

Campbell, M. H. and Nicol, H. I. (1998). Tolerance of tree seedlings to pre- and post-emergence herbicides. Proceedings 9th Australian Agronomy Conference, Wagga Wagga, pp.276-8.

Jones, R. E., Vere, D. T. and Campbell, M. H. (2000). The external costs of pasture weed spread: an economic assessment of serrated tussock control. *Agricultural Systems* 22, 91-103.

Optimised productivity of crops and pastures

Project Title	Shelterbelts and crop production in north east Victoria
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	DAV-69A Dr Michael Crawford Agriculture Victoria Department of Natural Resources and Environment RMB 1145 RUTHERGLEN VIC 3685 02 6030 4500 02 6030 4600 michael.crawford@nre.vic.gov.au
Objective	To measure the effects of shelterbelts on crop production in north east Victoria.
Background	Substantial beneficial effects of shelter on agricultural production have been claimed in countries where extensive shelter networks have been developed. A trial at Rutherglen Victoria in 1990, showed beneficial effects of shelter provided by eucalypts on wheat and oat yields in the sheltered zone. Up until now, this had been one of the few scientific trials conducted in Australia. A nationally coordinated and systematic effort to validate the reported effects of shelterbelts on crop and pasture production commenced in 1993 in the form of the National Windbreak Program . From this research and from the modelling work derived from it, it was expected that better prediction would be made of shelter values to particular situations and therefore would allow for better planning of the placement of trees on farms.
Research	From 1994 to 1996, the impact of tree shelterbelts on the growth of lupins and wheat was monitored at a site near Dookie in north east Victoria. Two shelterbelts consisting of 8-12 m high native trees were located along adjacent sides of a paddock. Crop parameters such as plant numbers, biomass, leaf area and grain yield were determined along transects emanating from each belt. To minimise soil and shelterbelt variability, a second experiment using artificial shelters made of shade cloth was conducted at Dookie in 1996 and near Rutherglen in 1997. Crop growth and yield were compared with results from similar areas in the open paddock, away from the influence of shelter.
Outcomes	Results from the tree shelterbelt experiment at Dookie were highly variable, thus precluding any significant conclusions to be drawn from this experiment. Variability resulted from inconsistencies in soil conditions (especially drainage) and shelterbelt uniformity, as well as the inherent biological variation found in crop growth. In the second experiment using artificial shelters, no significant impact of shelter was found in either year of this experiment.

Implications Publications	Crop growth and yields inside the shelters were similar to that found in the open. A possible reason for this is that average windspeeds of 2.0 ms^{-1} do not limit crop growth in this environment. Alternatively, shelter effects may be so small that they cannot be detected using traditional methods with the associated sampling errors that they contain. Despite the lack of significant results in the first experiment, this project has made a major contribution to the National Windbreak Program. Significant crop yield benefits from windbreaks are unlikely in regions of low average windspeed and in areas where extreme wind events are rare. Furthermore, windbreak effects are subtle and variable. Effects may be easily masked by factors including soil variation, upwind terrain, discontinuities in windbreaks through tree death and natural variation in crop growth across the paddock. However, general conclusions on the role of tree shelterbelts on farms need to be formulated from the perspective of the National Windbreak Program. Sudmeyer, R.A., Crawford, M.C., Meinke, H.M and Poulton, P.L. (2000). Effect of artificial wind shelters on the growth and yield of rainfed crops. <i>Agroforestry Systems</i> (in prep.). Crawford, M.C., Noble, P.A. and Haines, P.J. (1998). Shelterbelts and wheat production in north east Victoria. Proceedings of the 9th Australian Agronomy Conference, Wagga Wagga, NSW. pp. 685-686.
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Project Title	Blue Gum Timberbelt Design For Alley Farming
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	DAW-70A Tony Albertsen Agriculture Western Australia PO Box 1231 BUNBURY WA 6230 +61 8 9780 6289 +61 8 9780 6136 talbertsen@agric.wa.gov.au
Objective	The objective of this project was to measure the production effects at the interface between pasture and Tasmanian blue gums grown for pulpwood, and then build these into an economic model which would help farmers to optimise the design of their own alley farming projects
Background	Tasmanian blue gum is being extensively planted across parts of southern Australia for the production of pulpwood. Plantings in 1999 exceeded 50,000 hectares nationally, because this crop is often more profitable than grazing. The apparent extra volume of edge trees and the anticipated shelter and hydrological benefits of these trees had suggested that blue gums in an alley farming layout would be even more profitable than plantations. Alley farming also offers the prospect of farmers remaining in working occupation of their land pursuing traditional enterprises, rather than move off the farm to make way for fence-to-fence industrial plantations.
Research	Thirty sites were selected for the establishment of plots in the trees and pasture respectively. The sites were spread over a wide area of the high rainfall agricultural zone, 600 mm to 1100 mm annually. Pasture yield was measured each year for three years by periodical cuts at a set distances from the edge trees, in order to define the extent of pasture lost due to the competition from trees. These results were then expressed as the equivalent width of pasture lost. Tree height and diameter were measured for each of the outside three rows, for three consecutive years. Tree volume was calculated from these measurements. Harvest volume estimates were limited to six sites.

	A spreadsheet model (BLUEBELTS) was adapted to calculate the profitability of a blue gum alley farming project. Pasture loss distance and the extra volume of edge trees, expressed as a percentage of inside-row trees, were included in the model using the means of plot data. The model was also modified to reflect the effects of design on tree harvesting costs, and to incorporate the option of pruning edge trees.
Outcomes	Pasture loss distance clearly increases with the age of the trees. There is typically a loss of almost 10 metres of total annual pasture production in the year in which the tree crop reaches 10 years of age, which is the usual age at harvest. This loss is more pronounced at the start of the season. The project confirmed that edge tree volume is substantially greater than the volume of inside row trees. The edge effect does not extend into the plantation beyond the outside row. The effect is highly variable, but the cause of this variation could not be established due to the low number of sites with trees of harvestable age. Economic modelling showed that narrow tree belts are generally more profitable than wide belts, and an alley width of about two tree heights is most profitable unless grazing returns are high and tree growth poor.
Implications	Farmers in the high rainfall zone can have confidence that pasture loss distance is much less than one tree height, and that edge trees produce more wood than inside trees. Further research is warranted to relate the size of the edge effect to readily measurable site characteristics. The project outcome is encouraging to farmers who find that they need to plant trees in a dispersed arrangement on a substantial part of their farms to improve catchment water balance and reduce the impact of salinity and wind on the sustainability of their farming system.

Optimised direct returns from Tree Products

Project Title	Development of an Australian "Farm Forestry Site Selection Manual"
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email: Internet:	CAL-4A Dr Richard Harper Department of Conservation and Land Management Locked Bag 104 BENTLEY DELIVERY CENTRE WA 6983 08 9334 0306 08 9334 0327 richardh@calm.wa.gov.au www.calm.wa.gov.au/projects/plantations_splash.html
Objectives	- Produce a farm forestry site selection manual; - Critical evaluation of current site selection practice in farm forestry; - Identification of priorities for future farm forestry site selection R & D; - Increase sustainability and profitability of farm forestry.
Background	Farm forestry is emerging as a major new land-use in Australia and will provide a range of economic, environmental and social benefits, such as income diversification and increased profitability for farmers, greater export income, land degradation control and increased rural employment. For these benefits to be realised, however, trees have to be grown profitably. Tree performance (survival and growth) is related to climate and soil (site) properties - if trees are planted on inappropriate sites they will grow poorly or die. Similarly, various management decisions (e.g. whether or not to cultivate, apply fertilisers, species to select and

	stand density) are dependent on soil and site conditions. Species and inputs can be tailored to a site's requirements thus increasing profitability and the sustainable use of resources. It is thus critical that site selection methods are as rigorous and effective as possible. Farm forestry, however, is moving into districts where plantation forestry has not been practised and site selection standards are not available. The Australian "Farm Forestry Site Selection Manual" will fill this gap by specifying the best methods for site-selection for farm forestry, at the regional and paddock scales. These methods will be proposed as industry standards to be used by landholders, extension advisers and the farm-forestry industry. They will also be suitable for the description of forestry experimental sites by scientists. The manual will also be suitable for use as a component of farm-forestry studies at the TAFE and undergraduate level.
Research	Project team-members visited areas of major farm forestry expansion in southern and eastern Australia and inspected and discussed site selection practice with a range of practitioners, scientists, consultants and other stakeholders. Key literature on land evaluation for a variety of land-uses was examined.
Outcomes	Several unifying principles about farm forestry site selection are clear: ▪ A primary premise of all site evaluation is that methods should be explicit, quantitative, consistent and repeatable. There are constraints on the time and money that can be spent on site evaluation. ▪ The large variation in climatic and land resource attributes across Australia requires a robust, multi-scaled system, from region to field. ▪ The relationships between land attributes, soil management practice, and tree response are often not quantified. Thus activities such as fertilisation, cultivation or tree spacing are often still applied by prescription, rather than actual requirement. ▪ Many field experiments and tree breeding trials do not adequately describe the sites that the trees have been grown on. Thus, one of the largest potential benefits of site evaluation – the extension of trial results to new areas – is lost. We recommend that all trial sites are adequately characterized, and present a protocol for doing so. ▪ New digital technologies will aid the implementation of quantitative site evaluation.
Implications	It is clear that this manual could form the basis for regional and State codes of practice for new farm forestry schemes. The manual is also relevant to the establishment of plantations and bushland on farmland for carbon sequestration.
Publications	Ryan, P. J., Harper, R. J., Booth, T. H., McKenzie, N. J., and Gilkes, R. J. (in review). The Australian Farm Forestry Site Selection Manual. Rural Industries Research and Development Corporation, RIRDC Research Report Project CAL-4A. Harper, R. J. (2000). Site evaluation for farmland revegetation. In Proceedings 'Restoration with Native Species Workshop,' Kings Park Botanical Gardens, Western Australia, 14 February 2000. Harper, R. J. (in review). Site evaluation for the revegetation of farmland – undertaking the site survey. <i>Tree Note</i> Harper, R. J., and McGrath, J. F. (2000). Using soil survey for farm forestry and greenhouse sink site selection and management. <i>ACLEP Newsletter</i> 8, Harper, R. J., Ryan, P. J., Booth, T. H., McKenzie, N. J., and Gilkes, R. J. (1999). The Australian "Farm Forestry Site Selection Manual". In Proceedings 'Australian Forestry Council, Research Working Group 3 (Soils and Nutrition),' Rotorua, New Zealand, November 15-19, 1999. Harper, R. J., Smettem, K. R. J., and Gilkes, R. J. (2000). Land assessment to integrate trees with agriculture for carbon sequestration, salinity control and profit. In Proceedings

‘Australian and New Zealand Soils Conference,’ Lincoln University, New Zealand, 4-8 December, 2000.

Ryan, P. J., Harper, R. J., Laffan, M. D., Booth, T. H., and McKenzie, N. J. (2000). Developments in site evaluation for farm forestry in Australia and the relationship to sustainability and productivity. In Proceedings ‘Managing Forest Soils for Sustainable Productivity, 4th International Conference on Forest Soils,’ University of Vila Real, Portugal, 18-22 September, 2000.

This project was supported by the **Natural Heritage Trust**

Project Title:	Identification of pest resistant eucalypts using near-infra red spectroscopy
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	CSE-78A Dr Rob Floyd CSIRO Entomology GPO Box 1700 CANBERRA ACT 2601 02 6246 4089 02 6246 4155 R.Floyd@ento.csiro.au
Objectives	▪ To develop near-infrared reflectance spectroscopy (NIRS) methods as a means of rapid and early prediction in juvenile trees of important tree characteristics such as pest resistance. ▪ To identify pest resistant trees of key species of eucalypts for farm forestry in southeast Australia.
Background	Application of chemical pesticides and poisons to reduce damage by insect and vertebrate pests in plantations is costly to plantation owners and also incurs hidden costs of health hazards and loss of biodiversity. It has been proposed that incorporating naturally resistant trees in plantation is an alternative to applying chemical pesticides. To include resistance traits into tree improvement programs, a rapid and effective method of detecting resistance is required. NIRS has the potential to satisfy this requirement.
Research	We used a range of feeding choice experiments to determine the resistance of individuals of a number of <i>Eucalyptus</i> species to feeding by insect and marsupial folivores. Once resistant trees were identified, we examined components of the leaf chemistry to determine mechanisms of resistance which were then tested using manipulation experiments. Efficient methods of preparing leaf material for NIRS analysis were tested and statistical models constructed to allow the prediction of the chemical composition of foliage and also the level of consumption by insect and marsupial herbivores. Finally, the chemistry of juvenile and adult trees was compared to determine if NIRS analysis of seedlings could be used to predict resistance of adult trees.
Outcomes	We determined the chemical basis for resistance to insect and marsupial folivores in farm forestry. An excellent understanding of some important resistance mechanisms and of the application of near-infrared spectroscopy to identifying plants that express key resistance traits has been gained. One of the strengths of this work is that the resistance traits that we have demonstrated (e.g. sideroxylonal and cineole) are strongly represented in the NIRS models that we have developed. We are now able to use NIRS to predict resistance rapidly and with great confidence since the resistance traits have been correctly identified and experimentally verified. We have demonstrated substantial cross-resistance between marsupial herbivores and one major group of insect defoliators, the Christmas beetles (<i>Anoplognathus</i> spp). Although all the marsupial species examined are susceptible to the effects of sideroxylonal (albeit at different concentrations), we found that a range of different insect defoliators did not respond the same

	way as Christmas beetles.
Implications	Major differences between the chemical composition of seedlings and adult leaves of some eucalypt species have been shown.
	Near-infrared spectroscopy proved to be a highly suitable tool for rapidly assessing components of natural herbivore resistance in eucalypts. The presence of some cross-resistance between insect and marsupial herbivores is particularly promising for the incorporation of resistance into genetic improvement programs. The difference between chemical profiles of leaves of juvenile and mature plants needs further investigation.
Publications	Matsuki, M., Ebber, M., Foley, W. & Floyd, R. (1998). Factors affecting leaf consumption by Christmas beetles in SE Australia. Abstract & poster, Gordon Research Conference, Los Angeles. Matsuki, M., Ebber, M., Foley, W. & Floyd, R. (1998). Factors affecting leaf consumption by Christmas beetles in SE Australia. Abstract & poster, Australian Applied Entomology Research Conference, Brisbane.

Project Title Conifers in the dry country	
RIRDC Project No.:	CSF – 57A
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Objectives	▪ To identify conifer species which have the potential to grow in the low rainfall areas of Australia as well as outlining potential uses. ▪ To provide detailed information on wood properties and growth of a few selected ▪ species of conifers which have the potential to grow as commercial plantations in the 400-600mm rainfall zone of temperate Australia. ▪ To identify problems which will require further research.
Background	Conifer species from the dry areas of many countries (particularly from the Mediterranean region) have been introduced to Australia over the last 100 years, but their performance in terms of timber production and other social benefits have not been comprehensively reviewed. As part of Australia's Vision 2020 plan to increase the national plantation area, the expansion of softwood plantations into the drier areas will require species other than radiata pine. This highlighted the need to identify those conifers with the potential to become economically viable as plantations as well as other species that have amenity and social benefits.
Research	A review of experimental trials and plantings of conifers within Australia and overseas was conducted to identify those with the ability to grow in the drier areas of Australia. The five species chosen as having the best opportunity to grow commercially were examined in detail for wood properties, growth capacity and drought tolerance. Economic evaluations were undertaken to determine the viability of plantations.
Outcomes	Opportunities for growing conifers as plantations in the 400-650 mm rainfall zone of temperate Australia exist and these areas can provide an additional source of income from the sales of sawlogs. Other product options exist but are dependent on existing forestry infrastructure.

Implications	Internal rates of return from growing plantations will only be positive if the plantings yield a growth rate greater than 12m ³ /ha/year. This is possible with the use of genetically improved seed. Other potential benefits of using dry country conifers include preventing site degradation, lowering of water tables in salt affected areas, windbreaks to protect pastures and stock and adding value to properties as an aesthetic component.
Publications	This study has identified conifers with the capacity to grow in the drier areas of Australia as well as those that have commercial and amenity potential. With indications that the salinity problems in the rural areas are going to compound, the need to establish large scale plantings in the catchment zones is becoming increasingly evident. Conifers with the ability to tolerate dry conditions as well as providing an economic return provide an attractive alternative to the slower growing eucalyptus species.
Publications	<i>Mediterranean conifer species suited to low rainfall forestry in Australia.</i> in National Low Rainfall Tree Improvement Workshop Proceedings. 1999. Eds Bush,D. & Bulman,P. RIRDC Publication 99/66.

Project Title		Forecasting tree growth and yield and financial returns of key agroforestry species across Southern Australia	
RIRDC Project No.:	DAV-129A		
Researchers:	Dr Tom Baker	Mr Peter Bulman	
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Objectives	- Improve the reliability of forecasting tree growth and yield of key agroforestry species by developing height, basal area and volume predictions according to grouped site productivity classes. - Investigate relationships between tree growth rates and site factors, and construct mathematical models of tree growth that could be incorporated into financial models such as FARMTREE. - Improve landholders' knowledge of the relative economic returns and benefits from adopting different agroforestry regimes.		
Background	Tree growth rates are important when predicting agroforestry returns and benefits. Landholders and investors need this information in order to make informed decisions about investment and management options.		
Research	Research included the collection and collation of tree growth data and site and soil characteristics. The project focussed on utilising data from long-established trials to find relationships between species and site and growth rate. The project was managed by the Victorian Department of Natural Resources and Environment (NRE) and Primary Industries and Resources of South Australia (PIRSA). The work was collaboratively undertaken principally by the Centre for Forest Tree Technology (CFTT), Forestry SA, Department of Forestry University of Melbourne, NRE and PIRSA.		
Outcomes	Six <i>Eucalyptus</i> species were studied in detail and based on actual data, growth predictions were made on a range of sites. Site productivity classes for the different species were developed based on "site types" grouped by climatic and soil information.		

Implications

Growth modelling methodologies suitable for incorporation into FARMTREE were also investigated. The methods decided upon are easy to apply, efficient and accurate.

The growth predictions based on site productivity classes can be used as a general guide to tree growth on similar sites. The predictions are only indicative of the rates of growth expected and only with the presence of actual long-term data, will the predictions be verified.

After further development and testing, the modelling methodologies could be incorporated into FARMTREE or a similar package for use by owners and managers of small farm forests with the expectation of providing improved growth predictions.

Project Title**Potential production of tannin and fuelwood from plantation grown bipinnate acacias.****RIRDC Project No.:**

DCL-3A

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Objective

To identify plantation-grown bipinnate acacia species that can successfully provide a fuelwood source and tannins for wood adhesive production.

Background

The bipinnate acacias belonging to the taxonomic section Botrycephalae, are native to south-eastern Australia. The bark of one of these, black wattle (*A. mearnsii*), was stripped from trees in native stands to tan leather and its wood was used by bakeries and for domestic heating. Despite extensive cultivation overseas of *Acacia mearnsii* and other bipinnate acacias for a range of wood and non-wood uses, they are not grown in plantations in Australia. In 1992 CALM was the first organisation in Western Australia to test twelve of these bipinnate acacias in a plantation configuration as part of its search for additional species that may extend the commercial tree planting range to nutritionally poor and lower rainfall sites. A number of species in these acacia trials showed promise at two years of age.

Acacia mearnsii, produces the world's most important vegetable tannin (Doran and Turnbull 1997) and is grown commercially for bark and wood products across 500,000 ha in many countries including South Africa, Brazil, India and China. Originally vegetable tannins were used for tanning leather but they are now used to make water-proof wood adhesives and anti-corrosive additives. Australia used to be a net exporter of vegetable tannins but in 1997, A\$7.2 million of tannin was imported to meet Australian demand for wood adhesives (Australian Bureau of Statistics). Although the wood of some of the bipinnate acacias, such as *A. mearnsii* and *A. dealbata* (silver wattle), are used to make high quality paper, rayon, charcoal and composite wood products, this project focuses on the tannin characteristics of their barks. Most of the wood products are more reliably tested when the trees are closer in age to full rotation (10-12 years). However, the moisture content and air-dry density of the wood and the ability of the species to coppice were assessed at half rotation age (c. 5 years) to indicate the potential of the species for fuelwood production.

Research

Three bipinnate acacia trials were established at three sites across the south-west of Western Australia: Darkan (Bowelling), Busselton (Jarrahwood) and Mt Barker. Twelve bipinnate acacia species were each represented by two provenances with the exception of *A. fulva* represented by a single provenance. Each of the trials also included four South African seed sources of *A. mearnsii*. Bark samples were taken from a sub-sample of trees representing the

	provenances of all 12 species and the best commercial <i>A. mearnsii</i> seedlot. To obtain sufficient tannin for a bulk tannin analysis, samples from a number of trees (depending on their size) from a single provenance of each species were stripped of their bark. Only 10 of the species had enough bark to complete the exercise as <i>A. deanei</i> and <i>A. elata</i> trees were too few and too small. Eleven kilograms of freeze-dried tannin from each species were passed onto Bunnings Timbagem and Dyno Industries for wood adhesive quality and tannin additive assessments respectively The standing trees stripped of their bark for tannin analyses were also sampled for wood. Only a single provenance of each species was sampled and the number of samples taken depended on the number of trees stripped of bark. The cut stumps (5 - 20 cm above ground level) were observed a year later for signs of coppice growth.
Outcomes	Whilst the major outcome of the project was to identify that <i>A.mearnsii</i>, <i>A.fulva</i> and <i>A.decurrans</i> were the best performing species in south-western Australia, the latter species particularly on the higher evaporative sites, there were numerous smaller observations that may be of use in the development of this group of species. ▪ Site preparation incorporating both ripping and mounding in areas subject to water-logging yields better survival and growth. ▪ Good weed control is needed prior to planting as no herbicide over -spray has been developed for this species. ▪ The species with the greatest wood production across all three sites at 5.5 years of age were <i>A. mearnsii</i>, <i>A. decurrens</i> and <i>A. fulva</i>. At the lower rainfall sites <i>A. decurrens</i> was clearly the best species. ▪ The species with the highest air-dried wood density at 5.5 years of age was <i>A. fulva</i> followed by <i>A. decurrens</i> and <i>A. mearnsii</i> , respectively. ▪ The bulk extraction of tannin from 10 of the species, <i>A. mearnsii</i>, <i>A. decurrens</i>, <i>A.trachyphloia</i>, <i>A. filicifolia</i>, <i>A.dealbata</i>, <i>A. fulva</i>, <i>A.irrorata</i>, <i>A.silvestris</i>, <i>A.parramattensis</i> and <i>A.glaucocarpa</i> showed that all these species make an acceptable wood adhesive glue. ▪ Based on wood production and density, it appears that the best species for fuelwood production in south western Australia are <i>A. mearnsii</i>, <i>A. decurrens</i> and <i>A. fulva</i>.
Implications	The project clearly indicates that three bipinnate acacia species of value in south-west of Western Australia for tannin production for adhesives are <i>A. mearnsii</i>, <i>A. decurrens</i> and a little known species, <i>A. fulva</i>. Adhesives made from the tannin of these species have acceptable performance. The same three species would make excellent short-rotation fuelwood species based on their growth rate and wood density. Based on their ranking at the three sites, it appeared that <i>A. mearnsii</i> and <i>A. fulva</i> performed better with higher rainfall whereas <i>A. decurrens</i> would be of greater use on the drier sites. With greater understanding of the breeding development of <i>A. mearnsii</i>, it is apparent that none of the present world-wide breeding programs select to survive in a lower rainfall environment. This was further demonstrated with the commercial <i>A. mearnsii</i> seedlots attained. Whereas much experience has been gained for provenance selection for <i>E. globulus</i> drought-tolerance, the same level of understanding has not been reached with these bipinnate acacia species. It thus leads to the question as to whether, through provenance plantings at these sites, especially <i>A. decurrens</i>, survival and growth may improve to easily compete with <i>E. globulus</i>.
Publications	Barbour, L. <i>Tannin and Fuel Wood from Plantation Grown Bipinnate Acacias</i>. A report for the RIRDC/LWRRDC/FWPRDC Joint Agroforestry Program. 2000. Barbour,L. Promise of the acacias in WA. <i>Trees and Natural Resources</i> 37(4) 1995 Barbour,L. The Promise of the Acacias in Western Australia. <i>IFA Newsletter</i> 36(2) 1995.

Project Title	Integrated mallee processing for carbon products, eucalyptus oil and electricity
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email: Internet:	OIL - 3A Colin Stucley, Managing Director Enecon Pty Ltd, acting in co-operation with: • WA Dep't of Conservation and Land Management • Western Power Corporation (co-funder) • The Oil Mallee Company of Australia • CSIRO Forestry and Forest Products 03 9888 6711 03 9888 6744 cstucley@enecon.com.au enecon.com.au
Objective	Assess the technical and commercial feasibility of integrated processing of mallee eucalypts
Background	This work has been initiated as one mechanism to provide commercial incentives for large scale revegetation using mallee eucalypts in agricultural areas of WA to remedy salinity, where commercial incentives for other tree crops do not exist.
Research	The study team: ▪ Examined and costed the activities for growth, harvest and transport of mallee trees to centralised rural processing facilities ▪ Made activated carbon from samples of mallee wood and assessed this carbon for applications in the water treatment and gold industries ▪ Conducted preliminary design and costing for a large scale processing facility making activated carbon, eucalyptus oil and renewable electricity ▪ Assembled data from the above activities in a comprehensive financial appraisal of a new processing industry
Outcomes	The study work indicated that the proposed processing plants are financially viable, and that this approach offers a real commercial incentive to farmers to grow mallee eucalypts in large numbers.
Implications	The positive study outcomes have helped generate interest in a full scale demonstration facility. A \$5 million plant is to be built at Narrogin, south east of Perth. Western Power, the Australian Greenhouse Office and Ausindustry have all committed funds to the project. It is hoped that the demonstration plant will commence operation mid 2001, as the first of a number of such facilities to be built across the wheatbelt in coming years.
Publications	Forthcoming RIRDC publication "Integrated Processing of Mallee Eucalypts - Technology and Costing Report" This project was supported by the Natural Heritage Trust

Cost effective multi- purpose agroforestry systems to meet commercial and environmental objectives

Project Title	Adapting Computer Software To Evaluate The Visual Impact Of Farm Forestry Layouts
RIRDC Project No.: Researcher: Organisation: Phone: Fax: Email:	CAL-2A Dr Grant Revell The University of Western Australia. School of Architecture & Fine Arts. NEDLANDS Western Australia 6907 08 9380 1555 08 9380 1082 grevell@cyllene.uwa.edu.au
Objective	To provide the software and documentation necessary to simulate the visual effect of farm forestry layouts over time, in order to evaluate the impact of the layout on landscape character, visual amenity and agricultural management. The software will incorporate various design criteria generated from property planning exercises to provide realistic simulations.
Background	Over recent years, the land planning and design methodologies developed by the Western Australian Department of Conservation and Land Management's (CALM) Farm Forestry Unit, in association with The University of Western Australia (UWA), have attempted to evaluate and ameliorate the visual impact of farm forestry layouts. Experience in the southwest of Western Australia has shown that the ability to visualise the impact of proposed revegetation strategies is instrumental in supporting landowner's revegetation placement and implementation decisions.
Research	To date, this work has utilised a range of computer software tools that try to realistically simulate farm forestry proposals across the landscape, with varying levels of success. A number of impediments, however, have been identified in the wide spread use of these computer aided design representation tools. Consequently, in 1998 the RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program funded the Western Australian Department of Conservation and Land Management (CALM) and The University of Western Australia (UWA), to investigate and document procedures currently available that would assist, or supplement the adaptation and potential development of software for farm forest design application.
Outcomes	This research documents the software reviews, their adaptation, application and evaluation with the support of a case study farming property and community located in the Boree Gully, Blackwood Basin, southwest, Western Australia. The research demonstrates that selected, readily available software can be suitably adapted to aid in the representation and evaluation of visual impacts associated with farm forestry layouts. For the purposes of the study, the most suitable combination of adaptive software included Geographic Information System (GIS) software, and Computer Aided Design (CAD) software. The software nominated for use in this project included <i>ARC/INFO</i>, <i>3D Studio MAX</i>, <i>Corel Paint 7</i> and <i>AutoCAD</i>. These packages met the criteria of data compatibility and were able to create the following visual simulation products: images, animations, and virtual reality models. The availability of these visual products offered the opportunity to provide an accurate, unbiased and graphically interesting design simulation of the proposed farm forestry layouts.
Implications	It is expected that such design simulation tools will provide greater value to the revegetated landscapes aimed at receiving the more traditional economic, water use and wind break benefits. Future research opportunities were identified to improve image development in farm forestry design practices, as well as potential commercialisation and communication strategies.

Project Title: Thinning native regrowth for timber production and improved biodiversity	
RIRDC Project No.:	GAN-1A
Researcher:	Dr Jeanette Murray and Mr David Thompson
Organisation:	Greening Australia
Phone:	02 6772-3248
Fax:	02 6771-4094
Email:	greenau@northnet.com.au
Objective	To maintain biodiversity values when thinning dense regrowth forest on farms.
Background	Many properties in northern New South Wales have areas of dense regrowth forest that has arisen from previous clearing or logging. Such areas often have low value for agricultural or forestry production. Due to lack of ground cover they can have erosion problems and due to a limited range of habitats can have low value for native conservation. Such areas are often left unmanaged or are completely cleared, neither option giving the best result for timber or agricultural productivity, or in some cases nature conservation.
Research	This project set out to identify appropriate silvicultural strategies that could enhance the productivity of certain regrowth areas whilst maintaining or enhancing habitat and conservation benefits. It recognised that certain areas of the farm might be devoted exclusively to grazing, timber production or to conservation. Thus the project focussed on areas of the farm where all three components might be successfully combined.
Outcomes and Implications	Any thinning regime will vary depending on the end product desired. The project concluded that the “selection method” of thinning offered the most flexibility to landholders. This method involves removing selected trees from a forest stand. The benefits of this method is that light cuttings could be carried out which had a lower impact on biodiversity than more intensive methods, and greater scope was available for increasing a range of habitats for birds and other animals. To maintain biodiversity it was essential that a diversity of native tree and shrub species be retained as well as a range of habitats including hollow trees, logs, mistletoes, nectar, water and seeding grasses.
Publications	Murray, J. and Thompson, D. (2000) <i>“A farmer’s guide to maintaining biodiversity when thinning regrowth forest”</i> . RIRDC publication number R00/12

Project Title: Alley Farming for improved water management and nutrient cycling in sandplain cropping	
RIRDC Project No.:	UWA-36A
Researcher:	Dr Ted Lefroy
Organisation:	Centre for Legumes in Mediterranean Agriculture, University of Western Australia
Phone:	08 9380 2561
Fax:	08 9380 1140
Email:	elefroy@cyllene.uwa.edu.au
Objectives	To measure in a sandplain alley farming system; ▪ the extent to which the trees can intercept water and nutrients leaching below the root zone of a lupin/wheat crop rotation ▪ the amount and source of water used by tagasaste

	the extent and seasonal variation in above and below ground competition between trees and inter row crops and pastures.
Background	Alley cropping has been advocated as a means of addressing ground water recharge and wind erosion. This experiment set out to compare water use in sole crop, tagasaste alley farming and tagasaste plantation
Research	Water balance, grain yield and nitrogen balance of conventional lupin/wheat rotation and tagasaste alley farming were measured at Moora, 150 km north of Perth (lat. 30° 45'; long. 116° 40').
Outcomes	WATER USE: Recharge to the perched water table in 1998 was 193 mm under sole crop and 154 mm under alley crop (52% and 42% of annual rainfall), reducing to 32 mm (9% of annual rainfall) under alley crop when groundwater uptake by trees (122 mm) was included. Deuterium:hydrogen analysis of tree xylem sap indicated the trees only took up 45 mm (27% of total tree water use) from the soil in 1998. Soil water uptake by trees in alley cropping extended 2, 4 and 8 m laterally from the tree rows in their first, second and third years of regrowth after cutting in 1996. Beyond 8 m from the trees, deep drainage occurred at the same rate as in sole crop. CROP YIELD: Grain production was 23% higher in alley crop than sole crop in the first year of the study, 8% lower in the second year and 32% lower in the third indicating, increased levels of competition as the trees coppiced from 50 cm in 1996 to 5 m in 1998. NITROGEN INPUTS: The tagasaste trees derived 83% of their nitrogen from the atmosphere. Inputs of fixed N were estimated to be 83 kg/ha/yr for alley trees and 587 kg N/ha in plantation. This suggests the trees may not take up significant nitrate left by annual legumes, and the large input of N has potentially negative implications in terms of nitrate pollution of aquifers.
Implications	Plantations would be a more appropriate strategy than alley cropping as trees in alley cropping used no more water than trees in plantation, reduced crop yield by ~ 20% over years 2 and 3 and relied heavily on the presence of a shallow fresh aquifer. Plantations would make best use of these localised aquifers. Tagasaste plantations on fresh water tables cut and grazed annually would need to occupy 40% of a catchment of this type to account for all the recharge, reducing to 20% if the trees remained uncut. The limiting factor would be availability of such shallow aquifers.
Publications	Lefroy EC and Stirzaker RJ (1999) Agroforestry for water management in the cropping zone of southern Australia. <i>Agroforestry Systems</i> 45: 277-302. Lefroy EC, Stirzaker RJ and Pate JS (2000) The influence of tagasaste trees (<i>Chamaecytisus proliferus</i>) on the water balance of an alley cropping system on deep sand in south western Australia. <i>Australian Journal of Agricultural Research</i> (in press). Lefroy EC, Pate JS and Stirzaker JS (2000) Growth, water use efficiency and adaptive features of the tree legume tagasaste (<i>Chamaecytisus proliferus</i> Link.) on deep sands in south western Australia. <i>Australian Journal of Agricultural Research</i> (in press). Unkovich MJ, Pate JS, Lefroy EC and Arthur DJ (2000) Inputs of fixed N by the fodder tree legume tagasaste (<i>Chamaecytisus proliferus</i>) in deep sands of Western Australia assessed using the N¹⁵ natural abundance technique. <i>Australian Journal of Plant Physiology</i> (in press).

Project Title Fodder species- commercial and environmental options

RIRDC Project No.: UWA-53A
 Researcher: Dr Ted Lefroy
 Organisation: Centre for Legumes in Mediterranean Agriculture,
 University of Western Australia
 Phone: 08 9380 2561
 Fax: 08 9380 1140
 Email: elefroy@cyllene.uwa.edu.au

- Objectives**
- Identify the current status of fodder trees and shrubs in Australia compared with the situation at the time of the last review in 1991.
 - Identify tree and shrub species with potential for use as animal fodder and those species requiring further R&D to achieve their full potential.
 - Identify regions across Australia where the integration of fodder trees and shrubs is viable and desirable based on economic and environmental objectives in the context of the viability of other potential tree products.
 - Identify current researchers and determine the desirability, feasibility, scope and cost of a national fodder tree selection R&D program

Background

The development of commercial trees suited to the medium to low rainfall areas is seen as important in the management of groundwater recharge, dryland salinity and other threats to the sustainability of agricultural land use. Fodder trees were identified as having considerable promise in a recent JVAP study of prospects for commercial trees in this zone (Zorzetto and Chudleigh 1999).

Research

Review data bases of scientific papers and research reports on fodder trees and shrubs in Australia since the last major review was conducted in 1991. Contact individuals engaged in research, development or extension of fodder trees and shrubs identified by the literature search.

Outcomes

In progress (completion date 30 July 2000).

Project Title: Neem consultancy

RIRDC Project No.: AGT-6A
 Researcher: Dr Peter Chudleigh
 Organisation: Agrtrans Research
 Phone: 07 3870 9564
 Fax: 07 3371 3381
 Email: agrtrans@powerup.com.au

- Objectives**
- Carry out a desktop study to:
- Assess the potential for the use of neem tree production systems in low rainfall areas of Australia from the point of view of technical and economic viability, as well as resource sustainability.
 - Assess the current and future potential domestic and export markets for neem oil and neem products produced in Australia

Background

The neem tree (*Azadirachta indica*) has been known for a very long time to exhibit insecticidal properties. Modern science has been applied to the neem tree since the 1950s with most focus on its content of azadirachtin. The opportunity to grow neem trees in

	Australia has appeared to many to be a rational pursuit and worth of consideration provided useful products that are financially viable to produce can emanate from the tree. Some have also considered the tree may be used for plantings for environmental purposes in Australia. Past and current attempts have been made to explore the potential to select trees that have higher concentrations and to grow the tree in more favourable conditions to improve yields. The biggest challenge is to develop a production system that allows profitable production and distribution of formulated products. A particular focus of the current review is to assess the prospects for neem trees in the low rainfall areas of Australia where agroforestry that targets commercial production as well as providing a sustainability function are of great interest to the Joint Venture Agroforestry Program.
Research	This study involved desk-top research only, including telephone consultation with key contacts in neem and related industries.
Outcomes	There are no outcomes to date, however potential outcomes include further research in the areas of economics and potential economics of production, selection, clonal propagation, planting densities and cultural practices such as irrigation needs and fertiliser requirements, harvesting methods, extraction processes and testing and data assembly for registration.
Implications	The current market for neem based insecticides is small, registration of products still has not been achieved, and some evidence suggests that the efficacy of neem products may be restricted. Developing a competitive industry in Australia may be quite difficult. If an industry were to be established it would more likely be successful in the very far north of Australia and under an intensive system of production. It is unlikely that yields and concentrations of active ingredients from trees grown in the WA wheat belt would be as high as from trees grown further north. The report recommends that JVAP should explore developments in other countries regarding the rationale and expectations from neem plantings, the climates in which trees are being planted, and maintain a watching brief on performances achieved. RIRDC should also maintain a watching brief on the registration status of neem in Australia, and periodically update the potential for an Australian neem industry.

2.2 Agroforestry and Farm Forestry

Research in Progress

Targeted Strategies for Implementation of farm forestry

Project Title	Landcare loan fund project development
RIRDC Project No.:	BCL-1A
Start Date:	1/11/98
Finish Date:	31/07/00
Researcher:	Mr Derek Mortimer
Organisation:	Broken Catchment Landcare Network Inc. c/- DNRE, Sydney Road BENALLA VIC 3673
Phone:	03 57611 516
Fax:	03 57 611 628
Objective	To create a cost sharing structure for farm forestry and landcare works and encourage landholder uptake of farm forestry by developing a low interest loan fund, owned and operated by Landcare groups by June 2000.
Current Progress	The Landcare Revolving Loan Fund Limited has entered its second year of operation. Capital has been increased to \$30,000 with loans and donations from landcare and forest growers groups, and individuals. The Fund has recently been registered as an Environmental Organisation. This qualifies it to solicit tax deductible donations from the public. A total of \$22,000 in loans have been approved in autumn 2000 for perennial pasture and farm forestry establishment. The Fund Directors refer to Catchment Strategies and other recognised documents to guide their loan disbursement decisions. A presentation on the project was made to the Australian Landcare Council at their March 2000 meeting. The Council offered support to promote the concept to landcare groups elsewhere. The Benalla based Cooperative Farm Forestry Initiative (COFFI) is seeking to develop a “one stop shop” of landcare loan + technical advice + access to grower cooperative + facilitation. COFFI currently employs three technical advisers under the Federal Farm Forestry program. The final stage of research and development is the preparation of a book describing the story of the project. We expect the book will be available to the general public in 2001.

Project Title Seed and Information support for farm forestry	
RIRDC Project No.:	CSF-56A
Start Date:	1 January 1999
Finish Date:	31December 2001
Researcher:	Mr Tim Vercoe
Organisation:	CSIRO Forestry and Forest Products
Phone:	6281 8218
Fax:	6281 8266
Email:	atsc@ffp.csiro.au
Objective	The project will deliver information to farm forestry groups in a range of packages including: an advisory service, field days, training workshops, a national register of trials, climatic profiles, an information directory of commercially important tree species and their wood properties, a handbook of guidelines to assist species/provenance selection, enhanced TREDAT databases and supply seed for regional demonstration plantings.
Current Progress	The project has responded to inquiries from 120 groups and individuals on species provenance selection and site matching. About 500 seedlots of around 60 species have been dispatched to growers for testing under a range of conditions. Thirty five trial sites comprising around 80 ha of trials have been designed and planted with assistance from the project including workshops and training. Many of the trials are linked by common seedlots and are designed to enable future cross-site analysis. Research on the quality and suitability of a range of species for pulp and composite wood products has been completed to look at the potential uses for residues and thinnings from sawlog plantations of these species. Climate suitability profiles for a range of species have been produced to assist in matching them to appropriate sites. Performance and environmental data from a range of species and sites has been collected to support work on productivity estimates and the TREDAT tree performance database has been expanded to cover farm plantings as well as trials.

Project Title Assesment of the socio-economic implications of farm forestry	
RIRDC Project No.:	ECU-8A
Start Date:	30 May 2000
Finish Date:	30 September 2000
Researcher:	Professor Alan Black
Organisation:	Centre for Social Research Edith Cowan University JOONDALUP WA 6027
Phone:	08 9400 5844
Fax:	08 9400 5866
Email:	a.black@ecu.edu.au
Objectives	The project will assess the socio-economic impacts of of high rainfall forestry on rural communities. From a review of the Australian literature and through a study of two rural locations that have experienced extensive expansion of forestry on cleared agricultural land, together with a review of existing socio-economic data, this project aims to develop principles and guidelines that will help to minimise any negative impacts and maximise the positive benefits of farm forestry, not only in high rainfall regions but also in low and medium rainfall areas. The project will deliver a camera-ready report suitable for consideration of the JVAP management committee and subsequent publication.
Current Progress	This project has just commenced. Relevant literature is currently being compiled and case study communities are being selected in the South-West of Western Australia and in the Green Triangle Region of Victoria and South Australia.

Project Title	Farmwood Australia market development
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	TFG-1A 1 July 1999 30 April 2001 Mr Ross Henderson TFGA Farmwood P O Box 470 DEVONPORT Tas 7310 03 6427 0507 03 6427 7224 Farmwood@southcom.com.au
Objectives	▪ To stimulate the expansion of ecologically and economically sustainable farm forestry by providing viable returns to growers through organised regional coordinated marketing; ▪ Research niche markets and develop new techniques to service them as required; ▪ Research, compile and disseminate user friendly and up to date market information to member cooperatives Australia wide; and ▪ Secure economies of scale for farm forestry to ensure long term viability through cooperatives or other groupings.
Current Progress	1. Helped instigate the National Treegrowers Co-operative Workshop in Brisbane (Nov '99) as the precursor to Farmwood Australia. One third of the steering committee are currently finalising a draft of a proposed framework for this national co-operative. 2. Has concentrated on China as the new opportunity. One thousand cubic meters of product being sold into China of pioneered low- grade hardwood logs and green sawn timber shipments in containers. There are trials here and in China. The developing trust and understanding on both sides is leading to more processing and investment here. Concentration is on flooring, furniture components and veneers for Tasmanian oak and minor species. There were three follow up trips and five visits from Chinese associates. The development of a use and export markets for the whole tree (stump to leaves) of camphour laurel from northern NSW. Taiwanese investors are looking closely at this project utilising local equipment with some addition investment. The possible export of Carribean pine from North Queensland has assisted in the development of Mourilyan Harbour export capabilities following a survey by the author. Carribean pine has proved less acceptable in North Asia but has led to opportunities in the Philippines that will probably link with first thinnings of Radiata pine from Victoria and Tasmania. There is a China/Taiwan consortium progressing woodchip sales or possibly pulplogs for timber and chip recovery and sales in China. 3. Contributed to the ANU Market Reoprt. Member of steering committee for development of Victorian e-commerce data base and marketing of Victorian private forests. Helped initiate and is a continuing contributor to the AFG Treegrower Co-operative Newsletter. Maintained active assistance to new co-operatives.

Sustainable use of natural resources

Project Title	Plantation design and biodiversity conservation
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	ANU-33A 1 July 1998 30 June 2001 Dr. David Lindenmayer Australian National University CRES CANBERRA ACT 0200 02 6249 0654 02 6249 0757 davidl@cres.anu.edu.au
Objectives	▪ To develop a scientific basis to inform the establishment of plantations so they retain some values for biodiversity conservation. ▪ To develop scientifically robust approaches and protocols to assess the value of remnant native vegetation in agricultural landscapes as habitat for a wide array of vertebrates. This will form guidelines for assessing clearing applications for native vegetation in areas targeted for plantation establishment. ▪ To collate new information on environmental changes in wildlife populations associated with plantation establishment and design. These data will place industry and resource management agencies in a strong position with regard to issues associated with long-term ecological sustainability of plantation forests.
Current Progress	This project is making excellent progress and extensive new information has been gathered that contribute considerably to biodiversity conservation within woodland remnants located in intensive plantation environments. A major long-term cross-sectional and longitudinal experiment - The Nanangroe Experiment - has been instigated. The experiment is examining the changes in biota inhabiting woodland fragments that occurs when the surrounding landscape is converted from one subject to intensive livestock grazing to one dominated by plantation softwood forestry. A total of 126 sites have been established in the study - 50 woodland remnants surrounded by newly planted Radiata Pine, ten sites in recently established Radiata Pine stands, 56 woodland remnants located in grazed landscapes, and 10 sites in cleared and grazed paddocks. Detailed field surveys of reptiles, birds, arboreal marsupials, terrestrial mammals, frogs and plants have been completed. Statistical analysis of baseline data for these groups show that several attributes of woodland remnants have a significant influence on the distribution of woodland vertebrates. These attributes include woodland remnant size, dominant woodland tree species, numbers of trees with hollows, the presence of rock piles and the abundance of large logs. Distinct changes in vertebrate communities are already apparent even after only three years of the commencement of the Nanangroe Experiment. The data gathered to date highlight the importance of retaining woodland remnants as part of the design of newly established Radiata Pine plantations to ensure that such areas make a contribution to nature conservation. This project is supported by the National Heritage Trust.

Project Title	
Quantifying conservation and environmental conservation	
RIRDC Project No.:	CSW-32A
Start Date:	1/02/99
Finish Date:	30/04/02
Researcher:	Dr Richard Hobbs
Organisation:	CSIRO Wildlife and Ecology Private bag 5, PO Wembley WA 6913
Phone:	08 9333 6442
Fax:	08 9333 6444
Email:	Richard.Hobbs@per.dwe.csiro.au
Objectives	- Quantify the extent to which native hardwood farm forestry on cleared agricultural land can contribute to achieving biological conservation goals. - Quantify the relationship between floristic diversity, natural enemy diversity and insect herbivore damage in farm forestry. - identify which farm forestry practices have positive or negative impacts on particular biological conservation goals, and how these practices may be modified to increase these conservation benefits without jeopardising commercial benefits. - Provide input to guideline development for farm forestry which promote enhancement of native biota eg. birds, mammals and insects, and minimise insect herbivore damage.
Current Progress	A range of study sites has been established in the Albany/Mt Barker area of south-western Australia in 4-6 yr old bluegum plantations adjacent to, and isolated from, large remnants of native vegetation. Sampling in spring and autumn has been carried out on an array of faunal groups including birds, reptiles, amphibians, bats and other mammals, and a range of insects. The study set up allows us to consider the contribution to conservation likely to arise from plantations in different landscape configurations and will provide the first detailed assessment of faunal use of plantations. Early results show a clear differentiation between isolated and adjacent plantations, and indicate a concentration of faunal use on the edge between plantations and remnants. The plantations clearly provide habitat or resources for a wide array of fauna, but further analysis will reveal whether the species using plantations are those of conservation concern or are mainly generalist species which are not at risk. Details of study design are available in the first issue of the project newsletter, available from the above address.

This project was supported by the **Natural Heritage Trust**.

Project Title	
Measurement and integration of fauna biodiversity values in Queensland agroforestry systems	
RIRDC Project No.:	QDN-6A
Start Date:	1 February 1999
Finish Date:	30 June 2001
Researcher:	Mr. Adrian Borsboom
Organisation:	Queensland Department of Natural Resources 80 Meiers Rd. Indooroopilly Queensland 4068
Phone:	07 3896 9300
Fax:	07 3896 9628
Email:	borsboa@dnr.qld.gov.au
Objectives	To measure and compare fauna biodiversity in sub-tropical eastern Australia in a) farm

	forestry eucalypt plantings b) cleared grazing land and d) native forests. ▪ To identify rare, threatened, beneficial and pest fauna species using farm forestry. ▪ To determine economic, practical and ecologically sustainable farm forestry practices to enhance fauna biodiversity and nature conservation values. ▪ To develop a farm forestry decision support system.
Current Progress	The project continues to run smoothly and within budget expectations. The 17 sites chosen to compare fauna biodiversity between cleared grazing land, <i>Eucalyptus cloeziana</i> plantations and native forest have now been surveyed twice. The winter survey was completed in July 1999, the summer survey between December 1999 and January 2000. Survey data storage, tabulation and preliminary analyses are progressing. A project outline and draft survey results were presented and well received at a farm forestry field day in SE Queensland in February 2000. The summer survey saw the number of bird species using the plantation sites increase significantly, partly reflecting the influx of summer migrants to the region. As expected, reptile and frog activity was higher on the survey sites during summer relative to the winter survey period. Comprehensive habitat measurements were taken on all sites in July/August 1999 and during the summer of 2000/2001. Plantation habitat measurements will bring added value to this project by providing a list of weed species and changes to weed species composition over time. This project is supported by the Natural Heritage Trust

Project Title	Irrigation management in young eucalypt plantations growing over high water tables
RIRDC Project No.: CSF-54A Start Date: 1 July 1997 Finish Date: 30 June 2000 Researcher: Dr Phil Polglase Organisation: CSIRO Forestry and Forest Products Phone: 02 6281 8204 Fax: 02 6281 8312 Email: philip.polglase@ffp.csiro.au	
Objectives	▪ to develop a bio-physical basis for efficient irrigation of young eucalypt plantations on sites with high water tables ▪ to assist plantation growers (in the Murray-Riverina region) to adopt irrigation strategies that are effective in terms of cost, productivity, and groundwater control (salinity) ▪ to ensure direct transfer and uptake of research outcomes through direct collaboration with the local farm forest community.
Current Progress	▪ Irrigation efficiency is low, 30 to 50% of the water applied remaining in soil available for uptake, the remainder being lost to run-off, evaporation from ponded water or subsequently from soil, or to deep drainage. ▪ When irrigated monthly on heavy soils, tree growth is boosted for less than 14 days before returning to low rates. When irrigated fortnightly, but in lesser amounts, tree growth is maintained while minimising groundwater recharge. ▪ Groundwater use at one site was 60% of total water use (transpiration). Here, the soil had neutral soil properties and groundwater was of low salinity. At all other five sites studied groundwater use was minimal, and soils at depth were alkaline, saline, sodic, massive clays. Thus site conditions greatly affect the ability of roots to grow and proliferate at depth. Results have implications for: ▪ efficient and conservative use of irrigation water ▪ methods to schedule irrigation, including the total annual amount of water needed, and the timing and frequency of irrigation to optimise growth per unit volume of water

- applied,
- site selection and management of tree plantations on a variety of soil types
- expectations for groundwater use by trees and reasons for differences among sites.

Project Title	
A manual for irrigated eucalypts incorporating salinity impacts	
RIRDC Project No.:	CSL-9A
Start Date:	1 April 1999
Finish Date:	31 March 2002
Researcher:	Dr Jim Cox and Dr Glen Walker
Organisation:	CSIRO Land and Water
Phone:	08 83038510
Fax:	08 83038550
Email:	Jim.Cox@adl.clw.csiro.au
Objectives	Production of a practical manual for commercial irrigated eucalypt plantations in the southern Murray-Darling Basin, incorporating new biophysical and economic analysis of sustainability and productivity issues in areas of saline water tables.
Current Progress	When trees are planted they first deplete soil water then use groundwater (eventually up to 300 mm/y) and the watertable drops a few metres. Low soil hydraulic conductivity and the accumulation of salt limit tree water use. The difference between transpiration and infiltration and the initial groundwater salinity influence the rate of salt accumulation. As groundwater usage declines, the depression in groundwater levels is reduced and the drawdown often only effects an area tens of metres from the plantation. Hydraulic conductivity and irrigation regimes substantially influence the magnitude and scale of the hydrologic behaviour of plantations grown over shallow watertables. Irrigation can largely increase tree growth, leading to increases in leaf area, transpiration and stem carbon as it limits groundwater uptake and salt accumulation. Seasonal leaching of salts through episodic rainfall or irrigation may extend the range of conditions under which trees survive. However, this recharge will negate most of the discharge gained. A balance between tree growth and groundwater control has to be reached. Preliminary results suggest that a compromise between groundwater control and tree growth on heavy textured soils in shallow watertable environments may be achieved by irrigating at half the annual rate (approx. 400 mm/yr).

Project Title	
Demonstration and development of fast growing irrigated eucalypt plantations in northern Victoria	
RIRDC Project No.:	DAV-131A
Start Date:	01/03/97
Finish Date:	31/07/00
Researcher:	Dr Tom Baker and Dr Michael Duncan
Organisation:	Department of Natural Resources and Environment Centre for Forest Tree Technology PO Box 137 HEIDELBERG VIC 3084
Phone:	03 9450 8687 03 9450 8663
Fax:	03 9450 8644
Email:	tom.baker@nre.vic.gov.au, michael.duncan@nre.vic.gov.au
Objective	To compare the performance of a range of eucalypt species and provenances for a range of soil types and irrigation water qualities

Current Progress	The Trees for Profit (TFP) species trials focus on <i>Eucalyptus camaldulensis</i>, <i>E.globulus</i>, <i>E.grandis</i> and <i>E.saligna</i> at irrigated sites in northern Victoria. In the past 12 months, trials at Cobram, Mangalore, Nathalia, Tatura, Timmering and Shepparton have been measured and foliage, soil and irrigation water chemically analysed to age 6 years. In addition, the project has also completed chemical analysis of trials at Appin South and Yarrawalla South to age 3 years. To age 6 years (and 8 years at Undera), trees at the most saline sites (Nathalia, Tatura and Timmering) showed a trend towards decreasing nitrogen concentration and increasing salt accumulation in the foliage of <i>E.globulus</i>, <i>E.grandis</i> and <i>E.saligna</i>. There was a trend towards increasing surface soil sodicity at most sites. <i>E.globulus</i> was the fastest growing species at all sites, and growth rates generally varied inversely with irrigation water salinity. At Yarrawalla South, while soil sodicity was quite high, salt accumulation was not apparent in the foliage of any species and tree growth rates were reasonable at age 2 years. However, salinity appears to be significant problem at Appin South. The surface was sodic, and significant salt accumulation was occurring in the foliage, resulting in poor tree growth.
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Project Title	Characterisation of tree root morphology in alley systems
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	DAW-93A 1 January 1999 30 November 2001 Mr. Robert Sudmeyer Agriculture Western Australia Agriculture WA, RMB 50 ESPERANCE WA 6450 08 9083 1111 08 9083 1100 rsudmeyer@agesp.agric.wa.gov.au
Objective	To improve pasture and crop growth in alley and windbreak systems by developing commercially sound competition management strategies based on an understanding of tree root morphology for a number of tree species and soil type combinations and how root morphology is affected by root pruning.
Current Progress	The distribution and density of tree roots was mapped adjacent to <i>E. globulus</i> timber belts at two sites using the pit face method. The first site was a deep sand (in excess of 5 m) the trees were 15 m tall and had been root pruned 3 times to a depth of 0.5-0.6 m. The second site was sited on a gravelly duplex soil, the trees were 16 m tall and had never been root pruned. At each a detailed soil description was made. Soil samples were collected at various distances from the trees for chemical analysis and determination of soil water content. Soil samples were collected and the roots washed out, dried and weighed. <i>E. globulus</i> roots extended 1.5-2 H (windbreak height), or 24-30 m, from the stem of the trees. Within 1 H of the trees the number of roots in the top 1.4 m of the soil profile was similar, however beyond 1 H the number of roots declined more quickly in the duplex soil than in the deep sand. Root pruning reduced the number and size of roots in the top 0.5 m of the soil profile but there were still a significant number of roots in the top 0.5 12 months after pruning.

Project Title	
Sustainability certification: practice and potential in farm forestry	
RIRDC Project No.:	PN99.2009
Start Date:	May 1999
Finish Date:	April 2001
Researcher:	Darren Sinclair
Organisation:	Australian Centre for Environmental Law (ACEL Consulting) PO Box 142 Lyneham, ACT, 2602
Phone:	02 6249 3397
Fax:	02 6249 4899
Email:	darren.sinclair@anu.edu.au
Objective	• Determine the commercial and environmental implications of certification for Australian farm forestry. • Investigate the practicalities of certification for small on-farm producers. • Determine how certification can be best utilised by small farm growers and the development of a workable model for stakeholder engagement. • Integrate sustainability certification with quality assurance schemes, potential carbon trading initiatives and Regional Forest Agreements.
Current Progress	This project has completed an international review of the practice and potential of sustainability certification in the farm forestry sector, and developed the project's conceptual framework. This provided the necessary theoretical basis on which to proceed with fieldwork involving actual farm foresters to ascertain the practical issues surrounding the potential application of forestry certification in South East NSW and in the South Coast region of WA.

This project is supported by the **Natural Heritage Trust**

Project Title	
An investigation of "Mundulla Yellows" affecting native Eucalyptus species	
RIRDC Project No.:	UA-51A
Start Date:	1 April 2000
Finish Date:	31 March 2001
Researcher:	A/Prof. John Randles
Organisation:	The University of Adelaide PMB 1 Glen Osmond SA 5064
Phone:	08 8303 7353
Fax:	08 8379 4095
Email:	john.randles@adelaide.edu.au
Objective	The project will survey the distribution and incidence of Mundulla Yellows (MY) disease in Eucalypts and other species relevant to agroforestry in a number of Australian States (SA, WA, NSW, VIC, TAS). The severity and expression of the disease in different regions and its micro and macro spatial distribution will be investigated. Using established methods, the association of phytoplasma infection with the disease will be tested, and the possibility of using chemotherapy to control the disease will be investigated.

Current Progress	1 - Description of the disease: the MY syndrome has been defined and symptoms described for a number of eucalypt and other native species. An illustrated guide for field identification is available. Several trial sites have been identified and marked in south-eastern SA and monitoring of disease spread has commenced. 2 - Survey for MY: A global positioning system (GPS) for use during the survey has been selected and purchased. It has been trialed near Adelaide for recording positions of sampling sites. 3.1 - Indicator species for MY: Attempts to use dodder for transmission to alternative species were unsuccessful due to failure of dodder to parasitise eucalypts. 3.2 - Feasibility of chemotherapy: Tissue culture of shoot tips is being developed. 3.3 - Possible phytoplasma association with MY: a PCR diagnostic protocol for phytoplasma identification is being set up using funds from other research partners.
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Project Title	Optimising nutrition for productivity and sustainability of farm forestry systems
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	UJC-6A 1 January 1999 31 December 2001 Dr R.A. (Bob) Congdon James Cook University Tropical Plant Sciences School of Tropical Biology TOWNSVILLE QLD 4811 07 4781 4731 07 4725 1570 Robert.Congdon@jcu.edu.au
Objectives	The major thrust of the research will be to identify pasture legume species which are able to tolerate different levels of shading under tree plantations in the wet tropics – providing improved forage quality and productivity for grazing in agroforestry situations, and improving soil fertility and reducing fertiliser costs through nitrogen fixation. The benefits to tree growers include enhanced tree growth, weed suppression (reduced costs for herbicides), and reduced erosion on steep or degraded sites (due to mixed ground cover).
Current Progress	A Nelder wheel has been established on the JCU Townsville campus, using African Mahogany (<i>Khaya senegalensis</i>), to provide a shade gradient for testing legume growth. An initial pot trial was used to build up the seed supply of potentially suitable legumes, and to allow observation of growth and phenological characteristics. A field trial, using shade cloth to establish controlled levels of shade, has already begun for some of the species for which large amounts of seed is available. The first of a series of pot trials examining shade tolerance of selected legumes over a range of light intensities is complete. Light response curves have been constructed for each species and dry matter production, nutrient content and root:shoot ratios will soon be determined. Initial results suggest that the species <i>Desmodium canum</i>, <i>D. intortum</i>, <i>D. ovalifolium</i>, <i>Arachis pintoi</i> and <i>Calopogonium mucunoides</i> are adapted to shaded conditions and may have potential in agroforestry situations. Trials beneath established plantations are currently being set up. The first of approximately four such trials has been established beneath a 10-year-old <i>Khaya senegalensis</i> plantation at the Australian School of Tropical Agriculture in the Burdekin. Other trials will soon be established beneath plantations located at Babinda, in the wet coastal lowlands, and on the Atherton Tablelands.

Project Title	Salt tolerant trees with high pulp quality
RIRDC Project No.:	UMU-19A
Start Date:	1 July 1996
Finish Date:	30 June 2001
Researcher:	A/Prof. Jen McComb
Organisation:	Murdoch University MURDOCH WA 6150
Phone:	08 9360 2336
Fax:	08 9360 6303
Objectives	▪ To provide farmers, wood pulp producers and land care groups with trees which have high pulp quality and can be grown in saline areas. ▪ To identify the genotypes combining salinity tolerance, fast growth, and good quality pulp from <i>Eucalyptus camaldulensis</i> x <i>globulus</i> hybrids through the establishment of new field trials on saline soils in WA, the Murray Darling Basin and Tasmania, and monitoring existing field trials in WA. ▪ To improve micropropagation and cutting propagation methods for the hybrids.
Current Progress	Field trials of <i>E. camaldulensis</i> x <i>globulus</i> selected for salt tolerance, and the control parent species have been monitored at Beverley, Mount Barker, Boyup Brook and Narrikup in WA, Coleambally in NSW and Cressey in Tasmania. The survival of the <i>E. globulus</i> is lower than that of the hybrids on most saline sites. The hybrids are showing a range of heights from better than the surviving <i>E. globulus</i> to very poor. The poor lines have plagiotrophic growth, a consequence of the choice of buds for micropropagation and will be discarded. The <i>E. camaldulensis</i> lines, as expected show best salt tolerance but poor height and form. The best performing lines are the best on all sites regardless of climate. Trees on an additional non saline site at Pinjarra, WA are now of a suitable size (10-20 cm diameter), for assessment for fibre properties and timber quality.

Optimised productivity of crops and pastures

Project Title	Trees for Shelter: a guide to using windbreaks on Australian farms
RIRDC Project No.:	CSL-7A
Start Date:	01 March 1999
Finish Date:	31 October 2000
Researcher:	Dr. Helen Cleugh
Organisation:	CSIRO Land and Water Pye Laboratory GPO Box 1666 CANBERRA ACT 2601
Phone:	02 6246 5574
Fax:	02 6246 5560
Email:	Helen.cleugh@cbr.clw.csiro.au
Objectives	▪ To produce an up-to-date and relevant resource in an accessible, informative and authoritative guide to using trees for shelter on Australian farms based on research and results from the National Windbreaks Program. ▪ To organise a self funded training workshop to coincide with the publication and launch of the book which will:

	▪ enhance the public awareness of this important resource, and ▪ comprise a series of lectures and discussions to present the key findings and their implications to the target audience and the wider community.
Current Progress	The draft text of the book has been written and circulated to all participants in the National Windbreaks Program for comment. Changes arising from these comments have been implemented. Illustrative material has been obtained from the various researchers involved in the National Windbreaks Program and explanatory diagrams have been created. These are currently being produced in their final form for the book. This book is part of the forthcoming JVAP guideline series.

Project Title	Using windbreaks to protect soil, crops and livestock
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	CSL-10A 01 July 1999 01 June 2001 Dr. Helen Cleugh CSIRO Land and Water Pye Laboratory GPO Box 1666 CANBERRA ACT 2601 02 6246 5574 02 6246 5560 Helen.cleugh@cbr.clw.csiro.au
Objective	The key outcome from this research project is an integrated and quantitative assessment of the role of shelter in reducing the risk of wind damage to crops and wind chill in grazing animals. This research will focus on identifying wind speed thresholds associated with crop damage and stock losses, and hence on the protection offered by shelter from windbreaks.
Current Progress	This project uses experiments to identify windspeed thresholds above which direct damage, sandblasting and lodging limits the productivity of crops. Once these thresholds have been established, measured and simulated wind climates at key agricultural locations are used to quantify the reduction in risk offered by windbreaks. We have completed the wind tunnel experiments that quantify the level of direct damage (leaf tearing, stripping and abrasion) in faba beans, and the subsequent yield impacts, for a range of windspeeds common in the SA cropping areas. A similar suite of experiments to establish damage thresholds and yield impacts for sandblasting are currently being conducted. We have identified, and purchased data from, automatic weather stations located in the SA cropping region that have adequate data quality and record length. Because these monitoring sites are distributed rather sparsely across the landscape, a numerical model has been implemented to generate spatial windfields at a 5 km resolution for the period 1997-2000. These spatial fields enable us to assess the wind climate, and thus the impact of wind shelter, at a paddock scale. The numerical simulations and wind climate analyses are underway.

Project Title	Quantifying the tradeoff between tree and crop productivity on farms
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation:	CST-6A 1 January 1999 30 November 2001 Dr Peter Carberry CSIRO Tropical Agriculture Agricultural Production Systems Research Unit PO Box 102 TOOWOOMBA QLD 4350 Phone: 07 4688 1377 Fax: 07 4688 1193 Email: peter.carberry@tag.csiro.au
Objectives	To enable landholder assessment of the productivity and risk of commercial agroforestry investment on grain farms in Australia's medium to low rainfall regions, this project aims to: ▪ simulate tree-crop competition for light, water and nutrients; ▪ quantify the potential benefits and risks of planting trees; and ▪ assist landholder assessment of the viability of agroforestry investments on farms
Current Progress	In order to simulate a tree-crop system within the APSIM framework, the system needs to consider a number of horizontally adjacent zones consisting of: (i) an area of trees, growing either as a forest lot or as a windbreak row, (ii) a "competition zone", within which the trees and the adjacent crop compete for water, nutrients and light, and (iii) the area of sole crop – affected by the microclimate impact of windbreaks out to about 20H. Progress has been made in developing the simulation capability of (i) and (ii) above – the proceeding National Windbreak Project (CSC52a) has already provided simulation capability for (iii). A functional and validated APSIM module for tree production (APSIM-Forest) has been developed. It can be parameterized for a range of species and be used to simulate species mixtures as well as extraction from groundwater resources. A number of design approaches to dealing with the dynamics of the competition zone have been explored. One approach has been to run APSIM concurrently for both the tree section and the crop section in the competition zone, with each run communicating with the other run. Another approach involves more intimate coupling of spatially explicit "slices" of vegetation and soil within a single APSIM simulation. At this point either design approach will meet the needs of this project, although the latter is expected to deliver improved model execution speed. This new feature is planned for incorporation into APSIM v1.7 in Sept. 2000.

This project is supported by the **Natural Heritage Trust**.

Project Title	Integrating agroforestry into low rainfall farming systems
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	SAR-19A 4/01/99 31/12/01 Mr Michael Bennell Primary Industries and Resources South Australia 08 8539 2110 08 8532 5646 bennell.mike@saugov.sa.gov.au
Objectives	▪ Provide quantitative information on the impacts of severe wind events on dry-land crop in southern Australia ▪ Analyse the risk and economic impact of physical crop damage on crops ▪ Identify low rainfall agroforestry and shelter systems most likely to be viable by undertaking a cost-benefit analysis ▪ Establish demonstration plantings of low rainfall agroforestry systems and institute long term monitoring to validate assumptions used in the cost-benefit analysis.
Current Progress	Direct plant damage: Potted Faba bean plants exposed to 10 and 15 m/s winds in a wind tunnel for 8 hours indicate that direct wind damage is minor with negligible impact on plant growth. Damage symptoms were confined to rub marks and tissue damage on the margins of leaves. Harvesting utilising a Yield Monitor provided data on crop variation in the lee of mature windbreaks. Cereals have shown a modest response to shelter with increased yield in the 3H to 10 H (H = Windbreak Height) zone ranging from 0 to 15%. Faba Bean showed a more consistent result with 3 sites all indicating a yield increase around 20% in the 3H to 10H zone. Yield improvement is limited to the 10H distance and a significant competition zone is consistently present. Sandblasting damage to wheat and canola crops at establishment was monitored. Biomass at maturity and yield for the wheat crop was significantly higher in the undamaged area with a yield increase of 5 %. Sites in eastern SA were selected and agroforestry planting of species and designs most likely to be viable in a low rainfall environment established. A monitoring program on forestry and agronomic returns has been initiated.

Optimised direct returns from tree products

Project Title	Inorganic-bonded wood-composites manufactured from mallee eucalypt and melaleuca species
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	ANU-35A 1 February 1999 30 November 2001 Dr. Phillip Evans Department of Forestry Australian National University CANBERRA ACT 0200 02 6249 3628 02 6249 0746 Phil.Evans@anu.edu.au
Objective	To improve the compatibility of mallee eucalypt and and melaleuca wood with Portland cement and develop suitable processing techniques to facilitate the development by 2005 of an inorganic wood bonded composit industry in Western Australia.
Current Progress	A study of the compatibility of mallee eucalypt wood with Portland cement has been completed. In addition, the suitability of chipped wood residues (with and without bark) from different mallee eucalypt species for the manufacture of cement-bonded panels (CBPs) has been determined. The strength properties (MOR and MOE) of CBPs manufactured from mallee eucalypt residues, cement and CaCl₂ content were low in comparison to similar boards made from radiata pine, probably due to unfavourable geometry of the eucalypt wood residues. Board strength was significantly affected by species but not by the presence of bark in the residue. However, boards containing bark showed increased thickness swelling and water absorption when immersed in water. Our findings have been submitted as a scientific paper for publication in the journal 'International Crops and Products'. Selected results were presented as a conference paper at a IUFRO symposium: 'The Future of Eucalypts for Wood Products', March 2000 in Launceston, Tasmania. A further paper will be presented at a forum entitled 'Lignocellulosics Technology-from Laboratory to Market', Pacifichem December 2000, Hawaii. Work on evaluating the suitability of Western Australian Melaleuca species: <i>M. acuminata</i> ssp. <i>acuminata</i>, <i>M. uncinata</i> and <i>M. lateriflora</i> ssp. <i>lateriflora</i> for the manufacture of CBPs is underway.

Project Title	Assessment of gain from breeding blue mallee
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	ANU-39A 1 July 1998 30 June 2001 Dr Mike Slee Australian National University Department of Forestry CANBERRA ACT 0200 02 6239 5451 or 02 6249 2573 02 6249 0746 or 02 6239 5451 Mike.Slee@anu.edu.au
Objective	To provide accurate information on the gains achieved using 3 simple breeding strategies in

	the oil producing blue mallee.
Current Progress	The detail of flower and fruit development in two 7 –year- old seed orchards has been recorded. These continuing studies have encompassed two flowering seasons to date. One orchard is clonal and is flowering very well. It is clear that individuals in a clone tend to flower at the same time. Whilst this was expected it was by no means sure as the blue mallee exhibits extreme variation in most features. However the spread of the flowering was extreme and one clone flowered so late it would have been unable to mate with any other clone in the orchard. Attention will thus need to be paid to flowering times of clones to ensure some do not flower at times separate from all others and thus inhibit mating. The clone in question has been removed from the orchard. The other orchard is made up of seedling trees. Here the flowering is generally poorer due to local site conditions but the impression is of more variation within the families than in then clones.

Project Title	Predicting tree growth in farm forestry and following thinning
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	CPF-1A 11 January 1999 1 August 2001 Dr. Michael Battaglia CRC for Sustainable Production Forestry GPO Box 252-12 Hobart, Tas. 7001 03 6226 7912 03 6225 7942 Michael.Battaglia@ffp.csiro.au
Objective	To develop a silvicultural decision support system for farm forestry by incorporating into an existing process-based model of plantation growth (PROMOD) the effects on tree growth and form of wide-spacing, planting in strips and silvicultural practices such as pruning and thinning. A user-friendly PC package will be available for use by landholder, tree growing cooperatives and industry groups by June 2001. It will predict wood product yield from only a few simple site descriptors, the layout of plantations and the plantation silviculture applied.
Current Progress	Two experiments have been established. At an agroforestry experimental site near Manjimup in Western Australia, physiological, microclimatic and growth studies have been carried out in winter (August), spring (November) and autumn (May) in four planting layouts: 1) conventional-plantation design; 2) trees in triple rows; 3) trees in single rows and 4) isolated trees. At a second site near Westerway, Tasmania the development of water stress and the implications of this on the gas exchange of trees on the northern-edge, in the centre and on the southern-edge of a 7 tree-wide shelter-belt is being assessed. In addition data on the effects of thinning on the growth, water use and pattern of light and photosynthetic activity within the crowns of 9 year-old plantation trees has been collated. The growth model PROMOD has been further developed and extended in preparation for extension to farm forestry applications that include non-conventional planting designs. This has included consideration of the time course of development of leaf area and stand biomass, the relationship between the soil volume explored by trees and water use, consideration of competition between trees and grass for water and consideration of how spacing changes the quantity of light intercepted by trees. An in-house seminar was given to staff of collaborating industry partner Bunnings TreeFarms (now Sotico) on project progress and several reports and publications are in preparation.

Project Title	
Silvicultural management for blackwood (<i>Acacia melanoxylon</i>) for growth, form and wood quality	
RIRDC Project No.:	CPF-2A
Start Date:	01 January 1999
Finish Date:	1 September 2001
Researcher:	Dr Chris Beadle and Dr Libby Pinkard
Organisation:	CRC Sustainable Production Forestry
Phone:	03 6226 7911
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Email:	chris.beadle@ffp.csiro.au
Objective	Prescriptions will be developed for silvicultural management of blackwood (<i>Acacia melanoxylon</i>) based on the a) effect of severity of pruning on growth and form; and b) interaction of nurse crop species with blackwood. Guidelines to ensure the applicability of prescriptions to a wide range of sites and environmental conditions in the medium to high rainfall zones will be produced and incorporated into a decision support system. The project will contribute to the education of blackwood growers, and assist them to produce high value blackwood from plantations and to manage blackwood sustainably
Current Progress	A post-doctoral fellow was appointed in January 2000 and a study examining options for form pruning blackwood and management of a <i>Pinus radiata</i> nurse crop commenced immediately in a five-year old plantation. Different intensities, of form pruning in the blackwood and thinning in the pines, have been established. Scaffolding towers have been erected, and used for gas-exchange measurements and to monitor changes in canopy size and distribution following imposition of the treatments. Growth plots are used to monitor changes in height and diameter and form of the blackwood. A second experiment that explores the potential of alternative nurse crop systems for managing form has been established. The treatments include a new approach to the use of conventional nurse crops, either <i>E. nitens</i> or <i>P. radiata</i> , where each blackwood row is separated by five nurse crop rows. The two rows most immediately adjacent to the blackwood row are progressively removed to waste as soon as they begin to suppress the blackwood, the middle row being retained and managed for solid wood. Another treatment looks at the potential of shrubby species as nurse crops in plantations. These species impose good form on blackwood in native forest systems.

Project Title	
Impact of insects on eucalypt plantations in the Murray Valley	
RIRDC Project No.:	CSE-72A
Start Date:	1 July, 1995
Finish Date:	30 June 2000
Researcher:	Dr. Robert Floyd
Organisation:	CSIRO Entomology GPO Box 1700 CANBERRA ACT 2601
Phone:	02 6246 4089
Fax:	02 6246 4155
Email:	R.Floyd@ento.csiro.au
Objectives	- To assess provenances and families of several species of eucalypts for resistance to pests of young trees in order to incorporate insect resistance into breeding programs in seed orchards. - To measure the impact of insect feeding on the growth and form of young eucalypts grown in existing plantations (Murray Valley and ACT) and new plantations established under irrigation or in high water table sites in the Murray Valley and to incorporate this information into growth and economic models.

	To develop a set of recommendations for the environmentally sensitive management of insect pests involving insect resistance in young trees for use in farm forestry.
Current Progress	Routine monitoring of insect damage and tree growth in plantations of <i>Eucalyptus globulus</i>, <i>E. grandis</i>, <i>E. dunnii</i>, <i>E. benthamii</i> and <i>E. maculata</i> and collection of data to determine phenology of major insect pests ended in the spring of 1999. Analyses of these data are proceeding. The most important foliage feeding insect pests have been identified as <i>Mnesampela privata</i> (autumn gum moth), <i>Cardiaspina fiscella</i> (brown basket lerp), <i>Phylacteophaga</i> spp. (leafblister sawfly) and <i>Anoplognathus</i> spp. (Christmas beetle). Analysis of patterns of resistance and growth at a provenance and family level is most complete for <i>E. globulus</i>. These data have demonstrated cross-resistance to insect attack at the provenance level for at least three of the species listed above. Also within provenance variation in resistance to <i>Anoplognathus</i> spp has been observed. A relationship between cumulative damage and growth rates for two <i>E. globulus</i> subspecies has also been found.

Project Title	Tree improvement for low rainfall farm forestry in southern Australia
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	CSF-58A 1 April 1999 30 June 2001 Dr Chris Harwood CSIRO Forestry & Forest Products 02 6281 8218 02 6281 8266 Chris.Harwood@ffp.csiro.au
Objectives	- The project will produce national improvement strategies for hardwood and softwood species for low rainfall regions through identifying and developing best currently available seed sources, targeting early production and distribution of seed from these sources and fast-tracking mass production of genetically improved planting material. - The project will also study the nature of genotype/environment interactions of short rotation woody crops using multi-locational clone trials. The results will guide the development of breeding strategies for oil mallees, in particular the question of whether separate breeding populations for western and eastern Australia are required. - The appointment of a national co-ordinator as part of this project, will lead the establishment of an Australian low rainfall tree improvement network and facilitate the widespread exchange of information and genetic material.
Current Progress	The Australian Low Rainfall Tree Improvement Group (ALRTIG) commenced activity in September 1999 with the appointment of a National Coordinator, who is aiding cooperation between the project partners. ALRTIG is producing improved breeds of a list of complementary 'key species' of trees, able to produce valuable products from diverse low rainfall farm-forestry sites in southern Australia. The initial phase of project development has concluded. Seven tree improvement strategies and an overview paper, explaining species selection processes and the strategies, have been completed for publication this year. These strategies incorporate information derived from analyses of many existing trials carried out by ALRTIG partner scientists. Numerous on-ground works will be completed during winter 2000. A comprehensive yield trial of maritime pine is being established at 10 sites in five states. Red ironbark breeding trials, based on a major seed collection from Victoria and stored seed, are being planted in Victoria and NSW. A survey of Brutian pine genetic resources is complete, and collection of biological material, on which clonal seed orchards and a base breeding population will be founded, will be completed this spring.

Information dissemination has been via stakeholder briefings and numerous media releases. A website will be launched during winter this year.
This project is supported by the **Natural Heritage Trust**.

Project Title	
Technologies for managing native forests on farms	
RIRDC Project No.:	CSF-59A
Start Date:	1 May 1999
Finish Date:	28 February 2002
Researcher:	Mr Peter Clinnick
Organisation:	CSIRO Division of Forestry and Forest Products
Phone:	02 6281 8220
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Email:	Peter.Clinnick@ffp.csiro.au
Objectives	▪ The introduction of technologies relevant to small-scale operations, with emphasis on the management of native forest. ▪ The production of forest practice guidelines for improving income, biodiversity and landscape values of private forests. ▪ The identification of research, development and demonstration needs of small-scale operations with an emphasis on native forests on private land.
Current Progress	Draft guidelines have been produced for: • Planning a native forest venture • Preparing forest management plans Poster presentations and leaflets have been prepared relating to: • Farm forest issues, project actions and outcomes • Native forest harvest planning Search of literature on potentially applicable practices relating to key project areas and planning legislation has been conducted and a draft document is currently in preparation. Potential field trials are being investigated.

Project Title	
The silvicultural basis for farm forestry in Australia – a national, collaborative review of past and present silvicultural research and proposals for a national network of strategic experiments	
RIRDC Project No.:	DAQ-222A
Start Date:	1 April 1997
Finish Date:	30 June 2001
Researcher:	Dr Rosemary Lott
Organisation:	Queensland Forestry Research Institute MS 483 Fraser Road GYMPIE QLD 4570
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Email:	lottr@qfri1.se2.dpi.qld.gov.au
Objectives	▪ To collate and review published and (in particular) unpublished data relating to the silviculture of key farm forestry species in Australia and identify deficiencies in available data. ▪ To analyse a selected silvicultural practice to determine the extent to which response to

	treatment is general or specific to species or sites. ▪ To develop and refine silvicultural prescriptions for the selected silvicultural practice for distribution to growers and to critically review currently available extension information on this practice. ▪ To develop research protocols for site characterisation and experimental design, data measurement and presentation in silvicultural research. ▪ Promote national networking among silviculture researchers on farm forestry. ▪ Promote increased awareness among farm forestry practitioners of the importance of good silviculture and provide information that can be used in an extension context.
Current Progress	A national register of Australian silvicultural trials, past and present, has been compiled using the Access database SILVDAT. The project targets silvicultural experiments on native species in plantation and species grown in farm forestry situations. SILVDAT currently contains a) bibliographic details for 293 published reports, b) descriptions of published (past) experiments, c) summary information from current trials from CSIRO and State government research organisations, and d) summary information describing some older unpublished trials, primarily from Queensland and New South Wales government forestry. Data collection is still in progress. A preliminary electronic copy of SILVDAT has been sent to several government forestry research organisations, with a request for supplementary information. Data is also being requested from private forestry companies. The database currently contains approximately 598 experiments, representing 275 from published reports, 78 unpublished experiments from Queensland, and approximately 245 unpublished from CSIRO and state government research. A minimum data set is used to describe most experiments, as required for the trials register due to be published soon. A review of Australian silvicultural research in hardwood plantations and farm forestry is underway, with an emphasis on past directions, future research needs, and areas where existing information could improve extension advice.

Project Title	
Silviculture of rainforest cabinetwoods	
RIRDC Project No.: Start Date: Finish Date: Researchers: Organisation: Phone: Fax: Email:	DAQ-240A 01 July 1998 01 June 2002 Dr Amanda Snell Queensland Forestry Research Institute PO Box 631 Indooroopilly QLD 4068 07 3896 9202 07 3896 9628 snella@qfslab.ind.dpi.qld.gov.au
Objectives	▪ To determine appropriate sites for preferred tropical rainforest timber species ▪ To increase the rate of successful plantation development of red cedar (<i>Toona ciliata</i>) by development of the most appropriate light environments and establishment procedures. ▪ To develop management prescriptions for spacing, thinning and pruning in single and mixed species plantations of high-value tropical timber species. ▪ To improve understanding of inter-species interactions in mixed species plantations.
Current Progress	Measurement and management (weed control, fertiliser application) of existing mixed species trials in north Qld, have been and are currently being performed for mixed species and red cedar trials. New trials to investigate the effect of planting density on cabinet timber species have been established at Malanda, however recent frosts have caused substantial damage to the trial and frost damaged trees were replanted. A trial at South Johnstone was destroyed by feral pigs (839B) however this trial has been replanted.

Project Title	Commercial eucalypt hybrid plantings for marginal lands in northern Australia
RIRDC Project No.: Start Date: Finish Date: Researchers: Organisation: Phone: Fax: Email:	DAQ-261A 1 August 1999 30 November 2001 Dr David Lee and Dr Garth Nikles Department of Primary Industries (QLD) QFRI MS 483 Fraser Road 07 5482 0885 07 5482 8755 Leed@qfri1.se2.dpi.qld.gov.au
Objective	Identify commercial forest tree populations that are well adapted, high yielding and profitable; and develop breeding and propagation systems from such genetic resources to help underpin a viable forestry industry for the 650-900 mm rainfall zone of northern Australia
Current Progress	Seed orchards and Taxa trials A seed orchard of <i>E. camaldulensis</i> was planted in north Queensland early in 2000. This facility has seedlots from 18 <i>E. camaldulensis</i> provenances. Taxa trials have been established across Queensland covering 11 ha. The north Queensland (NQ) site is testing 13 taxa - <i>Eucalyptus</i> species and hybrids (imported from South Africa), <i>Corymbia</i> species and <i>Khaya senegalensis</i>. Three trials in southern Queensland are testing 20 taxa - <i>Eucalyptus</i> species and hybrids, <i>Corymbia</i> species and <i>Acacia glaucocarpa</i>. Development of propagation technologies and strategies Methods to facilitate the deployment of superior material via vegetative propagation of are being tested. Two trials have evaluated the rooting potential of 12 <i>Eucalyptus</i> species and hybrids. Results of these trials indicate that different protocols may be required for each taxon. Development and testing of appropriate hybrids Seed has been collected from 35 interspecific crosses between <i>C. torelliana</i> and <i>C. variegata</i> (C x T). These hybrids will be tested in trials planned for the 2001-planting season. Additional C x T and other interspecific crosses involving <i>E. grandis</i>, <i>E. pellita</i>, <i>E. longirostrata</i>, <i>E. urophylla</i> and <i>E. tereticornis</i> are planned. This project is supported by the Natural Heritage Trust.

Project Title	Species testing and genetic improvement of forest trees for the Northern Territory
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	DNT-27A 1 July 1999 30 May 2002 Mr Don Reilly Dept of Primary Industries & Fisheries 08 8999 2316 08 8999 2043 don.reilly@nt.gov.au
Objectives	▪ More productive genotypes of high value native timber species suitable for planting in Northern Australia ▪ Genetic development facilities for seed and vegetative production of key high value species ▪ Improved knowledge of potential yields and site suitability for different native species ▪ Enhanced capacity for genetic development research and operational activity in the Northern Territory
Current Progress	The potential in northern Australia to utilise marginal land in the 900- 1500mm rainfall zone for hardwood plantations can be enhanced by the use of hardy, high yielding Eucalypt hybrids and exotics. This has not been possible in Australia until most recently in 1997/98 when Eucalypt hybrids became available. Promise in this area has been gained in North Queensland with the successful cultivation of some eucalypt hybrids and the subsequent survival and growth. This RIRDC project intends to follow up QFRI testing work done in NQ and else where by accessing better performing lines of eucalypts and eucalypt hybrids evaluating them under NT conditions. The more evaluations that can be performed, the better handle we will have on clone/hybrid x environment interaction. Sourcing some promising hybrids has become quite an obstacle in initiating this project due mainly to the confidentiality agreements suppliers of this material require. QFRI and Aust. Tree Seed Centre have been most helpful in making available seed sources for this project. Private companies, such as Yates and For-Bio have been approached for participation in and /or supply of material for the project but are reluctant due to the RIRDC requirement to publish results. On going developments for obtaining material include; sourcing vegetative material, purchase commercially produced seedlings of hybrids from NQ nursery and purchase hybrids and improved lines of exotics from over seas. A meeting has taken place in Queensland with QFRI staff and myself and to visit the already established sites evaluating clones and hybrids and to see the nursery situation and operations to get the whole operation underway. The two QFRI officers are due to visit NT in May 2000 to inspect proposed sites in NT and to assist with the planning aspects of the project. Two mainland sites are confirmed in writing from landholders and finalising of the third site on Melville Island are yet to be confirmed and are dependant on the commercial interest, Sylvatech being on board with the project. Interest has also been expressed to include the evaluation of potentially high yielding exotic hardwoods including Khaya sp., Teak, Pterocarpus spp and Albizia spp. Many of these species presently grow in and around Darwin or can be found in former CSIRO and Forest bureau evaluations.

This project is supported by the **Natural Heritage Trust**.

Project Title	Evaporation cell techniques to replace steam for the extraction of eucalyptus oil
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	OIL – 1A 1 June 1998 31 July 2000 Dr Jeff Caflin Chemical Engineering Industrial R & D PO Box 1059 Canning Bridge Applecross WA 6153 08 9274 6966 08 9274 6671 Waste@iinet.net.au
Objective	To produce design specifications for technology suited to in-the-field extraction of eucalyptus oil utilising passive evaporation, consuming little labour, generated energy or capital, and able to harvest, transport and extract oil at less than \$15/tonne biomass or \$1/kg oil or about 20% of current cost.
Current Progress	The oil mallee is considered one of the prime prospects for lowering the water table and controlling land degradation due to rising salt. To encourage planting, commercial uses for parts of the oil mallee are being developed including energy, activated carbon and essential oils. For salt degraded land located too far from centralised processing facilities in-the-field processing technology must be developed and evaluated. The Evaporation Cell is simple technology that might be ideally suited to in-the-field extraction of the essential oils contained in the oil mallee biomass. Feed preparation is already established as an important factor in making the essential oils available for extraction. However, high-energy devices have been found to cause reduction in yield due to losses during handling. The use of a roller press to crush the leaf cells without heating or excessive exposure to air is functionally the best, however, roller presses are heavy and of limited throughput. Economic assessment is required to determine the play off between losses and the type of device to be applied. Various methods of passive oil recovery have been studied and most experience significant losses due to ‘breathing’ of the cell with diurnal variations and the residual oil content of the expelled air. Use of an activated carbon absorber is looking technically the best. However, the activated carbon system is limited by the upfront capital cost and the need to strip the oil from the carbon regularly. Stripping, while technically straightforward, involves either a mobile stripping plant or taking the activated carbon to a centralised stripping plant. The economics associated with the logistics are yet to be performed. Cell design is well advanced and is based on the activated carbon recovery system. The cell utilises geosynthetic plastic liners sealed to the ground with a rudimentary forced-draft air circulation system that passes air through the absorber. The major parameter yet to be evaluated is the effect on yield of using or not using a floor. Some losses are expected, however they may not be so significant as to warrant the use of a floor, which may not be viable to recover after use. The losses are yet to be quantified and economics evaluated. The roller pressing of the leaves is technically the best device tested for liberating the essential oil from the leaf, however, it may be uneconomic based on capacity constraints. Activated carbon absorption is technically the best oil recovery method, however, economic concerns exist with respect to the stripping of the oil from the activated carbon. The Cell design is practical to use and in itself cost effective. Final implications of this research cannot be made as technical evaluations are ongoing and

economic evaluations have not commenced. At this stage the objectives are still achievable in full.

Project Title	
Silviculture and water use of short rotation coppicing tree crops	
RIRDC Project No.:	OIL-4A
Start Date:	1 July 1999
Finish Date:	30 September 2002
Researcher:	Prof. John Pate
Organisation:	University of Western Australia Botany Department Nedlands Western Australia 6907
Phone:	08 9380 2206
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Objective	Improved design, management and prediction of biomass productivity for short rotation coppicing tree crops (especially oil mallees) based on evaluation of silvicultural options (species and harvest season/frequency) and water use of regularly coppiced crops.
Current Progress	The trial site at Kalannie is fully set up and instrumented and we are now one third through a two-year period of data collection analysing growth and water-use of four contrasting treatments on oil mallee (<i>E. kochii</i> subsp. <i>plenissima</i>). These are: (i) 6-year old alley-planted uncut saplings, (ii) coppices of the same planting regenerating after a cut in February 1999, (iii) similar coppices resulting from a cut in September 1999, and (iv) mature (native) oil mallees growing in bushland close to the alley plantings. Data collection includes three-monthly shoot and root harvests of alley trees to determine leaf areas, shoot and root biomass and root starch contents, and six-weekly measurements on all treatments of shoot elongation, cuvette-based leaf gas exchanges and $^{13}\text{C}/^{12}\text{C}$ ratios of the dry matter of recently-formed shoot tips. Twenty three stems from randomly selected trees are also monitored progressively for transpiration using heat pulse units and water table depths and neutron moisture meter assays along soil transects across paddock-mallee-paddock used to further assess impacts of trees on the overall hydrology of the system. Rainfall interception is measured concurrently with stemflow and throughfall in the trees, thus providing useful insight on reaction of trees to specific rainfall events.

Project Title	
High value farm wood production in the semi arid zone	
RIRDC Project No.:	PN99.2001
Start Date:	February 1999
Finish Date:	May 2001
Researcher:	Mark Stewart
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Objective	- Investigate the development of high value wood products from dense timber species occurring in the semi arid zone. - Develop farm-based primary processing (sawing) techniques to maximise recovery of

	high value wood. • Investigate the efficiency of different sawing methods. • Bench-mark small scale and farm based timber production against a large, fixed sawing installation.
Current Progress	This project follows on from a previous JVAP funded study of on-site processing for farm forestry, which demonstrated the potential economic attractiveness of the use of portable sawmills. That study highlighted the benefits of targeting trees that produce high value sawn timber. These include species, such as <i>Eucalyptus cladocalyx</i> and <i>E. sideroxylon</i>, suited to low-rainfall areas. A problem, though, is that high value timber can be hard to saw to the tolerances required by furniture manufacturers. Portable sawmills have had difficulty in meeting those specifications. Major progress has been made in identifying critical factors in the processing of high value eucalypt timber, and the project has demonstrated that, with the right settings, portable sawmills can meet the specifications set by furniture manufacturers. The project has selected and prepared sample trees at the Victorian Timber Industry Training Centre for preliminary testing. Sugar Gum, (<i>Eucalyptus cladocalyx</i>) was the chosen species for all sawing trials conducted, to test the equipment and evaluate the process. This project's research will now focus on the sawing accuracy of the horizontal band-saw mill by targeting controllable factors relating to blade configuration. The study will conclude with production of a manual designed to help operators achieve maximum output of high quality wood from hard-to-saw species. This project is supported by the Natural Heritage Trust.

Project Title	Wood Products from low rainfall (450-650 mm) farm forestry
RIRDC Project No.: PN99.2002 Start Date: July 1999 Finish Date: July 2001 Researcher: Gary Waugh Organisation: CSIRO Forestry and Forest Products Clayton Laboratories Private Bag 10 Clayton Sth, VIC 3169 Phone: 03 9545 2122 Fax: 03 9545 2133 Email: Gary.Waugh@ffp.csiro.au	
Objective	• Identify at least four species of plantation grown trees to produce high value solid wood products from the low rainfall zone (450-650 mm) of the Murray Darling Basin. • Assist species selection for farm forestry in the low rainfall region of the Murray Darling Basin.
Current Progress	This project was begun following completion of an investigation of the sawn timber potential of trees grown in plantations in the medium rainfall (600–750 mm) zone of the Murray Darling Basin. That research, involving milling studies on timber from a range of established, unmanaged plantations, showed high recovery rates for appearance-grade wood can be expected from selected eucalypt species at the end of a 30–40 year rotation. The current project started with a survey of existing plantations in the 450–650 mm rainfall region, which covers large areas of north-eastern SA, north-western Victoria and western

NSW. Slow tree growth in this region means growers are likely to have more than one goal when planting trees. Managing land degradation will be important, and they may hope to derive income from salinity (and possibly carbon) credits as well as from sawn timber and other tree products.

The evaluation of existing species in plantation was completed in 1999-2000. Four eucalypt species were selected for the sawmill study to evaluate their potential to produce high value solid wood products. Boards from the study have been green graded and the grade information evaluated. At the start of June 2000, all nominal 105 x 43 mm dimension boards have been racked out into drying racks for conservative air-drying. Sample boards have been established with one board from every tree sawn retained.

This project is supported by the **Natural Heritage Trust**.

Project Title	Vineyard trellis posts from treated eucalypts grown in low rainfall areas or using effluent water
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	PN99.2003 June 1999 January 2001 Laurie Cookson CSIRO Forestry and Forest Products Clayton Laboratories Private Bag 10 Clayton Sth, VIC 3169 03 9545 2402 03 9545 2448 l.cookson@ffp.csiro.au
Objective	• Assist the development of markets for poles from locally grown eucalypt plantations initially developed to utilise sewerage and winery effluent. • Carry out a large scale harvest and preservative treatment of eucalypt poles and strainers of <i>Eucalyptus grandis</i>, <i>E. globulus</i> and <i>E. camaldulensis</i>. • Investigate the strength and load carrying capacity of treated round timbers as vineyard posts. • Establish demonstration and monitoring sites in north- eastern Victoria and southern NSW with poles. • Provide local woodlot growers with information regarding tree species and quality requirements to plan and adopt most suitable silvicultural techniques for round timber production.
Current Progress	So far, this project has evaluated Blue Gum, River Red Gum and Flooded Gum species from woodlots suitable for trellis and strainer posts in Shepparton, Deniliquin and Mildura. Thirty trellis posts of each species were evaluated for splits and knots and then strength tested by the Sunraysia Horticultural Centre. Work on this project is continuing.

This project is supported by the **Natural Heritage Trust**.

Project Title Utilisation of desert hardwoods as specialty timbers	
RIRDC Project No.:	PN99.2004
Start Date:	October 1999
Finish Date:	October 2002
Researcher:	Myron Cause
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Objective	• To establish basic resource and marketing information on selected native hardwoods of western Queensland. • To develop a viable wood processing industry by improving current technology to allow efficient and sustainable harvesting, processing and marketing of remote area timbers which are currently poorly utilised.
Current Progress	At this stage there appears to be significant enthusiasm for this potential new industry and early indications are that this is well justified. Additionally, the potential Queensland industry appears to be well positioned. So far some 'first time' density, hardness and wood property results for 'desert' timbers have been established. This project is supported by the Natural Heritage Trust.

Project Title Maximising the productivity and value of cypress pine on private land	
RIRDC Project No.:	PN99.2005
Start Date:	October 1999
Finish Date:	December 2001
Researcher:	David Taylor
Organisation:	Queensland Forest Research Institute MS 483 Fraser Rd, Two Mile Gympie, Qld, 4570
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Objective	• To establish basic resource information on Cypress pine in Queensland and New South Wales. • To develop a silvicultural protocols for managing cypress pine for high quality timber production. • To establish links with the Cypress pine industry and collaborate in durability research being undertaken within the industry.
Current Progress	In accordance with the projects working plan (11 May 2000), individual tree and log measurements have been recorded to enable harvested volume calculations and ancillary data to be collected for each plot. Tree felling and numbering, log mensuration and the identification of pathogens and injuries have also been conducted. The logs were merchandised to a top end diameter over bark of 15cm and then processed at random, with samples retained from each plot to determine green moisture content. This project is supported by the Natural Heritage Trust.

Project Title	Thermochemical processing of agroforestry biomass for phenols, cellulose and essential oils
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	PN99.2006 October 1999 January 2002 Dr Branko Hermescec Department of Forestry, Institute of Land and Food Resources University of Melbourne, Water Street Creswick, VIC, 3363 03 5321 4109 03 5321 4194 b.hermescec@landfood.unimelb.edu.au
Objective	• To develop a two stage process for the production of low molecular weight phenols, crude cellulose and essential oils using steam distillation and fast pyrolysis. • To encourage import replacement of phenols, cellulose and essential oils through local production from agroforestry biomass.
Current Progress	This project is applying a patented low temperature pyrolysis process originally developed with softwoods to plantation-grown eucalypts. The process degrades wood thermochemically in an oxygen-rich environment into a range of valuable chemicals and cellulose pulp. Laboratory work with <i>Eucalyptus grandis</i> and <i>E. globulus</i> feedstock has demonstrated the potential value of the process as a means of utilising wood from farm forests, and extended it to include extraction of essential oils from the leaves. The oil retrieval step gives yields about double those achieved with traditional steam distillation. Low temperature pyrolysis of debarked wood ground to sawdust-sized particles first degrades the hemicellulose into chemicals such as furfuryl alcohol. Then the lignin is selectively degraded to produce phenols of value in applications including adhesives and explosives. The wood's cellulose, left after extraction and degradation of the hemicellulose and lignin, is suitable for use in paper-making. Potential benefits of the process include replacing imports of high-value industrial chemicals with domestic production, sourcing them from biomass rather than petroleum, and providing a valuable new outlet for plantation-grown timber. Commercialisation is proceeding in association with two major international companies. This project is supported by the Natural Heritage Trust.

Project Title	The cost benefits of small log processing – laminated 3-ply flooring: a case study in Western Australia
RIRDC Project No.:	PN99.2007
Start Date:	March 1999
Finish Date:	January 2001
Researcher:	Phil Shedley
Organisation:	Valuwood International Pty Ltd PO Box 2184 Warwick, WA, 6024
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Objective	• To develop a competitive manufacturing process for laminated 3-ply flooring from short rotation farm hardwood and softwood woodlots. • Obtain feasibility data for determining the scale and cost of a locally based commercial laminated flooring factory. • To model the commercial costs of producing 3-ply laminated flooring. • To produce market driven guidelines to assist with decisions of which trees to grow on farms.
Current Progress	Laminated three-ply flooring offers a potential market for early thinnings from <i>Eucalyptus globulus</i> and <i>Pinus pinaster</i> grown in farm woodlots. The ‘floating’ floor panels, which have a 4 mm <i>E. globulus</i> veneer face and back and a cross-laminated <i>Pinus pinaster</i> core, are a light walnut brown colour and strongly featured with knots and other pleasing characteristics. Market and physical testing is in progress, and the panels are performing well in display floors subjected to heavy use. Further testing, to ensure they meet international standards for hardness and wear resistance, is being undertaken by the Australasian Furniture Research and Development Institute at Launceston, Tasmania. The <i>E. globulus</i> came from 6, 8 and 10 year old stands, with the younger timber generally giving the best results. This species presents substantial problems in sawing and drying, and only about 10% of trees provided suitable logs for this flooring product. It was chosen for the study because of its ready availability; other eucalypt species are likely to present fewer technical problems. No difficulties were encountered in processing the <i>Pinus pinaster</i>, which came from low-grade unpruned 12 year old stands. The possibility of using <i>E. globulus</i> for the core as well as the face and back is being examined. This would have the advantage of making a larger proportion of the wood from an <i>E. globulus</i> stand useable as less of the veneer produced would have to be of face grade. Obtaining a satisfactory hardwood-to-hardwood glue bond has proved difficult. An important part of the project has been producing a computer model for assessing the economics of laminated flooring production from woodlot timber. The model, covering all stages in the process from tree planting to the marketing of floor panels, has been completed. The successful production of laminated floor panels from woodlot timber has prompted industry consideration of commercial prospects. This project is supported by the Natural Heritage Trust.

Project Title	
Silvicultural research to facilitate the development of large scale commercial farm forestry on farms	
RIRDC Project No.:	PN99.2008
Start Date:	June 1999
Finish Date:	April 2002
Researcher:	Mark Lewty
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Objective	- To determine the optimum native hardwood species for pulpwood plantations in the 800 – 1300mm rainfall zone between Maryborough and Gladstone. - To identify the optimum silvicultural regime to maximise pulpwood yields of selected species - To provide extension on the best silvicultural practices for a viable pulpwood industry in central east Queensland.
Current Progress	This project has tested the native hardwood species in the Maryborough region, and selected the best species for operational plantings. It has also determined silvicultural regimes to maximise the expected timber yields, and examined site preparation, weed control and fertiliser application.

This project is supported by the **Natural Heritage Trust**.

Project Title	
Non destructive evaluation of intrinsic wood quality within on-farm woodlots	
RIRDC Project No.:	PN99.2010
Start Date:	August 1999
Finish Date:	July 2000
Researcher:	Dr Ross Dickson
Organisation:	Forest Research and Development Division SFNSW PO Box 100 West Pennant Hills Beecroft, NSW, 2125
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Objective	- To assess the applicability of non-destructive approaches (e.g. stress wave timer) for evaluating the intrinsic wood properties of plantation <i>Pinus radiata</i> and principally <i>E. dunnii</i>. - To assess the effects of heartwood/sapwood, moisture and density, log shape, log size, branch size together with wave velocity on grade recovery. - To identify and build information links between tree farmers and wood processors on product performance (e.g. structural grade), and wood properties (e.g. wood stiffness).

Current Progress

This study is progressing well with the *Eucalyptus dunnii* saw mill study now completed, and a data analysis currently in progress. The *Pinus radiata* saw mill study is in progress. This project is supported by the **Natural Heritage Trust**.

Project Title**A national appraisal for pruning for clearwood in eucalypts**

RIRDC Project No.:

PN99.2011

Start Date:

October 1999

Finish Date:

June 2000

Researcher:

Dr Kelvin Montagu

Organisation:

Forest Research and Development Division
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- To undertake a technical review of the knowledge base relevant to pruning in eucalypts based on national and international expertise.
- To produce a farm forestry extension publication incorporating a generic guide to the economics of pruning as a decision support tool for small growers.
- Develop a national strategy for co-ordinated R&D into hardwood pruning that is closely aligned with grower and processor requirements.

Current Progress

Literature has been comprehensively reviewed and current national “state of knowledge” has been collated. A workshop involving members of the taskforce from each state was held to discuss the issues arising from the literature review. Outcomes of the workshop documents have been circulated and work has commenced on producing final outputs.

This project is supported by the **Natural Heritage Trust**.

Project Title**Estimating the productivity of forest systems in southeast Queensland**

RIRDC Project No.:

QDN-3A

Start Date:

1 January 1999

Finish Date:

30 June 2001

Researcher:

Dr. Kristen Williams¹ and Mr. Paul Ryan²

Organisation:

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Objective

To research and develop the integrated modelling frameworks needed to deliver reliable estimates of forest productivity as the baseline for addressing contemporary land use planning issues linked to forest resource sustainability, productivity and inventory in Southeast Queensland.

Current Progress

This project represents a partnership between QDNR and QFRI in the regional application of current developments in the forest model 3-PG (Landsberg and Waring 1997). The work is undertaken through a collaboration of scientists and institutions with a common interest in spatial modelling of forest productivity. The GIS version of the software (3PG_Spatial in ARC/INFO) was jointly developed by CSIRO Forestry and Forest Products and Bureau of Rural Sciences. An agreement with BRS and CSIRO ensures access to the software throughout the life of the project. Apart from the principal investigators and associated staff in QDNR and QFRI (above), key collaborators on the project are Joe Landsberg, Nicholas Coops, Phil Tickle, Susan Hafner and Rod Keenan.

So that the project maintains currency with the research, development and application of the Forest Model 3-PG, an annual Science Forum is held in Brisbane. The second Forum (3-PG 2000: *New developments in calibration, performance, spatial inputs and practical applications*) was held on the 15th and 16th February. The forum was attended by over thirty forest research scientists from around Australia and is regarded as a success – providing a venue for discussion about the 3-PG model, comparison of experience and evaluation of progress. Presentations took stock of current applications, including issues of spatial information development, and identified a number of crucial areas for further research. The consensus is that the 3-PG model can be used immediately for wide-scale simulation and evaluation of plantation potential (with caveats related to the spatial accuracy of input data and the need for rigorous model testing and evaluation). As for the first forum (February 1999), a compilation of presentations and a summary of workshop outcomes will be distributed to participating scientists.

Achievements on the project in the last year have largely focussed on the preparation of spatial input data. A 25m DEM for southeast Queensland was rebuilt to hydrological standards using ANUDEM (Version 4.6.2). The DEM was used with SRAD to derive input layers for solar radiation and add topographic detail to the temperature layers (previously derived through ANUCLIM). The substrate indices of depth and texture were reinterpreted in quantitative terms to provide spatially-variable parameters for water balance in 3-PG (maximum plant-available soil water holding capacity, soil water power, soil water constant). A preliminary set of parameter estimates for *Eucalyptus grandis* were derived from readily available published/unpublished literature. These were spatially applied to a case study area as a test of the computational and data management logistics in using BRS's ARC/INFO 3PG_Spatial before applying wide-scale.

Destructive sampling of older plantation *E. grandis* (12.5 years) provided generalised biomass and leaf area allometrics. Calibration data for the growth of *E. grandis* and *E. cloeziana* were compiled from old trial and growth plots. 3-PG parameter estimates were iteratively developed by expert comparison with the calibration data. To increase the speed and consistency of parameter estimation, the potential of the non-linear parameter estimation software PEST (Watermark Numerical Computing) was investigated and demonstrated at the 3PG 2000 workshop. It was found to be a useful tool, worthy of further investigation.

The second year of the project will largely focus on the preparation of calibration data, parameter estimation and model validation. A wide-scale application of 3PG_Spatial (potential and imagery modes) will be used to investigate a range of methodologies for model testing and evaluation.

Project Title	Australian participation in the International Energy Agency's bioenergy program
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	SSC-2A 1 November 1998 30 April 2001 Dr. Stephen Schuck Stephen Schuck and Associates 7 Grassmere Road KILLARA NSW 2071 02 9416 9246 02 9416 9246 Steve.Schuck@bigpond.com
Objectives	Funding for Australian participation in Task 17: <i>Short Rotation Crops for Bioenergy</i> of the International Energy Agency's (IEA) Bioenergy program. The immediate outcomes include: ▪ Access to up to date information on biomass crop production systems and methods; ▪ Strengthened contact with international researchers and developers of short rotation energy systems; ▪ Participation in the executive committee of IEA Bioenergy with access to information and developments from other taskgroups. Anticipated outcomes include: ▪ Creation of new markets for agroforestry and energy crops; ▪ Stimulating bioenergy industry within Australia (a potentially important contribution towards reducing our domestic greenhouse emmissions); ▪ Developing new rural industries and jobs.
Current Progress	A group of organisations consisting of CALM WA, NRE (Centre for Forest Tree Technology), Forest Products Association of NSW, State Forests NSW, CSIRO Forestry and Forest Products, and QDPI, supported by the Biomass Taskforce has been participating in the IEA Bioenergy Task 17 <i>Short Rotation Crops for Bioenergy</i>, with Steve Schuck representing Australia on the Executive Committee of IEA Bioenergy. Dr Tom Baker of Victoria's Centre for Forest Tree Technology attended the Task 17 meeting in the USA in September 1999, representing the participation group. At the meeting he presented a 'synthesis' document co-authored with John Bartle (CALM), Ross Dickson (SFNSW), Phil Polglase (CSIRO) and Stephen Schuck (Biomass Taskforce) on short rotation energy crops in Australia. Stephen Schuck attended IEA Bioenergy Executive Committee meetings in Norway in May and Japan in November, where membership and involvement in IEA Bioenergy was further consolidated and expanded to include an additional four Tasks which are being supported by the Biomass Taskforce and participation subgroups of the Taskforce. From 6-10 March 2000 the <i>Short Rotation Crops for Bioenergy</i> annual meeting was held in WA. This meeting included technical visits to the integrated Mallee Eucalyptus project being conducted by CALM and its project partners.

Cost effective multi-purpose agroforestry systems to meet commercial and environmental objectives

Project Title	A whole-farm and regional agroforestry decision making system
RIRDC Project No.:	QDN-4A
Start Date:	1 February 1999
Finish Date:	30 June 2001
Researcher:	Mr. Phillip Norman
Organisation:	Queensland Department of Natural Resources 80 Meiers Rd. Indooroopilly Queensland 4068
Phone:	07 3896 9830
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Email:	Phil.Norman@dnr.qld.gov.au
Objectives	This proposal will provide potential farm foresters and policy makers with a multipurpose decision support system (DSS) which will allow a more comprehensive assessment of the suitability, sustainability and profitability of alternative forestry options in relation to agricultural enterprise in different farm systems by June 2001.
Current Progress	The project continues to run smoothly and within budget expectations. ▪ Project WEB site established on FERA, Forestry In Queensland site. Paper presented at IUFRO conference in January, and articles submitted to popular press (including Landcare News) ▪ Integrated JCU/UQ/CARE whole-farm/plantation financial modelling package developed in VBasic. Ready for external testing end of April following further refinements on advice from professional software designers. PlantGro tables linked to financial modelling package to provide biological growth data. Native forest component built into financial modelling package using expert information for Northern Tablelands ▪ Surveys of Northern Tablelands and Darling Downs experts and farm foresters (including surveys at Toowoomba Agricultural Show) to determine options and criteria for evaluation using MODSS method. Representative stakeholders for Darling Downs/Western Downs selected for testing. ▪ GIS thematic layers collated for Southern Queensland and Northern Tablelands. ▪ Technical group supplemented with invited experts in forest productivity and decision support. Consultations with and invitation extended to representative of CSIRO group. ▪ Initial pilots of MODSS applied to hypothetical data to identify initial preferred options for forestry in farm systems and develop stakeholder-driven scenarios.

Project Title	Feasibility of local, small scale native plant harvests for indigenous communities
RIRDC Project No.:	UNT-6A
Start Date:	01 February 1999
Finish Date:	30 June 2001
Researcher:	Dr Peter Whitehead
Organisation:	Northern Territory University Science Darwin NT 0909
Phone:	08 8946 6703
Fax:	08 8946 7088
Email:	peterw@gis.ntu.edu.au

Objective	To identify opportunities for small-scale enterprises, based on harvest of native plants by Aborigines, and to provide an assessment of cultural, economic and ecological sustainability.
Current Progress	The project has 4 phases: (i) consultation (ii) joint identification of options (iii) testing of options and (iv) framing of strategies. Phase 1 has progressed well, with many communities showing strong interest and committing resources. Work has expanded to include additional communities in Cape York as well as the Top End. Phase 2 is well advanced with a number of options (chiefly involving bush foods) matched to local availability and community interests. Phase 3 is underway, with information currently being gathered on local densities, costs of wild harvests, and market interest for several products. Work on ecological sustainability is progressing satisfactorily, with population/harvest models under development for eucalypt species used for artifact manufacture. The Maningrida community has sought assistance to identify alternatives to <i>Bombax</i> currently used for many carved artifacts and which appears to be over-harvested. Links have been made to a project on didjeridu harvest funded by the Jawoyn Association in Katherine. The full range of options to be tested requires further consultation, which may require more time than originally proposed. In general the project is proceeding well, although extension of timelines has been sought to facilitate the high quality of consultation and community involvement needed to promote uptake.

Project Title	Wattle seed production in low rainfall areas
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	AGT-7A 13 March 2000 14 July 2000 Dr Peter Chudleigh Agrtrans Research 07 3870 9564 07 3371 3381 agtrans@powerup.com.au
Objectives	Carry out investigations to: ▪ Determine the potential for the production of broad acre wattle seed in the medium to low rainfall areas of southern Australia ▪ Assess the implications for resource sustainability, particularly in saline areas of WA and the MDB ▪ Determine the potential for use of wattle seed as a substitute for wheat in breadmaking and any other large scale uses ▪ Assess the market size for wattle seed, both domestically and for export ▪ Assess the overall economics and technical feasibility of harvesting within a wattle seed production system ▪ Make recommendations as appropriate for further steps that might be undertaken by the RIRDC (JVAP) to further a potential industry based on wattle seed production.
Current Progress	A literature review has been carried out and sources of relevant information have been identified and currently being interrogated. Consultation with key individuals regarding markets, forestry and horticulture and resource management is currently being undertaken. Following this information assembly stage, an overall assessment of the concept will be undertaken

Effective Communications

Project Title	Development and demonstration of "The Carbon Farmer" Workbook
RIRDC Project No.:	HAS-8A
Start Date:	1 April 2000
Finish Date:	31 August 2000
Researcher:	Mr. David McClintock
Organisation:	Hassall & Associates Pty Ltd
Phone:	02 9241 5655
Fax:	02 9241 5684
Email:	Hassyd@ozemail.com.au
Objective	By the completion of the Project in August 2000 there will be groups of personnel in the field of forestry and agroforestry in each state and territory who will have been trained in the latest information concerning the returns from carbon credits that might be obtained from plantations of trees. They will be equipped with a copy of "The Carbon Farmer" spreadsheet, which will help them make calculations for the particular situations that they encounter.
Current Progress	A prototype of The Carbon Farmer model has been constructed. Field visits are being organised in order to demonstrate the model, to obtain feedback on modifications to ensure its relevancy and also to obtain any further growth data to tailor the model to specific situations. Workshop participants will also be briefed on the latest thinking on carbon credits. The proposed project timeframes are being met.

Project Title	Video – money in the mallee
RIRDC Project No.:	OIL-2A
Start Date:	1 July 1999
Finish Date:	31 August 2000
Researcher:	Mr Chris Richardson
Organisation:	Oil Mallee Association of WA
Phone:	08 9478 0330
Fax:	08 9478 0333
Email:	chrisr@oilmallee.com.au
Objectives	▪ Research the most appropriate way to encourage farmers to adopt new technology ▪ Produce a promotion/information video for farmers to stimulate oil mallee planting as an aid to salinity control. ▪ Distribute 100 copies of the video to rural advisors and sell 1500 copies to farmers.
Current Progress	A media and communications strategy titled 'Money in the mallee' has been developed by Tom Woodford of Curtin University of Technology and was presented to OMA in December 1999. The development of this strategy involved a literature review, surveys of agribusiness organisations, a farmer workshop and meetings with focus groups. Currently a promotional video is in the production phase and it is anticipated that completion of the video will occur in July 2000 in time for distribution to potential oil mallee growers prior to the oil mallee seedling ordering season for 2001 plantings which will commence in September 2000.

Project Title	Continuation and expansion of the Australian Master TreeGrower Research & Development Program
RIRDC Project No.: Start Date: Finish Date: Researcher: Organisation: Phone: Fax: Email:	UM-44A 10 February 1999 3 January 2001 Mr Rowan Reid The University of Melbourne Department of Forestry University of Melbourne Victoria 3010 03 9344 5011 03 9349 4172 r.reid@landfood.unimelb.edu.au
Objectives	▪ To stimulate the active involvement of farmers in the establishment, management and marketing of trees and forest products; ▪ To encourage greater landholder participation in regional and national farm forestry research and extension; and ▪ To develop and implement a course delivery model which satisfies participant's needs
Current Progress	The Australian Master TreeGrower Program continues to expand with 9 programs completed in 1999 and a further 4 by May 2000: Mackay (Qld), Ipswich (Qld), Beaudesert (Qld), Hastings (NSW), Armidale (NSW), Young (NSW), Midlands (Tas), Geelong (Vic), Seymour (Vic), Busselton (WA), Esperance (WA), Kojonup (WA), Wellstead (WA). This brings the total to 26 programs involving over 500 farmers and regional extension agents. Each program involves 8 days of seminars, workshops, practical exercises, industry tours, and farm visits. Staff of the Department of Forestry coordinate and deliver the program in partnership with regional extension staff and the support of industry, state agencies and national research and development organisations including CSIRO. The response from participants has been very encouraging and is backed up by the support and enthusiasm of regional research and development staff and timber industry representatives. Research and evaluation of the program has demonstrated that participatory education can increase the confidence and commitment of landowners in their own farm forestry ventures. The program has also encouraged farmers to become more actively involved in research and extension with many individuals now playing a leading role in regional farm forestry networks and extension events including the Agroforestry Expo '99. The national Agroforestry Expo '99 was convened by the Australian Master TreeGrower Program and involved more than 6 weeks of field days, seminars and workshops around Australia which attracted over 2500 landowners. A highlight was the involvement of Dr Jim Finley from Pennstate University, Pennsylvania and Linda Finley who travelled from Western Australia to Queensland and down the coast to Victoria to attend the regional events. More than \$20000 worth of private and corporate sponsorship was raised by the MTG program to support the work of many regional MTG participants and supporters who ran the regional components. The program was the winner of the prestigious 2000 Allen Stom Eureka Prize for Environmental Education Program valued at \$10000 presented by the Australian Museum.