



Practical Farm Forestry

Whole Farm Case Studies

by Campbell White & Associates Pty Ltd
and Alan Black

RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program
Sponsored by the Natural Heritage Trust and the Murray Darling Basin Commission

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ISBN 0 642 57964 4
ISSN 1440-6845

Practical Farm Forestry: Whole Farm Case Studies
Publication no 99/99
Project no. ECU-3A

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Project Manager

Professor Alan Black
Centre for Social Research
Edith Cowan University
Joondalup WA 6027

Phone: (08) 9400 5844
Fax: (08) 9400 5866
Email: a.black@cowan.edu.au

Principal Researcher

Campbell White & Associates Pty Ltd
PO Box 117
North Fremantle WA 6159

Phone: (08) 9336 3897
Fax: (08) 9336 6611
Email: gwhite@multiline.com.au

Management Committee Member

Mr Peter Eckersley
Agriculture Western Australia, Bunbury WA
Phone: (08) 9780 6204
Email: peckersley@agric.wa.gov.au

Management Committee Member

Mr Richard Moore
Conservation and Land Management, Busselton WA
Phone: (08) 9752 1677
Email: richardmo@calm.wa.gov.au

Management Committee Member

Mr David Bicknell
Agriculture Western Australia, Narrogin WA
Phone: (08) 9881 0228
Email: dbicknell@agric.wa.gov.au

RIRDC Contact Details

Rural Industries Research and Development Corporation
Level 1, AMA House
42 Macquarie Street
BARTON ACT 2600
PO Box 4776
KINGSTON ACT 2604

Phone: 02 6272 4539
Fax: 02 6272 5877
Email: rirdc@rirdc.gov.au
Website: <http://www.rirdc.gov.au>

Published in October 1999
Printed on environmentally friendly paper by Union Offset

Foreword

The project ‘Practical Farm Forestry Economics: Whole Farm Case Studies’ addresses two priorities identified as key research and development issues for 1998-99 in the Joint Venture Agroforestry Program Prospectus, namely:

- ‘Economic analyses and feasibility studies for farm forestry systems.’
- ‘Extension materials providing economic analyses for farm forestry within a whole farm planning context for different regions and farming systems.’

Despite various policy initiatives over the past six years, the uptake of farm forestry in Australia has been slow, lagging behind that in countries such as Finland, the USA and New Zealand. One major factor identified as a reason for this slow development is uncertainty. Uncertainty pervades the industry from the individual farm level right up to the level of marketing timber products in international market places. Questions about species selection, appropriate configurations, multi-objective planning, silviculture and ultimately harvesting and marketing the produce are all issues that the broader farming community is seeking answers for.

This project seeks to contribute to the growing body of information that can be used to support farmers in their decision making, decrease uncertainty and promote the faster development of the industry. Detailed documentation of ‘real life’ case studies, including an evaluation of the impacts, economic and otherwise, will help to increase general awareness that, given appropriate planning, farm forestry is an attractive proposition from a commercial, environmental and ‘lifestyle’ point of view.

The project team examined ten case study farms across southern Australia and found a multitude of approaches to the solution of common land resource management and economic challenges. In every case the objectives of the individual combined with commercial opportunities and environmental attributes to produce a forest resource which was achieving many benefits simultaneously.

This report, a new addition to RIRDC’s diverse range of almost 400 research publications, forms part of the Joint Venture Agroforestry Program, which aims to foster integration of sustainable and productive agroforestry within Australian farming systems.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/reports/Index.htm
- purchases at www.rirdc.gov.au/pub/cat/contents.html

Peter Core

Managing Director

Rural Industries Research and Development Corporation

Acknowledgements

The authors greatly appreciate the assistance, hospitality and time devoted to this project by all of the Case Study participants: Jim and Kay Whitem; Michael, Rosemary and Brian Cornish; Andrew and Jill Stewart; Mal and Bev Darby; Ian and Rosemary Dickenson; Noel and Kim Passalacqua; Rod and Vicki Fayle; Roy and Lurline Davies; Elva, Keith and Peter Rolinson; and Wade and Angela Anderson.

There are also many people across Australia who have helped to identify suitable case studies, provided additional information about the sites or who facilitated this project in other ways. Our thanks go to Rod Ashby, John Bartle (CALM WA), Lee Beatty (DNRE, Vic), Dr Rod Bird (DNRE, Vic), Peter Bulman (PISA, SA), Laurie Capill (DPI, Qld), Tim Douglas, Bob Hingston (CALM, WA), Michael Ince (DPI, Qld), Bill Loane, Arthur Lyons (Private Forests, TAS), Martin Novak (SFFA, NSW), Rowan Reid (Melb. Uni), Peter Stephens (Melb. Uni), Hugh Stewart (Treecorp Pty Ltd, Vic) and Richard Shoobridge (ITC Pty Ltd, WA).

Thanks, too, to Richard Moore (CALM,WA), Peter Eckersley (Agriculture, WA) and David Bicknell (Agriculture, WA), who were involved in the design of the study and provided helpful advice at various points in the course of the project.

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About the Authors

Gavin White and Colin Campbell are employed by Campbell White & Associates Pty Ltd. The company specialises in application of evaluation and analysis methodologies to natural resource management issues. Between them Gavin and Colin have over 10 years of experience in the evaluation of farm forestry and agroforestry projects.

Alan Black is Professor of Sociology and Director of the Centre for Social Research at the Joondalup Campus of Edith Cowan University in Western Australia. He has also recently completed a study of extension and advisory strategies for agroforestry.

Abbreviations

DSE:	Dry Sheep Equivalents
MAI:	Mean Annual Increment
BCR:	Benefit-Cost Ratio
NPV:	Net Present Value
RIRDC:	Rural Industries Research and Development Corporation
FWPRDC:	Forest and Wood Products Research and Development Corporation
LWRRDC:	Land and Water Resources Research and Development Corporation
JVAP:	Joint Venture Agroforestry Program

Executive Summary

This report examines the impact of farm forestry on 10 case study properties across southern Australia. The evaluations are conducted at the whole farm level and focus on identifying, describing and, where possible, quantitatively evaluating the economic, environmental and social impacts of farm forestry on the farm family and business.

METHODOLOGY

For the purposes of this project, farm forestry was defined as the planting and managing of trees to generate a positive contribution to economic, environmental and social outcomes for the family farm. The case study properties were sought through existing farm forestry networks and other industry contacts. Throughout the selection process the researchers endeavoured to include those sites that have not had wide exposure previously, but which local experts believed had an innovative or interesting story. The objective was to choose sites that would be relevant to local landholders and of interest to farmers outside of the district. The case study farms covered a range of geographical regions and rainfall zones across Australia.

Data collection was undertaken at on site interviews between the principal researchers and case study participants. Each interview was of approximately 4 to 5 hours and adhered to a standard process whereby the history of the property and environmental and social issues were discussed. A walk or a drive around the farm to discuss the farming system and the management of trees followed this. Financial and economic data was collected at a final office meeting. Supplementary data was collected through phone conversations with the farmers and advisers.

Analysis of the data relied on the formal business and land use planning records of the landholder or previous evaluation/modelling results. The economic evaluations were carried out using a spreadsheet based, purpose built, financial model. The taxation laws modelled reflect those currently in force for individual, tax averaging and company taxation regimes. The analysis does not incorporate the impacts of any proposed changes to the taxation system, such as the imposition of a Goods and Services Tax.

The purpose built model carried out an economic assessment using two discounted cashflow projections calculated net of tax. The baseline scenario consists of constant annual income for an 'average' year extrapolated over time for the hypothetical situation in which no revegetation had been carried out. This is compared against the scenario in which trees replace agriculture on some of the farm and the costs of establishment and returns to the enterprise over the project period are included in the farm income. The two primary measures used to describe the financial performance of the forestry project in relation to agriculture are Net Present Value (NPV) and the Benefit Cost Ratio (BCR).

RESULTS

All of the case study farmers considered the long-term viability (both economic and environmental) of their farming business to be the key motivating force to adopting farm forestry. They also recognised that long-term viability was dependent on achieving the maximum sustainable production from their farm business.

There are two facets to this issue. The first, and most important, is to ensure that the underlying resource base – the land – is protected from degradation to enable sustained levels of production (i.e. essentially addressing any environmental issues to ensure economic viability). The second is to ensure land use is matched to the highest value enterprises (addressing economic management issues through the most efficient use of resources).

In most of the case study properties, trees were actively employed to address economic and environmental issues simultaneously. In every case, both environmental and economic issues were considered. However, the final emphasis on environmental or economic motivation varied depending on the current physical and financial state of the farm, as well as individual perceptions of the challenges that faced the farmer and the tools available to address these challenges.

The second section of each study addresses the various methods used to implement farm forestry. The method of implementation of farm forestry is closely linked to the original motivating factors. Typically those with a more commercial focus have implemented farm forestry in block configurations on the land with lowest agricultural productivity (from an economic perspective – the land with the lowest opportunity cost). In many cases this land is well suited to growing trees. Those whose principal motivating factor has been environmental have made more effort to integrate the trees into the farm landscape in a way that maximises environmental benefits. However, most have also ensured that the trees are managed in a way that will maximise their future commercial potential, e.g. through thinning and pruning. *Eucalyptus globulus* featured strongly on nearly all of the ‘broadacre’ farms. This is perhaps due to the short rotations and relatively simple management requirements for producing a chip or pulp product.

Financing the establishment of trees can be a major determinant of the rate of implementation of farm forestry. Three of the ten farmers have made use of joint venture or profit share arrangements whilst three farmers have accessed grants or rebates to help fund the establishment of at least part of the farm forest resource. Several farmers expressed a preference to do all of the work themselves, to have a greater degree of freedom on which areas would be established and to fully own the fruits of their labour.

Eight of the ten farms can expect direct positive returns of varying significance to accrue from their farm forestry enterprise. In three cases the economic value of the forestry to the farms is very significant with annualised value of income (at 5% discount rate) being greater than 25% above that which would have resulted without the tree planting. The two cases where the farm forestry projects yielded negative economic 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.

Economic valuation of environmental benefits was not included within the main structure of the analysis for each case study. However, where these could realistically add value to the project, a basic analysis of the potential scale of these benefits was carried out. The results showed that environmental benefits from the trees can translate into significant economic benefits that may be realised through increased agricultural production. Where these accrue over a long period and benefit profitable agricultural enterprises, the scale of economic

benefits to agriculture can be many times the initial cost of implementation or the actual returns received through sale of forest produce. These results should be viewed with caution, however, as the external impact of tree planting on adjoining agricultural land uses is in no way certain. The assumptions used for this part of the analysis are somewhat arbitrary because of the lack of monitoring data available for review.

The environmental impacts of trees include: increased groundwater use; soil stabilisation through root systems; provision of stock shelter; provision of habitat for birds, beneficial insects and other animals; and aesthetic benefits in the landscape.

On some of the case study properties, trees were planted specifically to take advantage of one or more of these beneficial impacts. Often these environmental plantings were along creeklines or contours, in a shelter belt configuration, or in small block plantings on specific sites according to the environmental problem being addressed. On other properties where environmental impact was less of an issue, plantings were guided more by economic factors, but positive environmental benefits were expected. One issue that has been strongly apparent throughout this project is that effective planning and ex-ante (before implementation) evaluation at the project and the whole farm level can prevent costly mistakes. Effective planning and basic economic evaluation can be used as tools for fine-tuning the economic aspects of a plan against those which have a conservation objective.

For all case study properties, there was a positive social impact at the personal and family 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 to the community as well.

The 10 participants (and experienced farm foresters like them) are a valuable asset to the industry. In some cases the participants are actively involved in providing information and time to help development of the industry. Throughout this project the researchers have encountered a diverse range of farmers, farms, objectives and realisation of goals through different configurations of farm forestry. The industry at this level is dynamic, keen to promote its work and objectives, and receptive to any information that will help it make management decisions. Personal objectives, commercial opportunities and environmental attributes have combined to create a diverse farm forestry industry throughout Australia.

1. Introduction

This introductory chapter has three main sections. Section 1 provides an introduction to the broad issues associated with farm forestry, the rationale for farm forestry's importance to agriculture and resource management at a national level, and a description of the objectives of the project. Section 2 outlines the broad methodology that was followed in selecting, evaluating and reporting on the results of 10 case studies. Section 3 provides a short commentary on the interpretation of economic statistics and various figures and tables that are provided within each case study.

1.1 Background and Objectives of the Study

Analyses undertaken by AACM International, the Centre for International Economics, and Forestry Technical Services (1996) reveal that over 5 million hectares of cleared agricultural land in Australia are highly suitable for farm forestry. These analyses indicate that farm forestry can be a commercially attractive investment for rainfall areas over 600mm, particularly when environmental benefits are included in the analysis. Recent work in Western Australia (Bartle, Campbell and White, 1996) has shown that low rainfall farm forestry may also be a commercial option with the development of appropriate species and markets.

The potential benefits of farm forestry are many, including:

- adding to the national supply of timber, essential oils and other tree-based products;
- diversification and increase of farm incomes;
- synergistic effects on crop, pasture and animal production;
- amelioration and containment of land degradation;
- conservation of biodiversity; and
- reduction of greenhouse gases.

These outcomes benefit not only individual farmers but also the wider community; for example, by reducing Australia's reliance on imports and potentially contributing to Australia's exports, thus improving our trade balance.

A recent study by the Centre for International Economics et al. (1996:48) concluded that:

- The value of devoting the optimal share of farmland to farm forestry when a sustainable harvest is reached is estimated to be approximately \$3.1 billion a year (excluding the value of processed wood products). Most (88 per cent) of this accrues to farmers, though the broader community also benefits from cleaner water and the knowledge that land degradation has been reduced and the habitat for flora and fauna improved.
- Downstream processing also benefits. The estimated annual volume of wood available from farm forestry for the processing industries is almost four times the current annual harvest. If it were all processed in today's proportions it would have a market value of \$20 billion a year, and employment would rise by an estimated 40 000.

Despite the widespread recognition of the benefits of farm forestry at the research and policy levels and among a small percentage of the farming population, the development of a significant private farm forest resource has been slow by international standards.

Impediments to faster development of the industry have been the subject of numerous studies including those by AACM International, Centre for International Economics and Forestry Technical Services (1996), Greening Australia (1996), Curtis and Race (1996) and Alexandra and Hall (1998).

Impediments have been characterised by AACM as coming under four headings.

1. lack of a farm forestry culture;
2. economic uncertainties;
3. public policies; and
4. market impediments.

Issues in categories 1 and 2 above have been addressed directly in the development of this project. The project methodology and outcomes focus on evaluating the impact of farm forestry adoption on the farm enterprise at the whole farm level rather than only at the project level. Ten farm forestry case studies were conducted around Australia between December 1998 and June 1999. The evaluations, while giving particular attention to economic impacts, also document the environmental and social impacts on the farm as seen by the family. The aim of the case studies was to 'tell each farmer's story', including why they became involved in farm forestry, and to document the impacts of farm forestry on the economic, environmental, and social aspects of the farming enterprise.

In selecting the case study sites, the researchers endeavoured to find those who had made a significant investment of time and money in the establishment and management of trees and who were at a point in their individual projects where some harvesting and marketing of products had been carried out. It is most important to document the lessons they have learned, so that other farmers can benefit from the experience of the farmers who have implemented farm forestry early and are now getting to the 'pay-off' end of their projects.

The nature of farm forestry investment (long term with significant 'up front' establishment costs) deters many farmers. Although various education, extension and information programs have been developed, relatively little has been done in the way of economic analyses at whole farm level. Such information should be made accessible to farmers and is valuable in marketing the benefits of farm forestry. Given the long-term nature of farm forestry, the industry is only now getting to the point where a significant number of projects have reliable production and marketing data that can be objectively evaluated.

Any information that decreases the level of uncertainty amongst landholders in relation to the environmental and economic benefits arising from integration of trees into farming systems will positively influence the rate of development of the industry. The need for this information has been recognised by the Kondinin Group's (user pays) FarmLine information service, which has received over 50 inquiries on farm forestry over the past 12 months. The main areas of inquiry included the economic benefits, locally appropriate options in terms of species, management and marketing, and 'how to' type information.

Although incentive programs and investment structures that underwrite the cost of establishment do exist, documentation of farmer experience with their use will provide practical information to other farmers looking at farm forestry as an avenue for diversification.

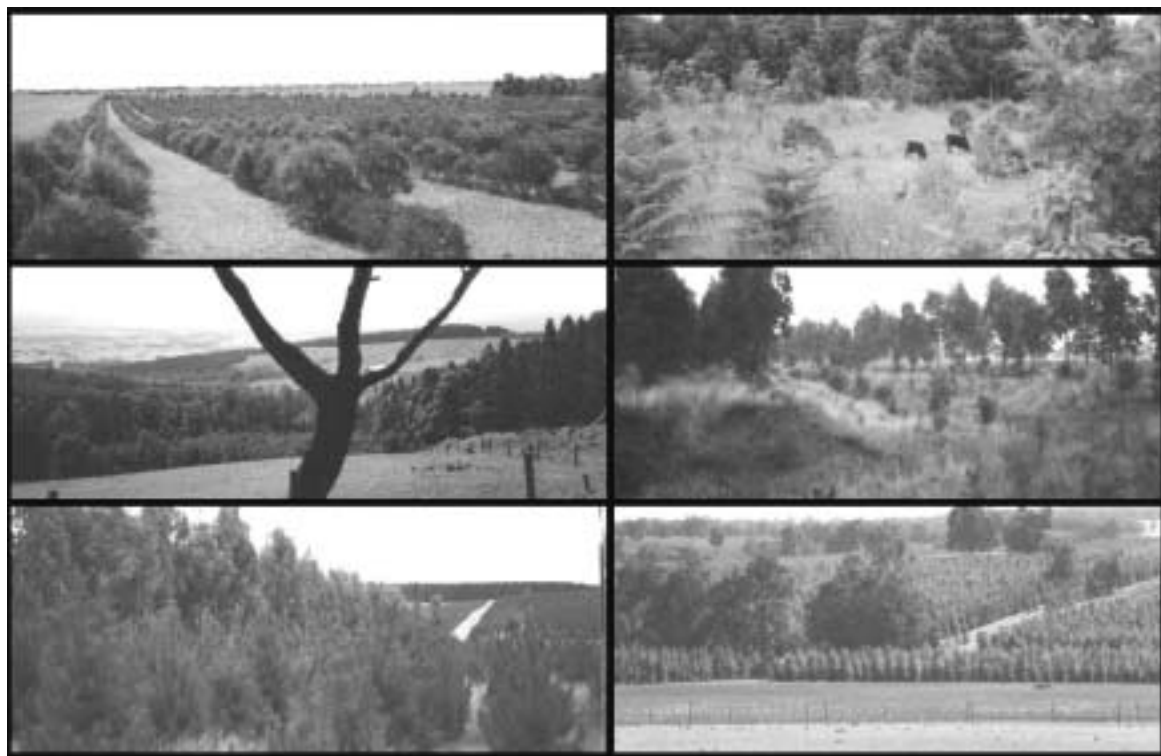


Figure 1: Personal objectives, commercial opportunities and environmental attributes combine to create a diverse farm forestry industry throughout Australia

Farm forestry means different things to different people. For this project, farm forestry was taken to mean the planting and management of trees to generate a positive contribution to economic, environmental and social outcomes for the family farm.

The logic was that tree planting (and associated costs) indicates a conviction by the farmer that there are positive benefits to be gained from integrating trees into the farming system. The purpose of the case studies was to draw out and document as far as possible what these benefits are likely to be, based on our knowledge of current and predicted impacts.

The case study farms covered a range of geographical regions, and rainfall zones across Australia. The locations of case study sites are shown in Figure 2.



Figure 2: Location of case studies.

1.2 Methodology

Selection of Case Study Sites

Case study properties were sought through farm forestry networks and other industry contacts. A request for Case Study Proposals was placed in the July 1998 edition of *Agroforestry News* and obtained a number of responses and contacts. Extensive consultation with the major extension advisory services in each state served to expand the list of possible sites. Throughout the selection process the researchers endeavoured to include those sites which may not have had wide exposure previously but which local farm forestry experts believed had an innovative or interesting story. The objective was to choose sites that would be relevant to local landholders and of interest to farmers outside of the district.

The list of sites was finalised after discussions with the farmers to explain the project objectives and the data requirements. All proposals were considered on the basis of their individual merit, preference being given to those that had good long-term financial records and an established silvicultural management regime. Case study properties were chosen to provide a good range of rainfall zones, farm forestry configurations, tree species, management strategies and, where possible, project financing arrangements. The availability of technical experts familiar with site history and processes was also considered.

Data Collection

Collection of data was originally to be carried out in each area by local farm management consultants and forwarded to the researchers where it would be analysed and written up. However, after considering the difficulty of finding and briefing suitably qualified consultants, and taking into account the risk of receiving inaccurate or incomplete data, this method was ruled out.

All sites were visited personally by the principal researchers and data collection was undertaken at these meetings. Supplementary data was collected through phone conversations with the farmers. Each interview was of approximately 4 to 5 hours duration and adhered to a standard process, beginning with a structured discussion of the history of the property and its environmental and social issues. A walk or a drive around the farm to look at the farming system and discuss the management of trees followed, with financial and economic data collected at a final office meeting.

Where possible, the evaluations have been based on the formal business and land use planning records of the landholder, as well as taking account of previous evaluation/modelling results.

Data Analysis

The project team aimed to apply a 'project report card' format, similar to that described in Walker and Reuter (1996) (applied to evaluation of catchment management), to create a simple format for outlining the results of the evaluations. The researchers found that despite the selection of regional role models, the level of monitoring and evaluation data required to apply this approach was not available. In comments on early drafts of the project report, some reviewers found the application of indicators for evaluation of social and environmental effects to be problematical, because of limitations in the available data. It was decided therefore to concentrate this part of the analysis on documenting the landowners' experience and their qualitative assessment of environmental and social impacts, rather than imposing a rigid evaluation structure with little or no supporting data.

The development of a purpose built financial evaluation model was required after a review of existing models found them to be unsuitable for evaluation of the diverse range of farm forestry regimes covered by the case studies. The purpose built model was designed to provide whole farm discounted cashflow analysis that projected the economic impacts of establishment of farm forestry over the project cycle. The evaluation examined stands that would have been planted up to the year 2001. The project cycle was defined as starting in the year before the first plantings and extending for one rotation of every stand until the last stand included was clearfelled. Land occupied by stands clearfelled before the end of the period was assumed to revert to agriculture at the same level of productivity as that which existed prior to the establishment of trees. The lack of any formal monitoring or evaluation processes or data at any of the case study sites precluded formal economic assessment of environmental impacts. These include issues such as shelter or competition effects and the impacts of high water use perennial vegetation on the rate of saline encroachment.

However, where forestry design and implementation have been carried out to achieve a balance of direct environmental benefits and indirect economic benefits on neighbouring agriculture, a limited evaluation which defines the scope of potential benefits has been included. This is achieved by making an arbitrary assumption about land resource productivity decline over the project period in the situation where no revegetation takes place (usually a 10% decline in productivity over the project period). This is compared against cashflows that occur under the assumption that revegetation will prevent this decline in land resource productivity. The difference in project Net Present Value (NPV, a term defined below) under this analysis and that calculated under the standard analysis is the projected direct economic value that will accrue to the farm in the form of positive impacts on neighbouring agriculture. Note that this value is a 'direct use' value only and does not account for other 'non-use' values such as existence, amenity or bequest values.

The model carried out an economic assessment using two discounted cashflow projections calculated net of tax. The baseline scenario against which all forestry activities were evaluated is referred to throughout the studies as the 'without trees' scenario. This consists of a constant annual income for an 'average' year extrapolated over time for the hypothetical situation in which no revegetation had been carried out. This is compared against the 'with trees' scenario in which trees replace agriculture on some of the farm and the costs of establishment and returns to the enterprise over the project period are included in the farm income.

A real discount rate of 5% was used for all evaluations. The use of a real discount rate excludes the impacts of inflation from the analysis. Sensitivity analysis to rates of 3,5,7 and 9% is presented within each report.

To present all studies on a common basis and to provide some measure of privacy to the participating farmers, the financial positions of the farm business at the start of each project is not considered. Both scenarios within each evaluation begin with the farm net liability of 0. The cash balance accruing to each scenario over time is 'banked' in a single account which earns an annual interest on savings of 5%; overdraft drawings on this account, such as those required to finance establishment of trees, are charged interest at an annual rate of 11%. The rates applicable to savings and overdraft drawing are chosen with regard to including some provision for financing costs within the model and have not been the subject of extensive research. Individual rates applicable will vary depending on many factors.

Taxation laws modelled reflect those currently in force for individual, tax averaging and company taxation regimes. The analysis does not incorporate the impacts of any proposed changes to the taxation system, such as the imposition of a Goods and Services Tax. For the purposes of this evaluation, expenditures on establishment and management of forestry are treated in the same way as those incurred as a consequence of engaging in agricultural production. That is, they are allowable deductions in the year in which they are incurred. This is regardless of whether the principal objective is a commercial one or whether the revegetation has a primary objective of land conservation. The Commissioner for Taxation considers commercial forestry as primary production. Expenditure on forestry or revegetation carried out primarily for land conservation purposes is allowed an outright deduction (under Section 75d of the Income Tax Assessment Act) in the year in which costs are incurred. All income derived from

commercial forestry operation is assessable in the year in which the trees are harvested. The main implication of taxation for farmers engaging in commercial forestry is that planning for the bulk income that occurs as stands are clearfelled is essential.

The final stage of this phase of the project was the development of case study reports for each site. It is hoped that these reports will be of use to farm forestry extension staff as well as being of interest to other land managers. Additionally, it is hoped that the reports will provide a valuable resource for each participant in providing a base data level for the development of better monitoring and evaluation techniques for their properties. For these reasons the reports are presented in a non-technical style and where possible the results are presented graphically.

1.3 Analysis and Interpretation of Results

The decisions of agroforestry investors are based on expectations of future timber income in addition to a range of other benefits, both monetary and non-monetary, that revegetation may bring to the farm e.g. water use, shelter or aesthetic improvement. In most cases a commercial forestry project consists of a series of expenses starting in the year of site preparation or establishment and continuing until clearfall when the majority of cash inflow occurs. Of course, commercial thinning of the stand throughout the life of the rotation can provide some income in the intervening years to offset expenses incurred in the ongoing management of the stand. Non-commercial or land conservation focussed forestry has the same general pattern of cash outflows without the cash inflows that result from harvesting.

Other benefits of forestry such as the impact of trees on groundwater levels and complementary shelter effects as the trees grow may also provide a monetary benefit to the farmer throughout the life of the project. However, the decision to invest in agroforestry must be made now and the investor must compare the value of expected future timber income with other possible investments.

To make a decision on forestry investment on purely economic grounds becomes a question of the worth of expected future income against these alternatives. Economists use the concepts of present value and discounting in an attempt to equate the various project alternatives. The two measures used within this analysis to describe the chosen forestry project in relation to agriculture are Net Present Value (NPV) and the Benefit Cost Ratio (BCR).

Net Present Value (NPV)

The NPV of a project is the sum of net discounted cashflow that occur in each year of the project. In this report the term 'project NPV' refers to the value gained by subtracting the NPV of the 'without trees' scenario from that of the 'with trees' scenario. If the value of project NPV is greater than zero, the project is profitable after repaying capital and interest costs. A project NPV of less than zero implies that the project is not profitable under the assumptions defined in the analysis.

Given NPV for a range of alternative investments, it is possible to rank the alternatives on the basis of NPV. The project with the highest NPV becomes the most preferred. However, the selection of the discount rate to apply to the project is a critical factor in the

calculation of project NPV. A basic analysis of the sensitivity to project NPV is presented within each case study report.

Another limitation of the project ranking based on NPV is that it is an absolute measure. It cannot be used to interpret the efficiency with which scarce investment funds are allocated between alternative projects. For example, a project which requires relatively small capital investment, but which creates impressive investment returns (relative to its cost), may not be chosen over a very large, marginally acceptable project that has a larger NPV. See Table 1 for an illustration of this principle.

Despite its limitations, NPV is the preferred method for choosing between projects (Department of Finance, 1997: 118); however, a relative measure of project worth, the Benefit Cost ratio (BCR) is also included.

Annualised NPV (Annuity)

The model calculates the equivalent net annual return (i.e. annuity equivalent). The project ranking is identical to NPV ranking, but this annuity measure of profitability describes an annualised value of income that would result from implementation of the forestry at the prevailing discount rate. When divided by farm area it gives the increased (or decreased) annual income increment per hectare over the whole farm that is attributable to the investment in forestry.

Benefit Cost Ratio (BCR)

The BCR provides a relative measure of project worth (relative to the amount invested in the project). It is calculated by taking the present value of gross benefits minus 'associated costs' and dividing this value by the present value of 'project economic costs' (Price-Gittinger, 1982: 345). The BCR has the disadvantage of being sensitive to the conventions used to separate project costs and benefits. Its advantage is that it can provide a guide to the most 'efficient' projects in terms of returns per dollar invested.

The calculation of the BCR within these case study reports is conducted before tax because of complexity in identifying net benefits and costs attributable to the project after tax. For this reason in some rare cases the BCR results presented may conflict with the information given by NPV. In all cases the BCR will overstate the actual after tax return per dollar invested. For example, Case Study 3 results show that the NPV for the forestry project is negative; however, at the 5% discount rate applied, the BCR is greater than one. This would not normally be the case as, despite the fact that project ranking may differ between the two measures it is not possible for them to give conflicting evidence about the profitability of a single project. This inconsistency is due to a complex interaction between discount rates, and the modeling of marginal taxation rates and averaging.

Ultimately the decision to invest in agroforestry will be made on the basis of a host of factors, some economic and others not. However, the 'bottom line' for this evaluation is that if the forestry project has a NPV greater than that of agriculture it will be profitable if the assumptions about future production and prices hold.

The BCR can be used to decide between alternative forestry enterprises (requiring separate evaluations and comparisons of results) as it gives a reasonably technically ‘robust’ indication of the expected real returns *per dollar of the landholder’s money invested*. BCR can also be of use when looking at the attractiveness of the alternative establishment options. The BCR of trees established using an annuity contract will always be high relative to the situation where the landholders establish and manage the trees themselves. This is because of the fact that aside from the opportunity cost of the land contributed, there is very little investment required by the landholder and the ratio of returns to cost is high.

The table below outlines a summary results set from the ‘Agroforestry Calculator’. This model is available from the RIRDC website and is used to carry out economic evaluation of agroforestry at the project level. The results have been constructed for a situation in which landholders must decide whether to establish and manage the trees themselves (DIY or ‘Do it yourself’) or enter into an annuity agreement with a professional farm forestry organisation. Both the DIY and the annuity agreement are profitable investments compared with existing agriculture, but the DIY scenario has a significantly higher project NPV than does the annuity agreement.

The BCR of the two alternatives, however, shows a different pattern. The Annuity agreement has a relatively high BCR (i.e. the ratio of returns to costs is high) because the costs of an agroforestry project under the lease/annuity option are very low. The DIY scenario requires significant capital investment by the landholder in establishment and management. It is not possible to say from these results which option is best for the farm business. The analyst must decide which option will fit best into the overall structure and financial position of the business. The landholder’s objectives and vision for the forestry project and the farm as a whole are vitally important factors to consider.

Table 1: Example of a summary result set from Agroforestry Calculator.

	NPV	Annualised NPV	BCR
Current	\$35,292	\$2,830	1.00
DIY	\$46,671	\$3,743	1.65
Sharecrop	\$43,489	\$3,577	9.47
Lease/Annuity	\$41,897	\$3,360	74.82

For an explanation of the process of cost benefit analysis for agroforestry projects, refer to Abel et al (1997).

IMPORTANT INFORMATION

These case study reports are based on information and assumptions developed in consultation with the farmers and local agriculture and forestry personnel.

The economic evaluations attempt to describe the impact of farm forestry on the farm business. The models used to produce this information are simplified representations of the farm and can only predict what the likely impact of revegetation might be. The models also do not capture complex interactions that may exist between farm enterprises.

Significant fluctuations in commodity prices or yields, natural factors such as drought and fire, or adjustments and policy changes in financial markets all have the potential to render these results invalid over the term of the evaluation.

Prospective farm forestry investors are strongly advised to consult with an appropriately qualified forestry consultant to identify locally appropriate species, management and markets.

Case Study 1

**Jim and Kay Whittem
Albany, WA**



Figure 3: Location of Case Study Site

The Farm

The Whittem's farm is located at Napier in the South West region of Western Australia. It is approximately 40kms South East of Mt. Barker and 32kms North of Albany. Historically, the South West region around Mt Barker and Albany has been recognised as a sheep and cattle grazing area. However, in recent times (the last ten years), agricultural practices have become more diversified with significant increase in the area planted to grape vines for wine production, plantation forestry and farm forestry for wood and pulp production, and canola for oilseed.

The property is 522ha in total, of which 400ha is arable and receives an average annual rainfall of 650mm. Prior to concentration on implementation of farm forestry, land use was sheep grazing for meat and fine wool production (19-20 micron). The soil on the property is generally deep sand over clay, with some areas of deep gravelly sand over clay. The average stocking rate before introduction of the farm forestry enterprise was 7DSE/ha.

The property is fairly typical of the area. Neighbours that were previously involved in sheep and cattle grazing, are now also involved in tree planting, mainly through leasing paddocks for plantation plantings to local timber plantation companies.

From a regional perspective, the farm is situated at the lower end of the annual rainfall requirement (650mm plus) which is considered viable for commercial timber/pulp production using *Eucalyptus globulus* (Tasmanian Blue Gum).

Objectives of the Farm Forestry Enterprise

Jim joined the Napier/King LCDC in 1988 and at that time one of the major issues for the catchment was the eutrophication of Oyster Harbour. Tree planting was seen by the catchment group as one method to reduce nutrient run-off into the Kalgan River (which runs past the property) and feeds into the Oyster Harbour. Jim became president of the Napier/King LCDC in 1990.

Jim considers that the real motivation for planting the first trees on his property was a mixture of guilt and peer pressure. As president of the local catchment landcare group, he felt that he wasn't actually doing a lot to support landcare principles on his own property, compared to others in the group.

The first non-commercial tree planting occurred in 1992. These trees were to act as a wind break along a fence line in a sandy paddock which was prone to windblow. He was impressed with the first season's growth of the trees, and decided to plant one of his poorer, wind blown paddocks (also subject to water logging) to Blue Gum belts for commercial timber production, at 10m x 1m spacing in 1993. In 1994 he planted the neighbouring paddock at 12m x 1m spacing, and has planted Blue Gums every year since then. The planting history and layout of his commercial plantings are shown in Table 2 and Figure 4 below.

Table 2. Planting history

Name/ Paddock Number	Spacing	Year planted	Propn. Planted	Area planted (ha)	Number of Trees	Soil Description
Middle Paddock (12)	10m x 1m	1993	90%	32.6	27,000	Sandy
Windmill Paddock (11)	10m x 1m	1994	95%	33.0	30,000	Good Sand
Back Paddock (10)	12m x 1m	1995	100%	36.6	26,000	gravel/clay
Soak Paddock (2)	12m x 1m	1995	100%	30.0	20,600	Poor sand
North Paddock (9)	12m x 1m	1996	100%	20.0	11,000	Poor sand
Bradleys Paddock (7)	12m x 1m	1996	100%	31.0	30,000	Poor sand
South Paddock * (13)	12m x 1m	1997/98	100%	18.0	13,300	Poor sand
Stud Paddock * (14)	12m x 1m	1997/98	100%	17.0	13,200	Poor sand
Ram Paddock * (15)	12m x 1m	1997/98	100%	7.0	5,100	Poor sand
TOTAL				225.2	176,200	

* 50% died due to insects and dry spring, replanted radiata in 1998

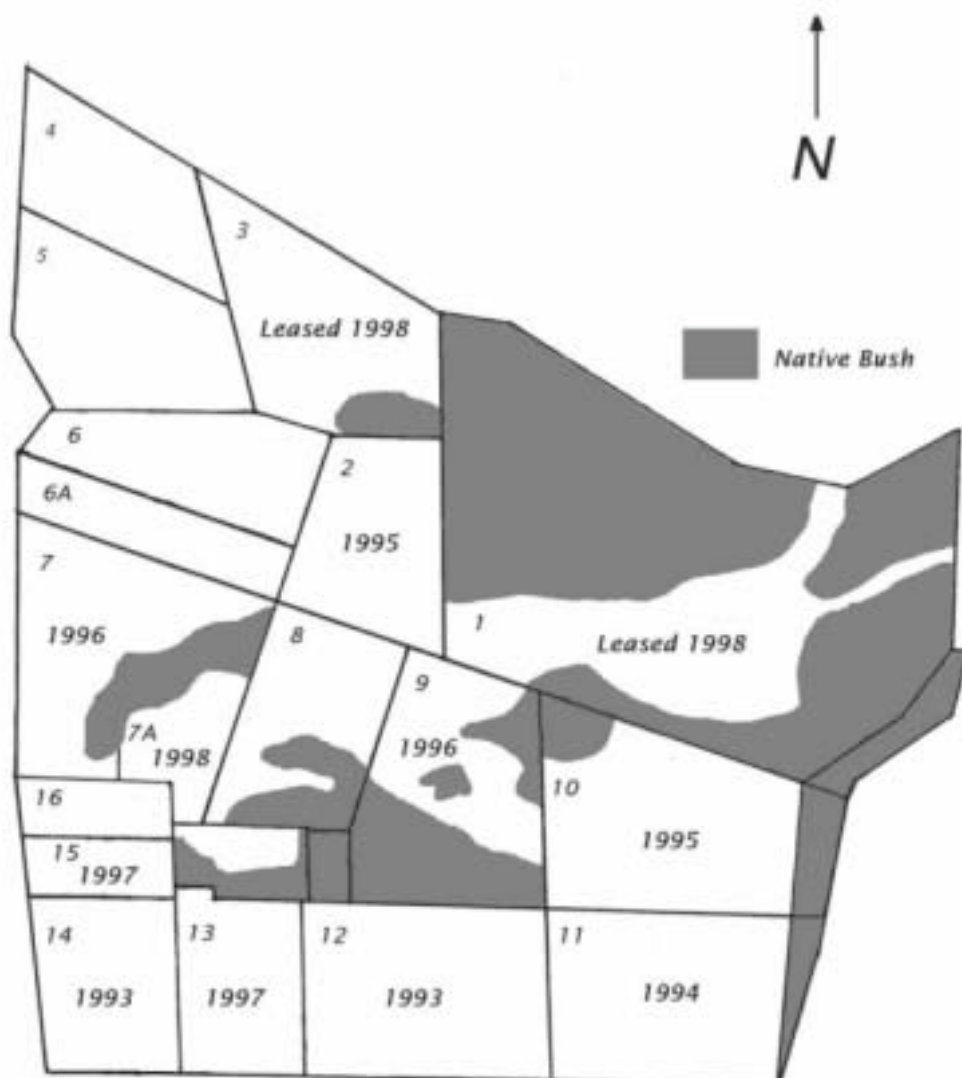


Figure 4: Whittem's property - Tree planting history

The Whittems consider that wind erosion was at least 50% of the reason for their becoming involved in farm forestry. Their farm has very sandy soils and tree planting was an obvious way to overcome the wind erosion problem. At the same time, planting trees was seen as a way to help reduce the eutrophication problems of Oyster Harbour and the Kalgan River by increasing water use on the farm and reducing nutrient run-off into the river.

While the environmental benefits of tree planting were a major motivation for the Whittems to become involved in farm forestry, the potential economic benefits also played a significant role in encouraging them along that line. At the time of their original decision to get involved, there was information circulating from local tree plantation companies that illustrated the potential for good returns from both plantation and farm forestry trees for pulp and timber production.

Even though economic and environmental benefits had a positive influence on their decision to plant trees, in the early 1990s there was still considerable opposition and scepticism among the local community towards tree planting. This came from a belief that trees would force out traditional farmers and decimate the local community. Additionally, the environmental and economic benefits of trees that were being claimed were unproven. Social acceptance of farm tree planting varied from positive to negative, depending on the section of the community being consulted.

In summary, the Whittems' primary reasons for adopting farm forestry were environmental (to stop wind erosion and reduce nutrient run-off), and economic (to improve the long-term farm financial performance). Social influences that encouraged adoption of farm forestry came mainly through involvement with the landcare group.

Implementation and Management of Farm Forestry

As indicated in Table 2, the first planting of trees intended for commercial harvest was in 1993. This consisted of Blue Gums at 10m x 1m spacing (1000 stems/ha) over approximately 32 hectares. The second planting was also at this spacing. However, Jim felt that given the close spacing between trees in the rows, the trees would require a larger soil volume once they started to mature and all subsequent plantings have been at 12m x 1m spacing.

The Whittems are currently managing for pulp and sawlog production. Jim has high pruned (6m) 80 to 100 stems per hectare and may manage these for production of sawlogs at age 20. However this will depend on the value of sawlogs when the first thin for pulp occurs (probably at age 10). Non-commercial thinning within the stands is not planned. Jim believes that although the trees are planted in rows at 1 metre centres, the 12 metre spacing between rows will allow enough soil volume for good growth.

Because of the uncertainty about markets and the price that will be received for sawlogs, they are leaving their options open by managing the trees for multiple products. The only cost of doing this is Jim's time in form pruning the trees. At this stage it appears that clearfelling the stands for pulp at age 10 will probably prove to be the most profitable strategy. Therefore it is this strategy and not that of growing some trees out to sawlog production that is analysed in this evaluation.

The Whittem's typical establishment regime is:

- Deep rip tree planting lines.
- Spray knockdown herbicide (Glyphosate @ 1l/ha).
- Fertiliser application (Rockdust @ 200kg/ha).
- Plant seedlings in winter (June, July, August), using a mounding tree planter.
- Sheep and lambs allowed back to graze the paddocks in March (7-10 months).

Estimated costs associated with the establishment and management of Blue Gums for sawlogs are given below.

Table 3: Bluegum Establishment and Management Schedule

	Year	Cost /ha
Ripping (farm tractor)	0	\$12.50
Spray herbicide	0	\$5.00
Spray application (labour)	0	\$5.00
Planting (labour)	1	\$80.00
Seedlings	1	\$200 (800 @ 25c each)
Fertiliser spread	1-2	\$25.00 (rock dust 200kg/ha @\$125/t applied)
Fertiliser spread	3-10	\$13.00 (rock dust 200kg/ha @\$65/t applied)
Rabbit control	1-2	\$5.00 (shooting at nominal cost)
Annual maintenance	2-10	\$10.00 (firebreaks, etc)
Pruning	4	\$200 (80-100 sph @ \$2.00/tree)
10 year cost (nominal)	\$758.50	Per hectare

The costs of establishing and managing Blue Gums for pulp are similar, however as pruning is not required, this cost can be ignored.

In 1997, 50% of the area planted was killed by a combination of spring beetle and a drier than average spring. These were replanted (21ha) in 1998 to *Pinus radiata*. The estimated cost of establishment is \$720/ha with an annual maintenance cost of \$20/ha.

Table 4: *Pinus radiata* planting and thinning regime

Establishment planting Year 1	1600stems/ha	
1st Thinning Year 12		to 450/ha
2nd Thinning Year 18		to 250/ha
3rd Thinning Year 24		to 125/ha
Clearfall Year 30		
MAI	17	m ³ /ha/yr

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Whittem's farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 19 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1999. The evaluation examines one rotation for each stand established before 1999 and concludes when the last stand is clearfelled.

The baseline scenario looks at the likely outcome had the farm continued under the management regime that existed prior to the implementation of the revegetation strategy. This is compared to the scenario that exists currently with integrated tree plantings and sheep grazing for production of fine wool (at reduced stocking rates).

There is considerable uncertainty inherent in defining many of the production parameters (both agriculture and forestry) and extrapolating these over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the ‘with trees’ and ‘without trees’ scenarios has come from interviews with Jim and Kay Whitem and consultation with local forestry and agricultural personnel. Information relating to costs, prices and yields of the plantings is drawn from information compiled by Jim and Bob Hingston of the WA Department of Conservation and Land Management.

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm are calculated on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs subtracted to gain a measure of gross income. Annual cashflow is presented net of tax. The impact of the 1998 establishment failure and subsequent replanting to *Pinus radiata* has not been included within this evaluation because of uncertainty about the management, marketing and performance of pine in this area.

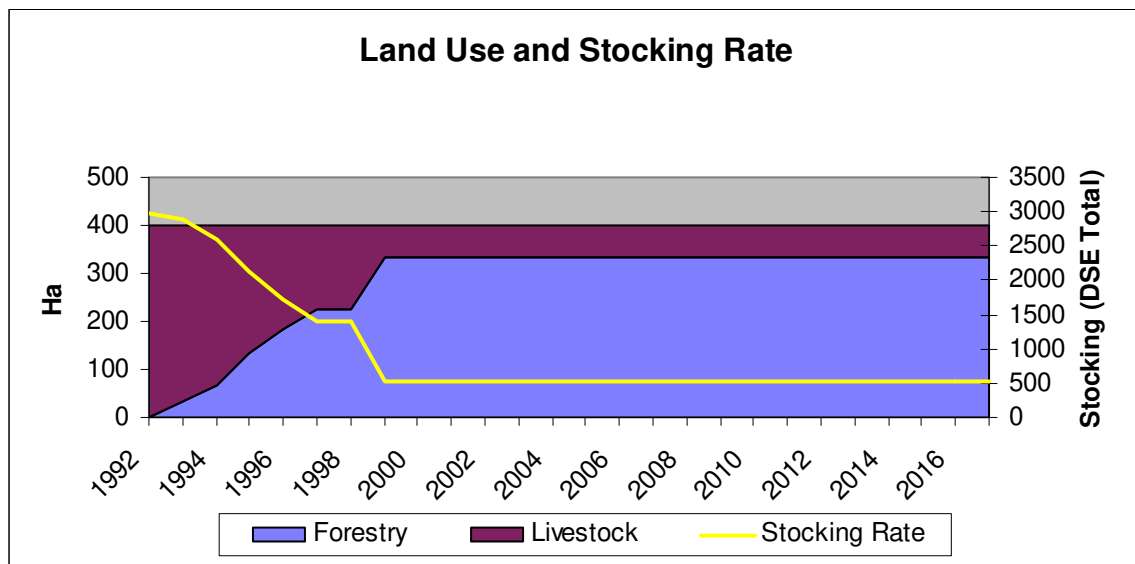


Figure 5: Land Use and Stocking Rate

Figure 5 illustrates that Jim and Kay have converted a large proportion of their farm to the Blue Gum forestry enterprise over the period of this analysis, and as a result, a significant amount of grazing potential has been lost. The actual and predicted impact of the conversion to farm forestry on farm income and cashflow is illustrated in Figure 6.

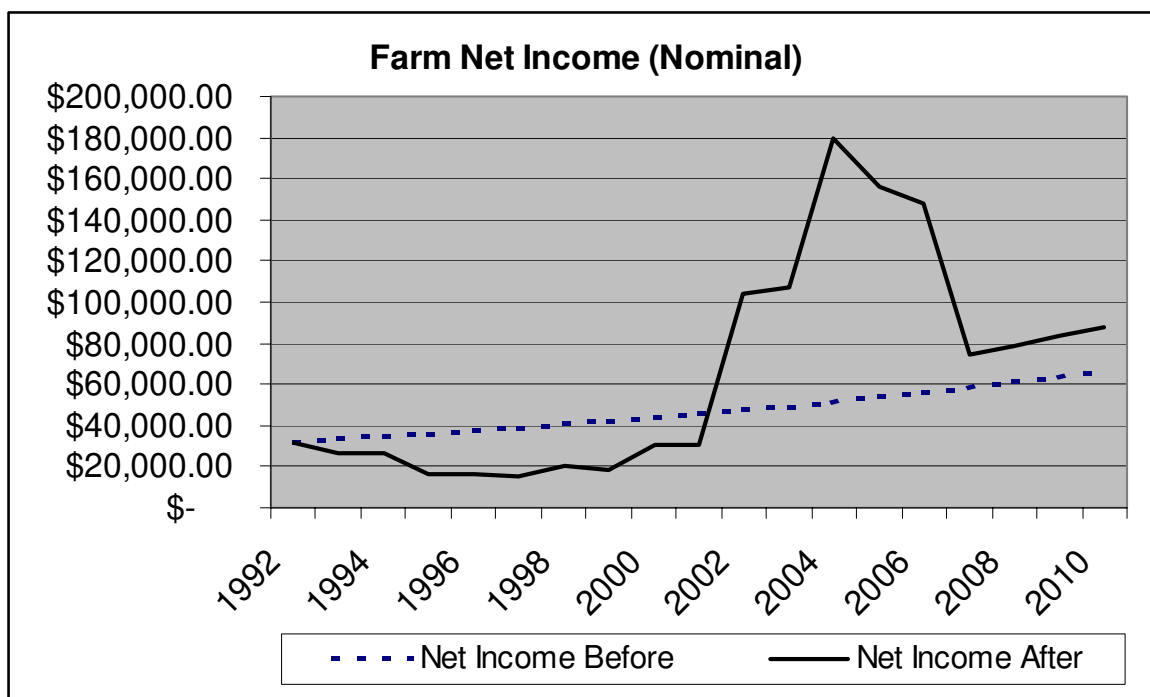


Figure 6: Farm Net Income (undiscounted) 1992-2010

Note that the cashflow without trees has been estimated as an average annual income. This income remains constant over time and is a baseline value against which the forestry enterprise income is evaluated. Interest on the cash balance accruing to each strategy is included within the analysis resulting in the upward trend of the 'Net Income Before' line.

The graph illustrates a significant reduction in annual farm income in the years leading up to the first harvest. This is a result of the cost incurred in planting and maintaining the trees, as well as reduced income from the sheep enterprise as more paddocks are taken out of intensive wool production and planted out. After establishment, grazing at reduced pressure is accounted for within the forestry stands. The initial reduction in farm income is offset in latter years by the large income that results from harvesting the trees.

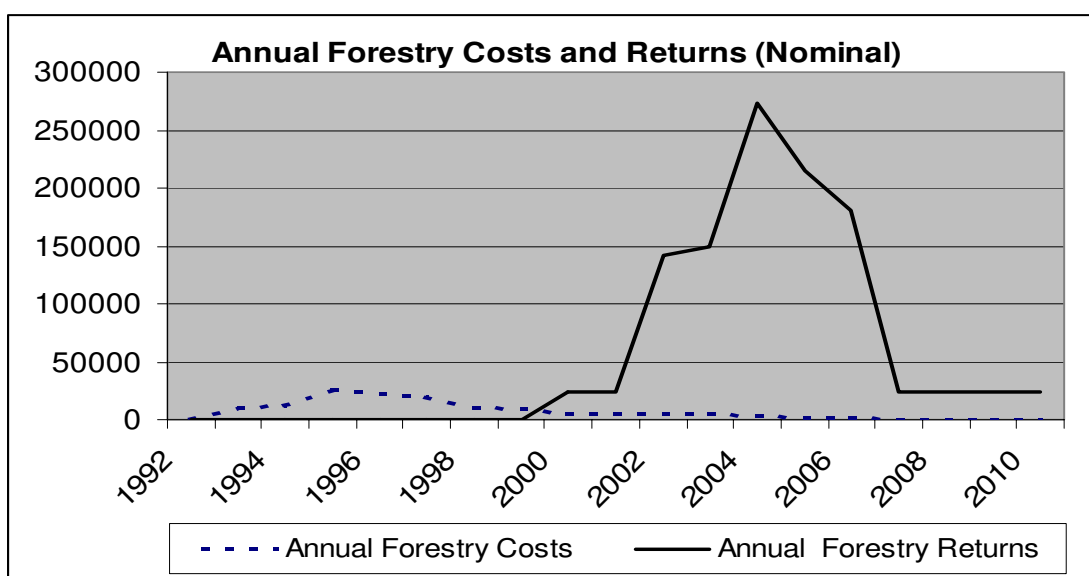


Figure 7: Annual Costs and Returns

The Net Present Value (NPV) of the cashflow (discounted at 5%) with trees is \$684,105, whilst the present value of the cashflow without trees is \$535,047. This indicates that using current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, the Whittens stand to make an after tax profit of \$149,058 on completion of the project.

NPV is a scale dependent project summary statistic. It can sometimes be misinterpreted as its results are absolute and give no information about the 'relative' profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project the BCR over the 18 year time frame is 3.93, indicating that for every dollar invested approximately \$3.93 will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV is calculated as an additional annual income stream of \$13,180 per year over the project period. The proportional increase in farm income over the 'without trees' scenario is significant at 28.80%.

Table 5: Project Summary Statistics

NPV	\$154,068
BCR	3.93
Annualised NPV	\$13,180
Proportional increase/decrease in Annual Income	28.80%

The uncertainty of both agricultural and forestry returns dictates that sensitivity analysis should be used to assess the impact of possible future price or yield variations to the profitability of forestry enterprises relative to the before establishment scenario.

Jim and Kay believe that the uncertainty inherent in grazing returns in their area and the rapid development of the Blue Gum forestry industry will lead to their farm forestry configuration being more profitable in the long run than if they had continued with agriculture. The results of this evaluation certainly support this view. However, for many farmers the short-term cashflow implications may be significant. They must be able to accept the reductions in annual farm income initially, in order to enjoy any longer term benefits.

The profitability of farm forestry relative to agriculture is obviously dependent on the assumptions used to calculate the cashflows. A limited sensitivity analysis shows the extent to which changing returns to grazing or to forestry will influence the outcome of the evaluation. The following graph displays the relationship between the difference in NPV under the 'with trees' and 'without trees' scenarios when assumptions relating to the income from agriculture and forestry are altered.

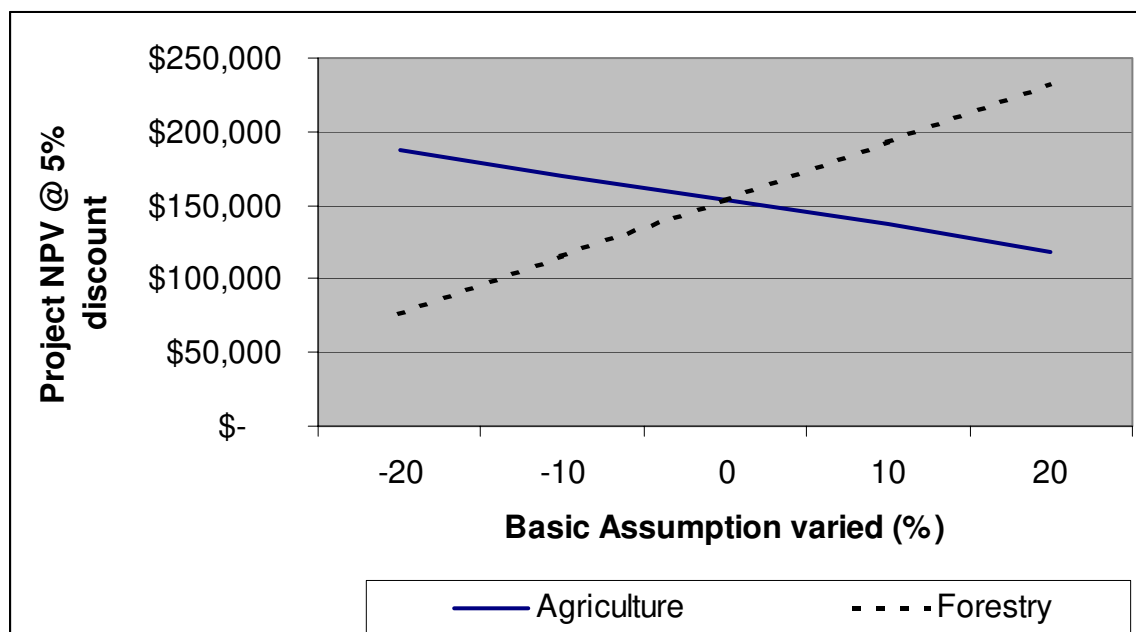


Figure 8: Sensitivity to Changes in Assumptions

Figure 8 indicates that project outcomes are more sensitive to changes in assumptions about forestry returns than those of agriculture. However, the project still produces a profit even if returns to forestry are 20% less than assumed (\$70,604) or returns to agriculture (which represents the opportunity cost of the land) are 20% higher than assumed (\$113,804). Under the assumptions that agriculture returns are 20% higher than assumed and forestry returns are 20% less than assumed the project still returns a modest after tax profit of \$35,716. Reversing these conservative assumptions significantly increases the profitability of the project. Assuming that agricultural prices are 20% less and prices received for forest produce are 20% more leads to an increase in NPV to \$265,649 with a BCR of 5.71.

Breakeven calculations define the extent to which tree returns must be lower than assumed (or higher returns to agriculture) before the project 'breaks even' with the 'without trees' scenario ie the difference in NPV for the two scenarios equals zero. Under the assumptions used for this analysis, forestry returns must fall to 62% or returns to agriculture must be 1.75 times higher than assumed before the project breaks even.

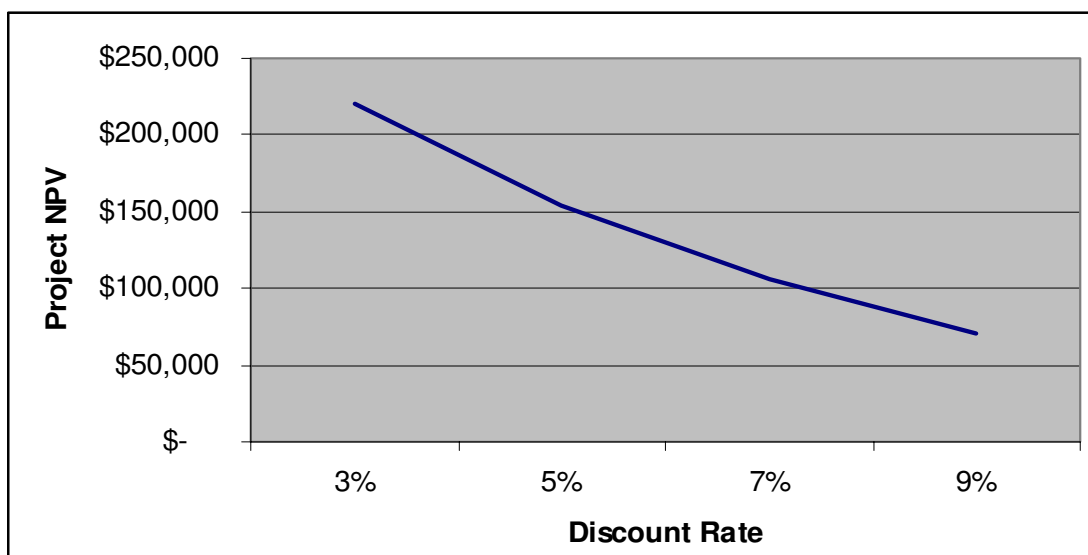


Figure 9: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make the forestry project less attractive economically because of the normal forestry pattern of costs and returns over time. However, the Whittem's farm forestry is quite robust with respect to changes in the discount rate; it will generate a positive NPV even when the discount rate is 9%.

Table 6: Key Assumptions

Jim and Kay Whittem	
Area of Farm (ha)	522
Arable Land (ha)	400
Current Value per ha	\$1875
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1993
Timeframe	24 yr
Interest Rate on Savings	5%
Interest Rate on borrowings	11%
Tax Regime	5 Year Averaging
Gross Margin per DSE	\$21.33
Ave Stocking Rate	7.5 DSE /ha
MAI of Globulus planting	16

Environmental Impacts

Since undertaking the tree plantings on their farm, the Whittems have experienced a significant reduction in the wind erosion problems they originally faced. At the same time, by increasing the amount of tree cover on the property there are now large shelter areas that offers sheep protection during lambing and normal grazing. Growth of the trees has, however, significantly reduced the growth of pasture in some areas.

In addition to shelter benefits, the water table which was rising at an estimated 10cm per year prior to plantings and was within 1m of the surface, has now stopped rising. This observation is based on a piezometer placed in the middle of the farm and now surrounded by 2 year old Blue Gums. Waterlogging has also ceased to occur in the paddock planted in 1993 that was originally sandy and waterlogged.

There is no data available on the effect the trees have had on nutrient run-off to the Kalgan river, however the impact on the water table and observed reduction in surface water discharge, would indicate that nutrient run-off may have been reduced.

Jim also believes the tree plantings have provided a large aesthetic benefit to the farm. He now likes to go down and walk amongst the tree stands, whereas before he never used to go and walk in paddocks as they were very sandy and windy.

A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting prevents an assumed decline in land resource productivity. It was assumed that a 10% decline would accrue over the 19 years of the project as a result of combined wind erosion and waterlogging under the 'without trees' scenario. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$154 068 to \$204 286, an increase of over \$50 000. It can be seen that any positive impacts of the trees on adjoining agriculture will have a strong impact on the profitability of the farm over the medium term.

Social Impacts

The social impacts of adopting farm forestry include the impacts on family lifestyle as well as impacts on relationships with the broader community. The social impacts of farm forestry are often directly linked to the economic and environmental impacts. As an example, farm forestry may reduce stress within the family because Jim is now happy to go out and walk among the trees, or because the longer term economic viability of the property is more certain.

Social impacts are difficult to quantify, and we have relied on anecdotal evidence from the interviews to describe the social impacts that farm forestry has had on their lives.

Jim describes himself as 'a bit of a greenie' at heart, meaning that he derives a great deal of satisfaction from planting and managing the trees on his property, knowing that they are improving the general environment of the farm. In this sense the family recognise that farming is a lifestyle choice for them, and pursuing farm forestry is a means of also pursuing a more satisfactory lifestyle.

Initial community reaction to tree planting was tentative, with some people opposed to trees because they believed tree planting would squeeze out traditional farmers and waste good agricultural land.

Jim and Kay believe that rather than reduce the local community size, with the downturn in prices for traditional agricultural commodities, tree plantations and farm forestry have helped to ensure the longer term viability of small rural communities through provision of jobs in pruning and maintenance, harvest and haulage. Jim estimates that approximately two thirds of local property owners now have at least some tree planting on their properties.

Summary and Lessons Learnt

The Whittembs see farm forestry as a way to ensure the long-term financial and economic viability of their property. The analysis of impacts presented in this case study suggests that there are positive environmental and social benefits to be gained from the farm forestry enterprise. However, the economic benefits are less certain. The analysis indicates that short-term cashflow will suffer, but cashflow over the longer term is likely to be improved.

Whether the Whittembs will be better off financially in the longer term depends on the relative returns of agriculture compared to those for farm forestry. The analysis shows that the project returns are relatively robust with respect to changes in the assumptions. It is difficult to predict these returns with any certainty, however history would illustrate that returns to traditional agriculture have been gradually declining over the last decade or so. Conversely returns to farm forestry have a better opportunity to improve because of increased demand for plantation based timber and wood products, although returns are based on trends in global markets and are far from certain. The sensitivity analysis shows that reduction in proceeds from agriculture and increased proceeds for forestry will have a large positive impact on the economic outcome of this project.

The Whittembs have planted trees on paddocks with lowest productivity in terms of traditional agriculture. This ensures that they are minimising the opportunity cost of planting. However, a significant proportion of the farm has been planted to trees, which impacts heavily on cashflow through reducing sheep income. The bulk of their farm forestry has been self-financed, which involves a trade-off between risk and return. This method of financing places a greater burden on short term cashflow, but provides the benefit of greater return in the long run as all harvest proceeds will flow to them. More recent plantings have been under a joint venture contract, where the short-term cashflow impact is not burdensome and risks associated with management and marketing are traded off against lower returns in the longer term.

Their decision to adopt farm forestry was based on a belief that it would provide longer term financial security, while at the same time addressing some of the environmental challenges facing the farm. Direct economic benefits which accrue to agriculture as a result of the tree planting will also have a significant positive influence on the finances of the farm over the medium term.

Case Study 2

**Brian, Michael &
Rosemary Cornish
‘Boolara’
Penola, SA**



Case Study 2: Brian, Michael & Rosemary Cornish

Figure 10: Case Study Location

The Farm

The 1032 hectare property 'Boolara' is situated in south-eastern South Australia, and is managed as a family business by Brian Cornish and his son and daughter in-law Michael and Rosemary Cornish. The property is 8km due east of Coonawarra, a major wine-growing region in South Australia, and is only a few kilometres west of the South Australian/ Victorian border.

Boolara has three distinct soil types that include acid prone sandy soils on the northern section of the property, undulating Red Gum/ Terra rossa soils in the middle section and flat low lying swamp in the southern section. The property is situated in a 700mm rainfall zone. The stocking rate ranges from 0 to 4 Dry Sheep Equivalents (DSE's) on the sandy soils, to 9 DSE's on the better Terra rossa soils and 11 on the remainder of the farm.

The property was purchased at auction in 1972, at which time the south-western half had been cleared and farmed, while the north-eastern section of the farm was scrub. The north-eastern section was subsequently cleared with the exception of 61ha of native shelter-belts. The cleared land was sown to pasture, with lighter country progressively planted to *Pinus radiata* and *Eucalyptus globulus*.

Originally the only farm enterprise was beef cattle, based on a Poll Hereford herd with bulls purchased externally. Over time the herd has been crossed with Simmental, Angus and Limousin bulls. Currently the herd consists of 270 breeders with progeny mostly marketed aged between 15-24months.

Farm forestry has been an integral part of the farm business since 1975 when the first plantings of Pine were undertaken. Plantings of both *Pinus radiata* and *Eucalyptus globulus* have continued at regular intervals to the present day, with a ratio of approximately 70% Pines to 30% Blue Gums for the forestry plantings.

From the mid-1980s a Merino wether flock was built up with the intention of buying in replacements, but problems arose due to imported infections and noxious weeds. In 1994, a ewe flock was established with total sheep numbers running at around 1500. Early in 1999, all sheep were sold off the property. However, Michael will eventually develop a flock of 1000 Merino wethers for reasons of diversification and flexibility in pasture management.

In addition to beef and forestry enterprises, a program of vineyard development was commenced in 1994. The vineyard program involved planting 3ha a year of selected 'Vine Improvement Society' rootstock Cabernet Sauvignon grapevines on two sites of Terra-rossa soil. Currently 16 ha of the farm is established to winegrapes, with the first vintage harvested in 1997 and all produce contracted to a major local winery. Proceeds from the Cabernet enterprise are not included within this analysis.

Objectives of the Farm Forestry Enterprise

Farm forestry has always been an integral part of the management of Boolara. Michael considers that too many farmers lock themselves into short-term commodity cycles without taking a longer-term view of the financial viability of agricultural enterprises. His overall farm business objective is to develop enterprises that have long-term stable cashflow, and farm forestry plays a significant role in achieving this objective.

Michael lists his reasons for involvement in farm forestry as follows:

- Considered as the most profitable land use on selected areas of the farm that offered poor grazing potential (the acidic sands).
- Provides diversification and offsets the traditional boom/bust cycle of agricultural commodities (different commodity cycle).
- Provides a mechanism to protect against water table salting.
- Acts as a carbon sink.
- Amenity benefits for stock grazing whilst stock exclusion from tree growing areas has not affected stocking rate on the best grazing country.
- Heavier fertiliser application possible on grazing areas.

Implementation and Management of Farm Forestry

Development of the forest resource commenced in 1975 with the planting of 32.4 ha of *Pinus radiata*. After an 8 year interval (1984), progressive plantings of approximately 20 ha a year have taken place. The total area of pines is now 174 ha. The aim of this management regime is to generate an annual income stream based on a 6-7 year thinning cycle.

The first thinning of the 1975 plantings occurred in 1987 with stems per hectare reduced from 1600 to 730. The second thinning took place in 1994 reducing stems per hectare to 470. The second thinning yielded 734 m³ of pulp, 781 m³ of saw log and 231 m³ of preservation (treated fence posts and strainers).

The 1984 *Pinus radiata* were thinned in 1996 and yielded 2200m³ of pulp in a whole tree chip operation. The most recent logging operation on 17ha of *Pinus radiata* planted in 1986 was in 1998, when the trees were thinned conventionally and yielded 137 m³ of sawlog, 1588.2 m³ of pulp and 475 m³ of preservation material. This operation contributed nearly \$45000 in net income to the farm. *Pinus radiata* planted in 1987 will be thinned in 1999.



Figure 11: 'Old and New' – 25 year old pines in the foreground with 1 year old Blue Gums behind. The vehicle is standing on an area to be planted in 1999 with *Eucalyptus globulus*.

The first planting of *Eucalyptus globulus* took place in 1992 on 13 ha of pasture land that had been grazed and fertilised for 20 years. It has shown good initial and continued growth. A second planting in 1993 of 28.3 ha was less successful due to poorer soils and a below average growing season in the first year. The latest planting of Blue Gums was in 1998 on an area of 30 ha. The total area of Blue Gums is now 71.3 ha. Michael intends to clearfall and chip both these stands at age 8-10 years. Production is forward contracted to Kimberley Clark.

Michael has a yearly planting program for shelter-belt trees. Initially this involved planting the central and southern areas of the farm in June/July using tubestock seed of native provenances. Since 1992 a direct seeding regime has been used, again with mainly native seed. With experience, this method has had increasing application particularly along fencelines where the current practice is to fence a 12 m (boom spray) width, and direct seed around September each year. There are 22 separately fenced areas of varying size. The eventual aim of having shelter-belts on every fenceline has almost been completed. Most of these shelter-belts will not be managed for commercial production; their objective is both to provide stock shelter and increase the visual amenity of the farm. However, some of the areas may be used in the establishment of *Eucalyptus* and *Cypress* woodlots. A program to retain existing old Redgums is also in place. These areas are being progressively fenced or, where possible, incorporated into direct seeded or tube stock areas.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Cornishes' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 58 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1999. The evaluation examines one rotation for each stand established before 1999 and concludes when the last stand is clearfelled.

There is considerable uncertainty inherent in defining many of the production parameters (both agricultural and forestry) and extrapolating these over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the ‘with trees’ and ‘without trees’ scenarios has come from interviews with Michael and Rosemary Cornish and consultation with local forestry and agricultural advisors.

The benchmark scenario used for comparison (‘without trees’) is the hypothetical situation in which no plantation establishment is undertaken. In other words, the scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1975. The second scenario (‘with trees’), which is compared to the baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1975. The vineyard enterprise has been excluded from this economic evaluation, as it is highly profitable and tends to obscure the impact of the trees. However, the vineyard is an integral part of the farm plan which seeks to match land capability to the most appropriate enterprises and makes highly profitable use of a valuable soil resource.

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows have been calculated for the farm on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs have been subtracted to gain a measure of gross farm income. Taxation is then calculated in each year of the analysis and subtracted to gain net farm income.

Figure 12 depicts the land use and stocking rate relationships for the farm based on the planting schedule outlined by Brian, Michael and Rosemary.

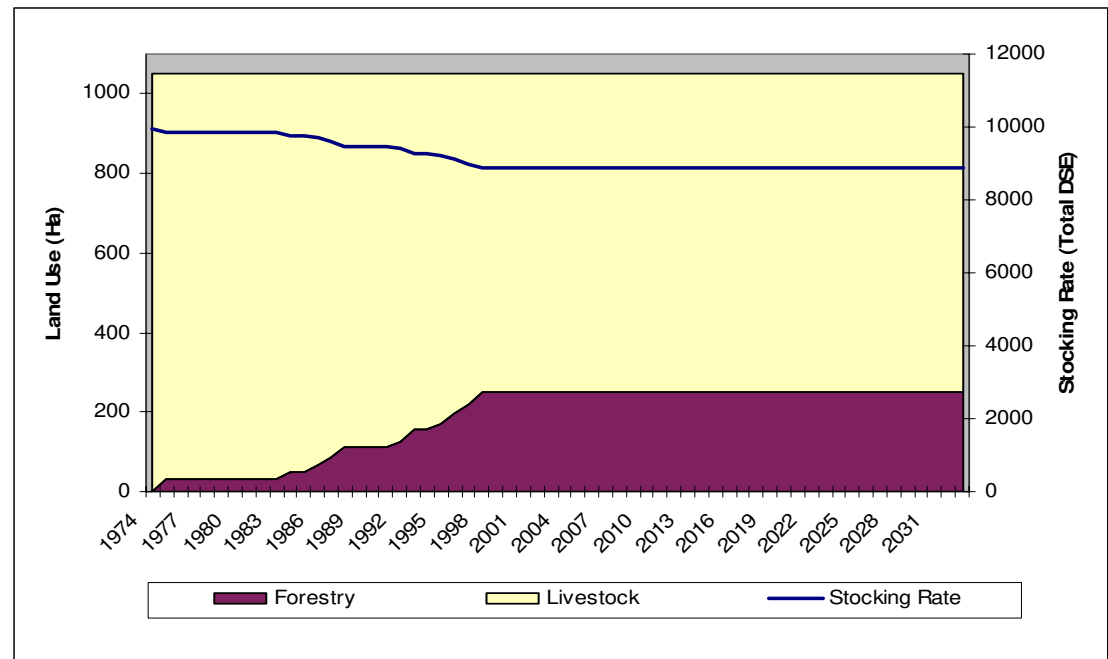


Figure 12: Land Use and Stocking Rate

The above graph does not reflect the full extent of forestry that will be planted on Boolara; it illustrates what has been established up to 1999, and does not include the 16 ha of Cabernet grapes. The produce of the vineyard is supplied under contract to wineries in the Coonawarra region. The Cornishes have focussed on developing land that had lower grazing value into a substantial forestry resource, whilst the impact on the carrying capacity of the property has been minimised.

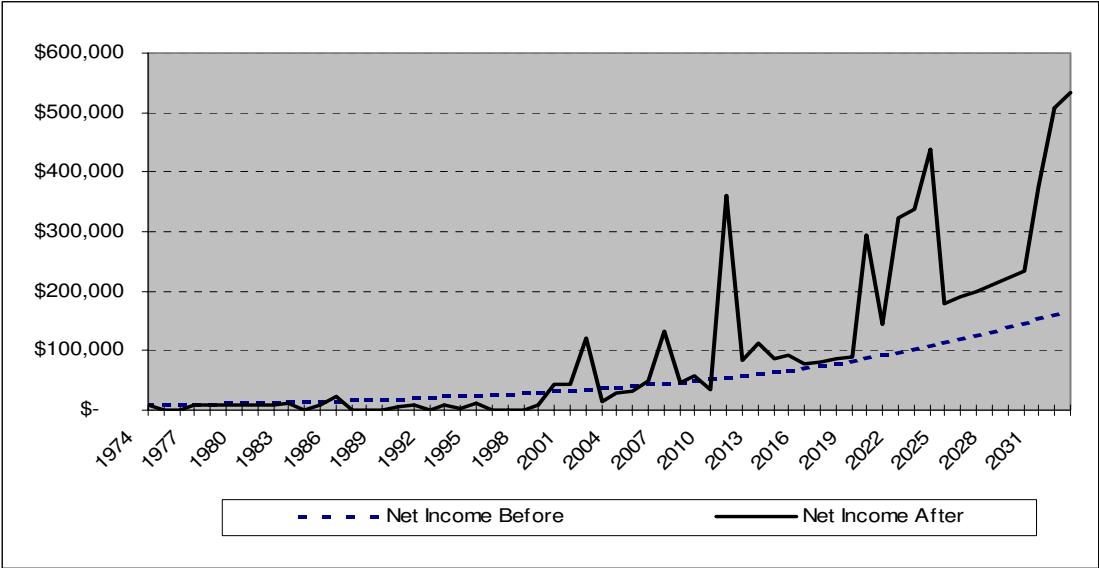


Figure 13: Farm Net Income (undiscounted) 1975-2033

Note that the cashflow without trees (the baseline) has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis. The graph illustrates relatively minor reductions in net farm income initially. However, cashflow implications become more significant between 1989 and 2000. After 2000 the income from trees begins to increase significantly. Net income is significantly above that of the 'before trees' scenario for nearly all years after 2002.

The following graph shows the scale of annual pre-tax costs and returns for the forestry enterprises.

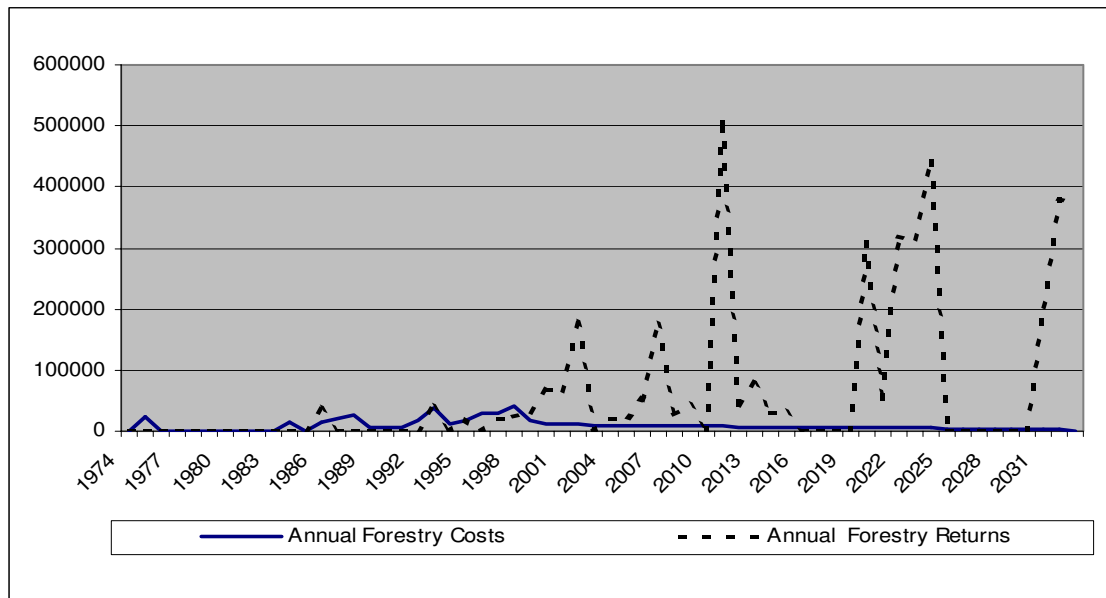


Figure 14: Annual Costs and Returns of Forestry (nominal)

The present value of the cashflow (discounted at 5%) with trees is \$665,114 while the present value of the cashflow without trees is \$504,202. This indicates that given current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, Boolara will make a significant profit (\$160,912) over the life of the project under the new multi-use scenario.

NPV is a scale dependent project summary statistic. It can sometimes be misinterpreted as its results are absolute and give no information about the 'relative' profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project, the BCR over the 58 year time frame is 2.35, indicating that for every dollar invested approximately \$2.35 will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV converts to an additional annual income stream of \$8,525 per year over the project period. The proportional increase in farm income over the 'before trees' scenario is significant at 32%.

Table 7: Project Summary Statistics

NPV	\$160,912
BCR	2.35
Annualised NPV	\$8,525
Proportional increase/ decrease in Annual Income	31.91%

The decision to develop a significant farm forestry resource is the result of both falling confidence in fibre and meat markets, and taking full advantage of distinct land management units with different production characteristics and available markets to sell forest products into. In this respect, the Cornishes' property is different from many of the properties examined as a part of this project. The availability of markets and the option to

forward contract sales of forest produce such as woodchips, before establishment of the trees, leads to a significantly reduced risk in establishing the forestry.

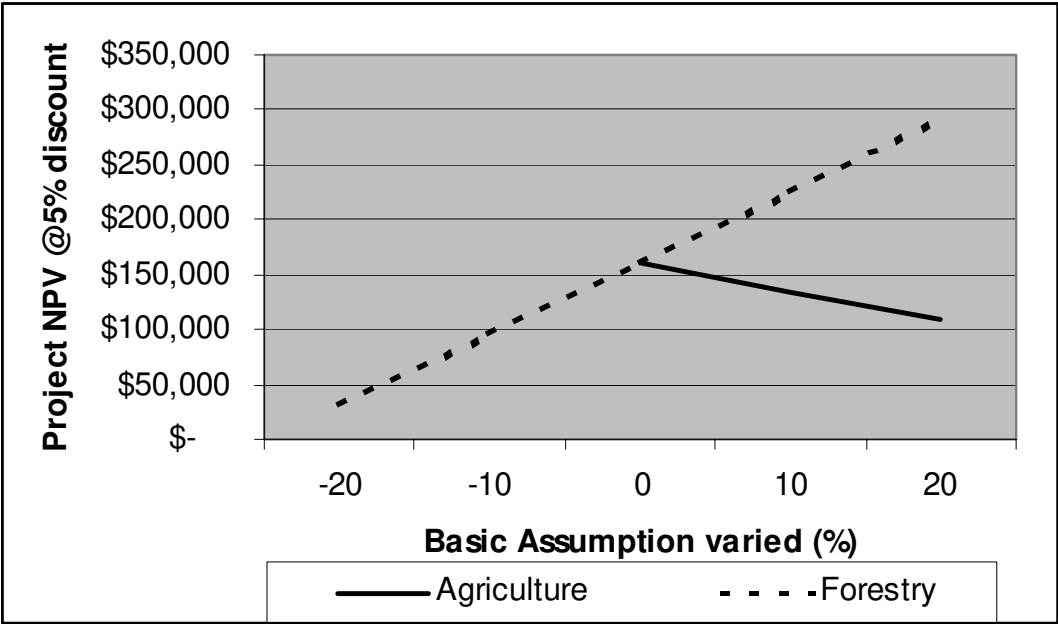


Figure 15: Sensitivity to Changes in Assumptions

The graph above indicates that project outcomes are more sensitive to changes in assumptions about forestry returns than those of agriculture. However, the project still produces a profit even if returns to forestry are 20% less than assumed (\$30,907) or returns to agriculture (which represents the opportunity cost of the land) are 20% higher than assumed (\$109,485). Under the assumptions that agriculture returns are 20% higher than assumed and forestry returns are 20% less than assumed, the project stands to lose money with the NPV falling to -\$20,799.

It must be noted, however, that Boolara is vulnerable to fluctuations in the returns received for agricultural produce. Given the returns assumed on the agricultural enterprises, even a small reduction in agricultural returns means that the farm does not generate a large enough cash surplus to avoid going into significant debt. A fall in prices for agricultural produce of more than 7% over the entire project life may be enough to bankrupt the property. Boolara has ‘weathered’ this storm now and stands to reap significant profits over the remainder of the project life. The Cornishes believe that forestry returns will increase whilst those of agriculture will continue to decrease. If it is assumed that forestry returns will be 20% higher whilst those of agriculture will be 5% lower, then the NPV of the project rises to \$179,023. Project returns are highly sensitive to changes in prices received and any increase in the assumed returns for forest products will strongly enhance the medium term economic position of the farm.

This puts the importance of the new vineyard enterprise to the farm into perspective. If it was included within the evaluation, the difference in NPV between the ‘with trees’ and ‘without trees’ scenarios would rise to \$828,266 over the life of the project, whilst the BCR would fall to 2.05 because of the high cost of establishment and management of the vines.

Breakeven calculations define the extent to which tree returns must be lower than assumed (or there are higher returns to agriculture) before the project ‘breaks even’ with the ‘without trees’ scenario, i.e. the difference in NPV for the two scenarios equals zero. Under the assumptions used for this analysis, forestry returns must fall to 75% or returns agriculture must be 1.63 times higher than assumed before the project merely breaks even.

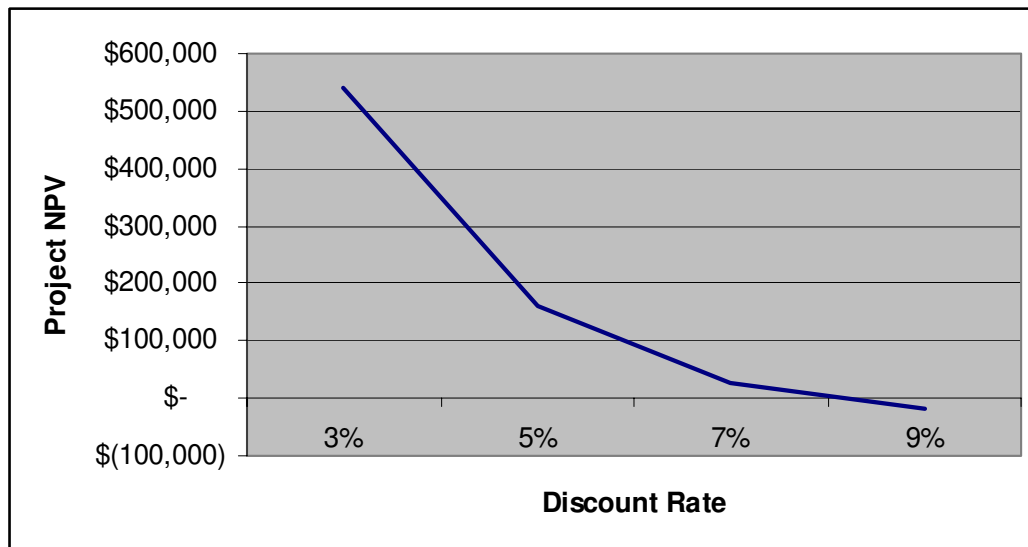


Figure 16: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make the forestry project less attractive economically because of the normal forestry pattern of costs and returns over time. The Cornishes’ farm forestry project is very sensitive to the discount rate because of the presence of *Pinus radiata*, which has a long rotation. Therefore at high discount rates, the effect of discounting income over a long time-frame reduces the real value of income from these plantings. A rate of 9% will result in a negative NPV for this project.

Table 8: Key Assumptions

Brian, Michael and Rosemary Cornish	
Area of Farm (ha)	1032
Arable Land (ha)	1032
Current Value per ha	\$1250
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1975
Timeframe	58 yr
Interest Rate on Savings	5%
Interest Rate on borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin(\$/DSE)	\$11.50
Tax Regime	Company
<i>Pinus radiata</i> MAI	17
<i>Eucalyptus globulus</i> MAI	17

Environmental Impacts

The fact that the Cornish property has no significant environmental issues that need addressing may be indicative of the positive impact of trees in the landscape. The large area of trees on the property, which includes 246 ha of commercial plantings plus significant areas of shelter-belt plantings, serves to protect against the rise of saline groundwater tables and associated salting problems. At the same time, shelter-belts and commercial plantings provide habitat for birds, protect soils from wind and surface water erosion, and provide shelter for stock.

A potential resource management issue on a regional scale, which may pose a problem in the future, is access to groundwater. There is increasing competition for this resource from many agricultural pursuits, and some farmers are concerned that the high water use of trees may lead to restrictions on plantation activities or irrigation opportunities for landholders.

Although land degradation issues do not currently threaten agricultural productivity on Boolara, it is possible that over the 58 year project period that these may appear. A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting prevents an assumed decline in land resource productivity. It was assumed that a 10% decline would accrue over the 58 years of the project under the 'without trees' scenario. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$160,912 to \$185,828, an increase of nearly \$25,000. It can be seen that any positive impacts of the trees on adjoining agriculture will have a strong impact on the profitability of the farm over the medium /long term.

Social Impacts

The social impacts of farm forestry include the impacts on relationships within the immediate family as well as the impacts on relationships with the broader community.

Michael sees his involvement in farm forestry as a means of guaranteeing a relatively risk free income well into the future. This in turn allows a much greater flexibility in succession planning for the family. He also states that on recently turning 40, he was more highly motivated to 'get things in order' on the property. His motivation is to be able to 'hand something on to the children'.

While Michael suggests that trees started as a hobby for his father Brian, they have grown to become the backbone of the farm business. Michael also enjoys associating with people in the forestry industry because they tend to think and plan for long-term goals and objectives.

From a community perspective, the forestry industry has a strong local presence, with several large sawmilling companies based in the region. Michael sees his efforts in private forestry as helping to promote the industry to other landholders. Brian, Michael and Rosemary won the 1998 Stihl Tree Farmer of the Year award. Michael is also involved as a committee member of the Green Triangle branch of Australian Forest Growers (AFG) as the Green Triangle AFG Committee member. He has organised several farmer and community group tours of the property, and has helped to arrange

conferences and meetings for the AFG. Brian Cornish is the State President of the AFG and a National Councillor.

Summary and Lessons Learnt

One of Michael's key messages is the need for farmers to adopt a much longer-term view of the management of their properties. He sees farm forestry as providing a viable method of achieving a reasonably secure, long-term cashflow for the farm enterprise.

The Cornishes' differ from other case studies undertaken because they have contracts in place for many of their commercial plantations. This provides a huge amount of security for future planning. The proximity and diversity of the local timber industry is an obvious advantage due to the security of markets. It highlights the importance of secure markets for farm forestry products to encourage other farmers to become involved.

Another highlight of the Cornishes' farm forestry enterprise is the way plantings have been specifically targeted for land that has the lowest opportunity cost. This ensures that economic benefits are maximised from the tree plantations. The environmental benefits of the trees in providing shade and shelter to stock, in addition to wildlife habitat and amenity benefits, enhance the overall positive impacts that farm forestry is having on the Cornishes' property.

Case Study 3

**Andrew and Jill Stewart
'Yan Yan Gurt West'
Deans Marsh, Vic**



Figure 17: Location of Case Study Site

The Farm

The Stewarts' farm, 'Yan Yan Gurt West', is situated just outside Deans Marsh, approximately 60 kms south west of Geelong in the South West region of Victoria, bordering the Otway Ranges. The majority of the 230 hectare property is gently undulating with some steep slopes and small areas of alluvial flats. The hills are formed on tertiary clay, silt and sand which have been deeply weathered leaving fine sandy clay loam surface horizons overlaying clay. These soils are inherently low in fertility and in this land system are listed as being of weak structure and prone to sheet erosion; tests performed by Ag-plus early in 1991 showed good structure and stability, possibly owing to the well maintained perennial pastures. In contrast the clay loam flats are quite fertile. These recent alluvial deposits are obvious along the valley floor where the Yan Yan Gurt creek and its tributary have cut channels through the soil profile. High discharge rates, dispersible clay soils and dispersible sandy clay parent material of low mechanical strength lead to gully and tunnel erosion. The average annual rainfall is 700 millimetres.

The Stewart family originally purchased the property in 1905. Andrew and Jill Stewart currently farm Yan Yan Gurt West in partnership with Andrew's parents Lindsay and Margaret Stewart. Andrew's siblings also have a financial interest in some of the timber plantations on the farm. Farm enterprises include prime lambs, wool, beef cattle and commercial timber. The property carries an average of 18 Dry Sheep Equivalents (DSE's) per hectare. The farm runs prime lambs from 1500 crossbred ewes and vealers from 65 Angus-Hereford cross cows.

The farm is fairly typical of the region. Depressed prices for agricultural commodities in recent times have forced farmers to attempt to increase productivity of existing enterprises, and to search for viable complementary enterprises to ensure long term cashflow.

Agroforestry is not uncommon in the region, with several Radiata Pine (*Pinus radiata*) and Blue Gum (*Eucalyptus globulus*) plantations situated on properties in the surrounding area, as well as a fairly active Agroforestry Network. Andrew is the coordinator of the Otway Agroforestry Network, which assists farmers in the broader Otway region to incorporate commercial trees into their farming systems.

The Yan Yan Gurt Creek flows through the Stewarts' farm and a number of other properties in the catchment. A Landcare project to revegetate the creek line has drawn a number of farming families in the community together and raised their interest in integrating trees into the farming landscape.

Objectives of the Farm Forestry Enterprise

Andrew has a favourite saying that he likes to give to the many tour groups that visit his farm: 'Agroforestry can turn land management problems into solutions which create environmental stability and commercial opportunity'. The farm planning and plantings that Andrew and Jill have carried out reflect this philosophy.

In 1992, the Stewarts embarked on a whole farm planning process to address issues of land degradation and declining productivity that had begun to arise after years of 'traditional' farm management. One of the first steps in the planning process involved

identifying the different land management classes on the property, and as far as possible realigning paddock boundaries so that they only contained one land type.

Integration of trees into the farming landscape is one of the key strategies used to address the management challenges that were identified in the planning process. The management challenges facing the farm were:

- growing salt areas;
- soil erosion from surface water run-off;
- gully erosion along the creek line;
- lack of shade and shelter for stock;
- lack of ecological balance;
- lack of land class subdivision;
- paddocks too big to allow the desired grazing control for stock and pasture management.

Trees were planted for shelter, erosion and salinity control, commercial timber to enhance property value, aesthetics and to create habitat for wildlife. The long-term view was 'to achieve sustainable production and to develop income security with commercial trees playing an integral role as superannuation' (NRE, Vic. 'AGUPDATE', No.10. Dec. 1997).

Implementation and Management of Farm Forestry

The first Blue Gum plantations were established in 1993, and comprise 8 ha in a joint venture planting with Midway Wood Products, Geelong, Vic. Andrew negotiated with the company to allow strip plantings rather than block planting which is the normal commercial practice. The Blue Gums were planted on the 'break of slope' on the southwest side of the paddocks to intercept water run-off from the hills. The aim was to provide shelter, reduce pugging of soils and control salinity. To achieve maximum shelter protection across the paddock, the trees are planted in strips approximately 250 metres apart. Each strip planting ranges from 7 to 12 rows wide, with 3 metres between rows and 2.5 metres between trees within a row. Andrew points out that landholders would have to be prepared to negotiate with forestry companies to allow planting in a similar configuration now.

Because Andrew's trees were part of a pilot program of joint venture plantings in the region, the company was willing to be more flexible in negotiating the planting configuration in order to gain a presence in the locality. Despite this, Andrew firmly believes that farmers need to be more forceful in dictating the planting configurations used in joint venture projects. This is the only way to ensure that plantings match the desired farm planning layout.

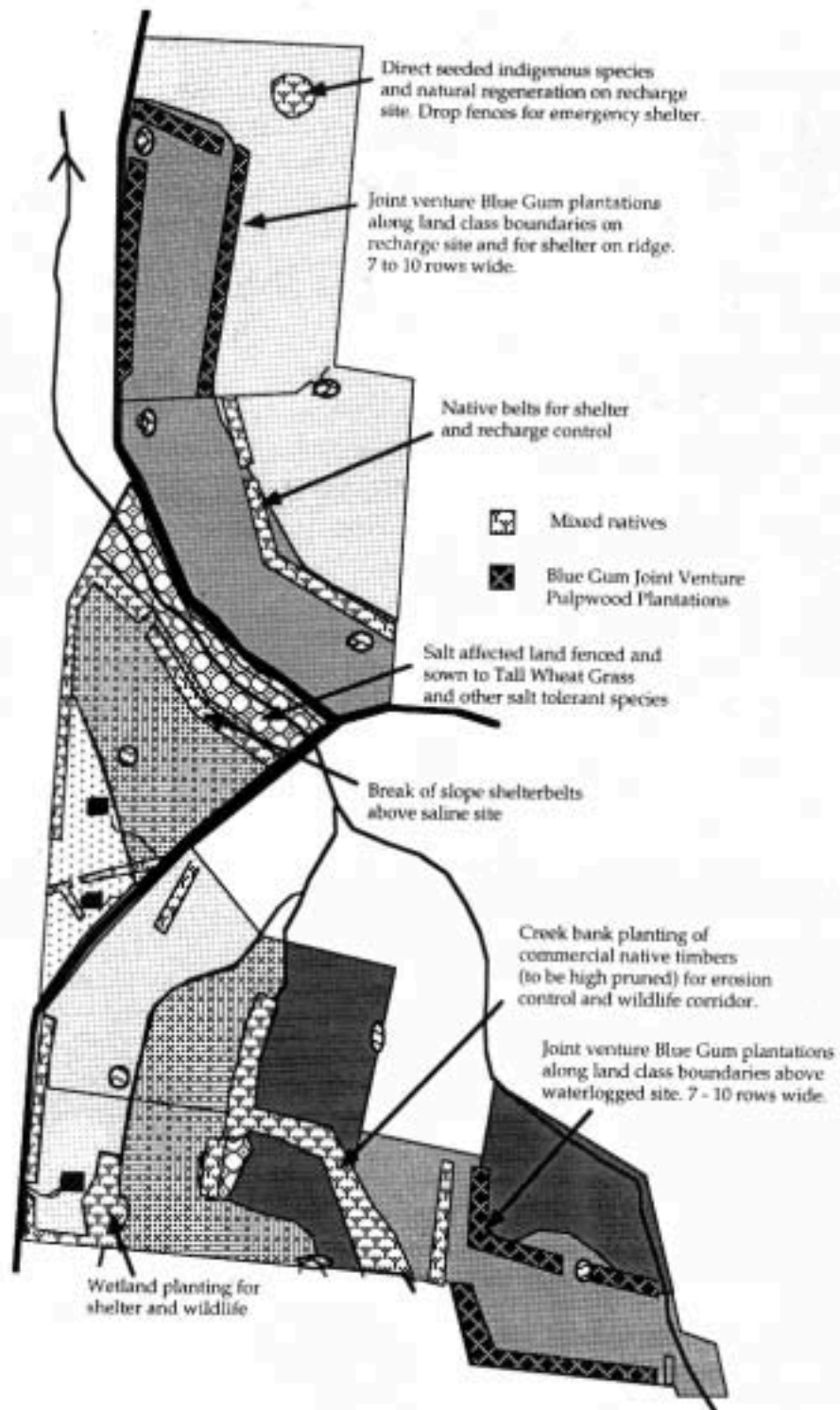


Figure 18: Farm Plan for Yan Yan Gurt West. Several plantings have been added to this plan since it was published in Rowan Reid and Andrew Stewart's book 'Agroforestry: Productive Trees for Shelter and Land Protection in the Otways'.

The Blue Gums are contracted for one harvest in 2005-2008 (age 12-15), but coppicing may allow a second and even third harvest at age 28 and 40 respectively. Andrew's choice to coppice or replant will depend on the availability and cost of improved genetic stock. Obviously any improvements in yield will need to be balanced against the cost of

re-establishment that will be required if replanting is chosen. The second rotation is not included within this evaluation.

The second multipurpose forestry planting was established in 1994, and consists of wide-spaced Shining Gum (*Eucalyptus nitens*) along the Yan Yan Gurt Creek. These have been planted in pairs on a 5 m by 6 m grid. At 18 months the poorest tree in each pair was culled. Andrew plans to prune the trees to six metres for quality saw-log production. Other species for commercial production include *Acacia melanoxylon*, *Eucalyptus globulus* and *Corymbia maculata*. Habitat trees and shrubs have also been planted along the creek bank to assist in the prevention of bank erosion and to provide wildlife corridors. Trees and shrubs planted include various Acacias, Tea Trees (*Melaleuca spp.*), She-Oak (*Casuarina spp.*), Bottle Brush (*Callistemon spp.*), local Eucalypts and Sweet Busaria, some of which will also be managed to produce high quality sawlogs. Forty species have been established along the creek in order to enhance biodiversity and other conservation values.

The third multi-purpose planting consists of four one hectare blocks of Radiata Pine (*Pinus radiata*) which will be pruned to six metres for high-quality saw-logs. The planting consisted of aged cuttings planted in rows four metres apart with three metre spacings between trees within rows. These plantings are situated along the creek line (to provide soil erosion control) above a wetland; and along the 'break of slope' to maximise shelter; and reduce saline recharge.

The other type of tree planting technique used on the farm, is direct seeding around a 2 hectare patch of remnant Messmate (*Eucalyptus obliqua*). This was done in 1992, and has proved extremely successful in improving shelter and wildlife habitat. This involved a total of 3 kilometres of direct seeding using 1.5 kg of seed and 19 different tree and shrub species. The patch is now used as emergency shelter for off-shears or lambing ewes.

This evaluation examines the impacts of 21.75 ha of revegetation that has been established to achieve multiple objectives of positive environmental and commercial outcomes. In total the Stewart currently have 25.9 ha established (or 11%) of the farm. By the time the whole farm plan is fully implemented in 2005, 32.2 ha or 14% of the farm area will be revegetated.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Stewart's farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 36 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 2000. The evaluation examines one rotation for each stand established before 2000 and concludes when the last stand is clearfelled.

There is considerable uncertainty inherent in defining many of the production parameters (both agriculture and forestry) and extrapolating these out over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the scenarios has come from interviews with Andrew and Jill, consultation with

Andrew's brother Hugh who is a professional forester, Peter Stephens from the Melbourne University School of Forestry and local forestry and agricultural advisors.

The benchmark scenario used for comparison is the hypothetical situation in which no plantation establishment is undertaken ('without tree' scenario). In other words, the scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1993. The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1993 ('with tree' scenario).

Economic Impacts

The economic impact is assessed using a spreadsheet-based model. The model compares farm Net Income with and without the forestry enterprises. To do this, enterprise cashflows for the farm have been calculated on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs have been subtracted to gain a measure of gross income. Taxation in each year of the analysis is calculated and subtracted to calculate net farm income.

Figure 19 illustrates the land use and stocking rate relationships implied by the revegetation program implemented on Yan Yan Gurt West. Although the Stewarts will continue to establish suitable areas to trees, these are not reflected within this analysis.

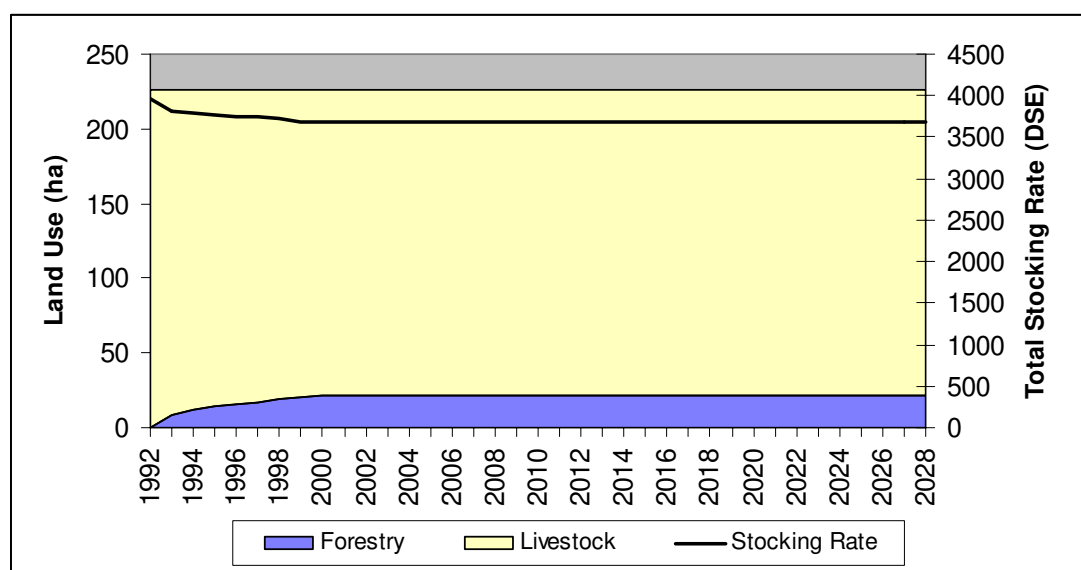


Figure 19: Land Use and Stocking Rate

The farm has been within the Stewart family since 1905. Andrew's father was one of the first farmers in the district to begin replanting trees. The farm plan has concentrated on implementing a multi-objective revegetation strategy for the property.

Plantings are in a wide range of configurations dependent on their main purpose. Andrew's brother Hugh has made a valuable contribution to plantation design. Bluegum woodlots have been established in a wide shelterbelt configuration designed to intercept waterflow onto seasonally waterlogged land. Creeklining plantings are multi-species, with understory and crop trees being managed for sawlog production. Several of the plantings have been carried out to exploit wet 'niche' areas within the landscape, with a

view to securing higher growth rates, as well as reducing recharge to developing saline flats.

Stocking rates within areas that are now planted to multiple species for conservation and economic reasons, are assumed to be significantly lower than on the rest of the farm. Some grazing within the established trees has been accounted for throughout the life of the rotations although the economic impact of this is minimal. Stocking rates within the remainder of the stands are assumed to be the same as on the rest of the farm.

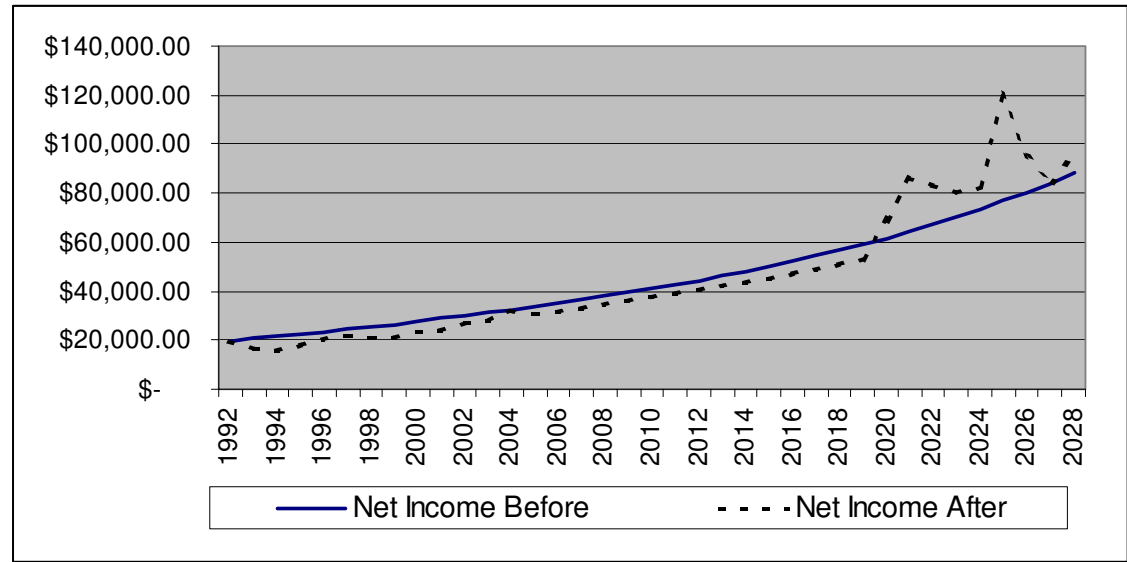


Figure 20: Farm Net Income (nominal) 1992-2028

Figure 20 above shows the income flow over time for the ‘with trees’ (net income after) and ‘without trees’ (net income before) scenarios. The graph of net income above illustrates the financial impact of farm forestry on the farm. Andrew believes that the benefits in productivity for the rest of the farm will more than compensate for the opportunity cost of the land occupied by trees. The graph shows a decrease in income over the majority of the project.

Note that the cashflow ‘without trees’ has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each strategy is included within the analysis, leading to the upward trends of the graph.

Figure 21 illustrates the annual costs incurred and income returned by the forestry enterprises to the farm.

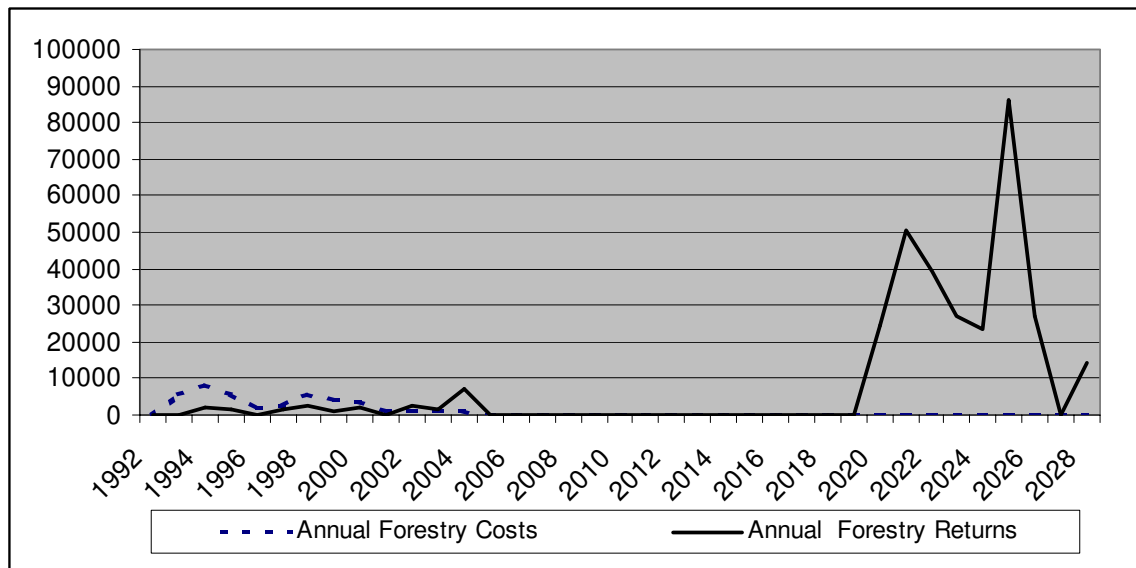


Figure 21: Annual Forestry Costs and Returns (nominal)

The present value of the cashflow (discounted at 5%) with trees is \$575,987 while the present value of the cashflow without trees is \$607,000. This indicates that given current agricultural and forestry price and production assumptions, the farm forestry investment will yield a loss over the term of the project (difference in NPV of -\$31,013, discounted at 5%). In annual terms, this loss equates to a reduction in annual income of \$1874 or 5% of income.

Whilst these values may be significant, the analysis does not account for other ‘external’ economic benefits that Andrew strongly believes will accrue to the farm. He states that ‘integration of trees into the farming system for multiple benefits is part of the risk management strategy. If some of the commercial trees don’t realise their predicted commercial value all is not lost, in their lifetime the trees have provided other important values to the farming system and catchment. If some of the commercial trees are not harvested, they will continue to provide benefits to the farm because of plantation design.’

Reduction in future levels of salinity and increased shelter for pregnant ewes and young lambs will both lead to cash benefits which are not reflected within this analysis due to lack of data. Because of Andrew’s strong belief in the positive external benefits of the trees to the rest of the farm, a basic degradation scenario was modelled. This involved an assumption that without trees, farm productivity would decrease at an annual rate of 0.27% in each of the 36 years of the analysis (i.e. a cumulative straight-line reduction over time of 10%). When incorporated within the evaluation, the difference is enough to turn the project from a loss making situation to one in which a significant profit is attained. Project NPV increases by \$53,000 to \$24,731.

The whole planning process and tree establishment process is explicitly focussed at ‘adding value’ to the adjoining agricultural land uses. Andrew’s pasture and sheep

management will make use of shelter provided by trees. This direct benefit combined with likely impact such as reduction of production loss to secondary salinity and waterlogging should confer benefits at least equal to those assumed here. Therefore it is likely that the economic value of environmental benefits accruing to agriculture will lead to a positive economic outcome at the whole farm level even though the projects viewed in isolation are not profitable.

NPV is a scale dependent project summary statistic. It can sometimes be misinterpreted as its results are absolute and give no information about the 'relative' profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project the BCR over the 36 year time frame is 1.31, indicating that for every dollar invested approximately 1.31 will be returned by the end of the project period. A negative NPV is not associated with a BCR in excess of one as is the case here. The reason for the conflict between the BCR and NPV is the impact of taxation on the income flows which occur from the trees (i.e. large income flows in years that stands are clearfelled). The NPV is presented after tax and states that the investment is unprofitable, whilst the BCR used here is calculated before tax and shows a profitable project (at a discount rate of 5%).

It is not possible to predict how the new proposed tax system incorporating a GST and reduced marginal rates will affect the project. However, the results of our analysis clearly highlight the need for good tax planning in relation to income flows from forestry investments.

Table 9: Project Summary Statistics

NPV	(\$31,013)
BCR (this value is an anomaly of the tax treatment)	1.31
Annualised NPV	(\$1,874)
Proportional increase/ decrease in Annual Income	-5.11%

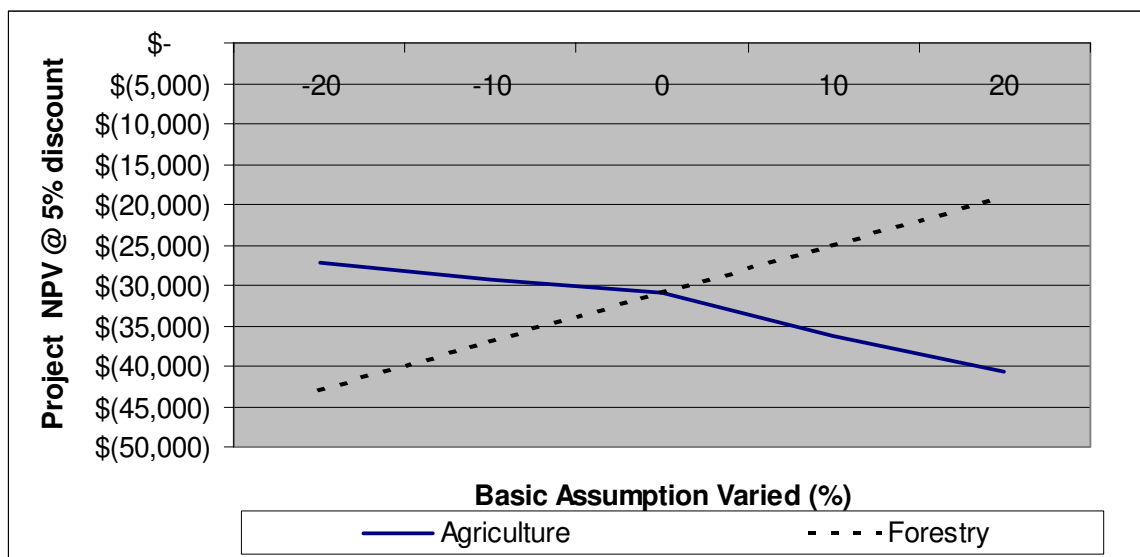


Figure 22: Sensitivity to Changes in Assumptions

Figure 22 shows that, under the assumptions made within this analysis, neither a large decrease in agricultural returns, nor an increase in forestry returns will yield a profit for the project.

Table 10: Key Assumptions

Andrew and Jill Stewart	
Area of Farm (ha)	230
Arable Land (ha)	230
Current Value per ha	\$3700
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1993
Timeframe	36 yr
Interest Rate on Savings	5%
Interest Rate on borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin(\$/DSE)	\$12.47
Tax Regime	5 year Averaging
<i>Eucalyptus globulus</i> MAI	12
<i>Pinus radiata</i> MAI	17.7
Creek planting MAI	12.6

Environmental Impacts

The environmental benefits of integrating trees into the farming landscape have been one of the driving forces behind the Stewarts' farm planning over the last few years. The aesthetic impact of tree plantings is most pronounced, especially along the Yan Yan Gurt creek line. The creek line was severely degraded with gully erosion, resulting in significant silt loading during times of high water run-off. The lack of tree and shrub cover along the creek line also allowed substantial nutrient loading from surrounding paddocks. Tree planting and fencing off stock along the creek line has practically halted any erosion, while tree planting on slopes further away from the creek has helped to control damaging effects from surface and groundwater movement.

The preceding section describes the economic evaluation of potential environmental impacts. Because of the way in which multiple objectives have been considered in the whole farm plan, actual economic benefits of the revegetation will probably be strong enough to yield a significant profit to the project when viewed at the whole farm level.



Figure 23: Before and after photos of the creekline revegetation before establishment and after 5 years of growth

Shelter effects of plantings have improved pasture productivity. Andrew states that the drying effects of October winds have been significantly reduced due to the shelterbelts that are now in place. Increased water use by trees planted strategically in the landscape should help to reduce the rise of saline groundwater. This in turn should help manage the salinity problem that was emerging over 10 ha of saline flats on the property.

The Stewarts have participated in a pilot program ‘10 Steps to Environmental Beef Farming’. The program benchmarks their current performance against 10 indicators of environmental sustainability. The 10 general indicators include:

- Big Picture – understanding general issues and interactions
- Soil
- Water
- Pasture
- Chemicals
- Tree cover
- Minimising pollution
- Resource/Energy use
- Whole farm planning/Environmental management planning
- Becoming more sustainable

Each general indicator has a subset of specific indicators which are scored and aggregated to give an overall rating against the general indicator. In turn, the general indicators are aggregated to give an overall rating for the farm. On a scale of 1 to 10, with 10 being the highest score, the current overall Environmental Sustainability Benchmark stands at 8.3.

Social Impacts

The social impacts of farm forestry, include the impacts on relationships within the immediate family as well as the impacts on relationships with the broader community.

Within the immediate family, the impacts of involvement in farm forestry have been very positive. Andrew and Jill, along with their parents Lindsay and Margaret, have a firm belief in environmentally sustainable management of the property. Andrew’s father, Lindsay, was one of the first farmers in the area to plant trees for windbreaks, as far back as the late 1960s. The family is obviously happy with the dramatic change to the farm landscape that has occurred over the last few years since implementation of the farm plan began. During pruning, tree planting and other activities, the extended family joins in for the day’s work on the farm and a chance to escape ‘the rat race’, often enjoying a barbecue at the end of the day. In this way farm forestry has had a positive impact on family relationships. Andrew’s siblings also have a financial interest in some of the commercial plantings.

From a community viewpoint, farm forestry on the farm has allowed a significant interaction with the broader community. Andrew is coordinator of the Otway Agroforestry Network. A number of field days are hosted on the property each year. This allows for broad interaction with the community. The Yan Yan Gurt Creek line revegetation project has also provided the opportunity for other farms, school groups and work scheme participants to become involved with the farm.

Summary and Lessons Learnt

The Stewarts have adopted a holistic approach to management of their property, with a long-term objective of developing an ecological balance on the farm. Integration of trees back into the farm landscape forms the main thrust of this strategy.

The case study illustrates that, with careful planning, it is possible to achieve both environmental and economic benefits from integrated tree planting in a reasonably short time frame. The environmental benefits of the tree plantings are already obvious, with shelter-belts providing added flexibility to lambing times, and pasture management. Whilst the economic analysis suggests that the long-term economic impact is not so positive, the evaluation is simplistic and cannot capture all of the benefits that will accrue to the farm. Limited modelling of land degradation suggests that modest assumptions about the ability of trees to prevent declining productivity of the land resource have the potential to ‘turn this project around’ in economic terms.

Despite the long term requirements of land use planning for land conservation objectives, it is difficult to escape the economic realities associated with planting trees on land that has high value in an agricultural land use. Whilst the land stewardship ethic of many farmers (including the Stewarts) would make it difficult to allow land to degrade over the long term, the strategy to address productivity decline should be evaluated extensively. This includes an assessment of the short to medium term economic costs and benefits of implementing the strategy.

Case Study 4

**Ian & Rosemary Dickenson
'Elverton' & 'Old Whisloca'
North Esk Valley, Blessington
Tasmania**



Case Study 4: I & R Dickenson

Figure 23: Case Study Site

The Farm

‘Elverton’ and the adjoining ‘Old Whisloca’ properties are located in the North Esk Valley in Tasmania, 35 kms north east of Launceston. Elverton Pastoral Pty Ltd. manages the properties, while Ian and Rosemary are the principals of this private company. The properties support mixed grazing, cropping and forestry enterprises over a total area of 2082 ha. They are 400m above sea level and receive an average annual rainfall of 850 mm. The soils on each property include a proportion of river alluvial soils, grading back to slopes and foothills made up of sandy loams and shales.

‘Elverton’ was purchased in 1969, at which time it consisted of run down pastures and heavily cut over native forests. During the mid-1970s, the Dickensons embarked on a long-term program of whole farm planning and farm forestry to achieve a vision of more sustainable management. This vision has been carried over to the ‘Old Whisloca’ property, which was purchased in 1989.

The program for sustainable management is based on the principles of Holistic Resource Management and is implemented through a whole farm planning process. The program focuses on achieving maximum production from the farm grazing, cropping and forestry enterprises through sustainable and integrated management of the farm’s resources.

Table 11: Property Enterprise Summary

Total Area	2082 ha
Native Forest	730 ha
Plantations	21 ha
Annual Cropping	250 ha
Grazing	1081 ha
Cattle:	
800	Simmental x breeding herd
730	Sim x calves
250	Replacement heifers
18	Simmental S.H. and Angus bulls
Sheep:	
1500	Merino ewes
1150	Merino weaners
850	Merino wethers
Deer:	
250	Mixed sex
Average stocking rate	15.6
Crops grown	Canning peas, poppies, malt barley, oats, seed potatoes.

Objectives of the Farm Forestry Enterprise

Ian states that the key principles of management for the two properties include:

- Holistic approach to resource management.
- Aiming for a balance between social, economic and environmental issues within the community.
- Ensuring the protection of native vegetation, soils and water quality.
- Implementing quality assurance systems to underpin Tasmania's clean green image.
- Ensuring the business is structured to maximise financial flexibility in times of low commodity prices.
- Aiding in the education of the next generation.

In keeping with these principles, and through his personal experience of managing farms over the last 30 years, Ian has developed a firm belief that farm forestry deserves greater recognition as a viable enterprise for farmers aiming for sustainable profitability. As such, Ian has been highly active in promoting farm forestry to both the farming and broader communities. His involvement includes membership of a number of State and National committees and advisory boards related to the promotion of Private Farm Forestry. More recently, he has been involved in the 'adopt a farm' program, which involves 4-5 visits a year from an urban school that has 'adopted' Elverton. The aim of these visits is to allow school children to learn more about the rural lifestyle and farming in general. Ian and Rosemary were awarded a National Landcare Award in 1998 for their implementation of landcare principles on the farm.

The principal objective of farm forestry has been to assist in the diversification of the farm income, especially in times where prices for other agricultural commodities are depressed. In addition, trees (native, plantation and shelter-belts) have been integrated into the physical layout of the property and are managed to provide maximum environmental and aesthetic benefits. The properties are both situated in the catchment for Launceston's water supply. Consequently, the impacts of forest and plantation management on water quality and nutrient run-off are a primary consideration on the property.

Implementation and Management of Farm Forestry

In 1969, when 'Elverton' was purchased, only 200 of the 1600 hectare property was cleared for agriculture, the rest being native forest which had been heavily cut over for sawlog production. When Ian commenced management of the forests at 'Elverton' in 1972, the principal objective was clearing native forests for conversion to a viable area of agricultural land with the sale of timber products (saw and pulp logs) as a by-product of this process.

To achieve this, Ian entered into a contract with a local wood-chipping company to supply 10,000 tonnes of pulpwood at 50c/tonne. He also sold any sawlogs that were collected in the process to local sawmills. In the first year, the company contractor harvested 200 m³ of sawlog and 11,000 tonnes of pulpwood. Ian was not impressed with the conversion ratio between sawlogs and pulp, and was unhappy with the general 'mess' left behind by the contractor. To overcome this, he decided to take over the harvesting contract himself. This resulted in an increased yield of sawlogs and a greater flexibility in planning areas to be left for wildlife corridors and shelter.

Ian reduced the contracted amount of pulpwood to 5000 tonnes annually. The following year he harvested 834 m³ of sawlog and 5000 tonnes of pulpwood. Elverton Pastoral carried out marketing and transport of sawlog. Ian continued logging in this manner for 8 years (3-4 months a year) before returning to the originally harvested areas to clean them up for conversion to agriculture.

In 1976, the fall in cattle prices forced Ian to contract harvest off-farm to supplement his cashflow. It was at this time that he began to realise the importance of establishing and maintaining commercially valuable timber species on the property to help diversify future farm income sources. In the same year, he became involved with the Forestry Committee of the Tasmanian Farmers and Graziers Association and embarked on a program of replanting four hectares of the farm to *Pinus radiata* per year. He got two years into this program, planting two blocks of four hectares before stopping. The decision to stop the program was based on a general opinion at that time in Tasmania that there was a high degree of uncertainty in Pine markets as well as a risk of oversupply from other states and countries.



Figure 24: Fence posts thinned from the *Pinus radiata* plantation for use on the property

He didn't resume his replanting program again until 1990, at which time he planted 13ha of *Eucalyptus nitens* in a 50 metre wide shelter-belt configuration which will eventually be harvested for pulp.

Since 1985, Ian had been looking to harvest native forest on the property to enable conversion to Pine and Bluegum plantations but was never happy with the prices on offer for sawlog and pulp. He was able to contract with a local mill to receive a reasonable 'average price' for all products (i.e. sawlog and pulp). This continued for 18 months delivering approximately 300 tonnes per week to the mill before payment problems arose and the contract ceased.

Currently there are 650 hectares of native forest on 'Elverton', comprising one 250 ha block that is currently being harvested and which will eventually be developed back to 200 ha of plantations using both hardwood and softwood species and 50 ha of sheltered grazing doubling as firebreaks. The second 400 ha block will be managed sustainably for production of sawlogs.

In summary, Ian's objective is to manage the forests on his property to improve the long-term financial and environmental benefits. This management began with harvesting native stands for conversion to cleared agricultural land but has progressed to conversion of some native stands to plantations of species with higher economic value. In addition, strategic landcare plantings of trees have been undertaken for stock and crop shelter as well as for water erosion prevention and aesthetic benefits.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Dickensons farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 40 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1999. The evaluation examines one rotation for each stand established before 1999 and concludes when the last stand is clearfelled.

There is considerable uncertainty in defining many of the production parameters (both agriculture and forestry) and extrapolating these out over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the 'with trees' and 'without trees' scenarios has come from interviews with Ian and Rosemary and consultation with local forestry advisors.

The benchmark scenario used for comparison evaluates the farm incomes as if land currently occupied by plantations had continued within a grazing enterprise, and no harvest of the native forest had taken place. The 'with trees' scenario evaluates farm income after (not including) original clearing activities but includes plantation establishment and the current harvest of 250 ha of native forest for production of pulpwood and sawlogs. Development of this area back to mixed grazing/ plantation configuration is not included.

To analyse social and environmental impacts it is necessary to rely on anecdotal evidence, since there have been no specific attempts to monitor impacts over time.

Economic Impacts

The economic impacts are assessed using a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm have been calculated on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs have been allocated to enterprises as appropriate. Annual cashflow is presented net of tax.

This analysis is somewhat different from others in this series due to Elverton Pastoral's involvement in logging and the associated costs involved with this activity. The company is paid a price premium on products loaded onto trucks to reflect the effort expended in harvesting and processing the timber. To balance this, all proceeds for the sale of forest product harvested from native forest are reflected in the cashflow at prevailing market 'stumpage rates'.

Figure 25 depicts the land use over time for the farm based on the planting schedule outlined by Ian.

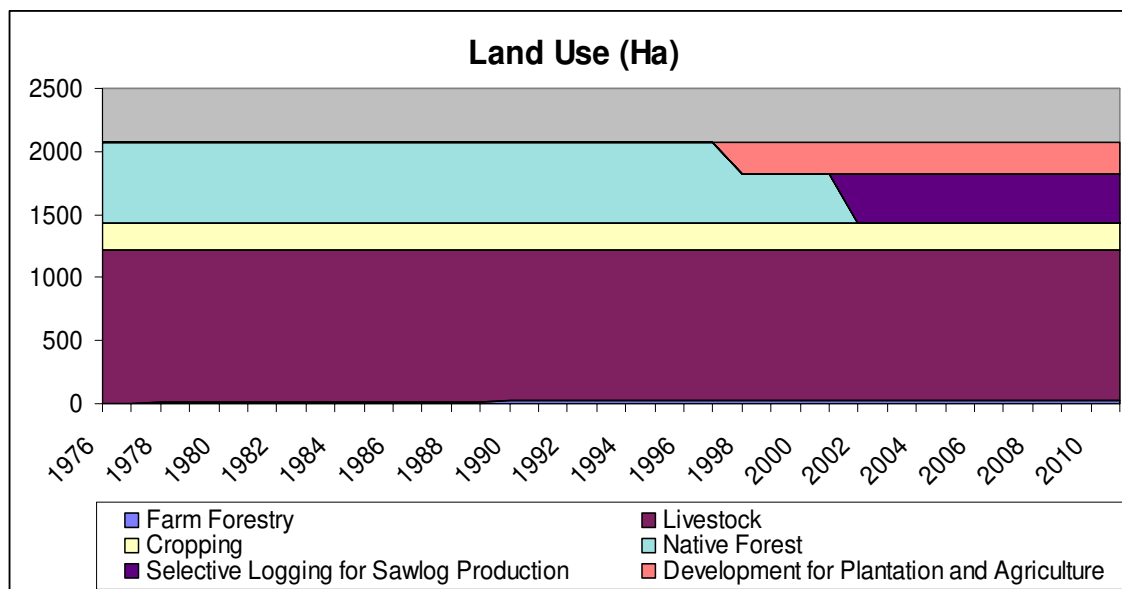


Figure 25: Farm Land Use.

To date, actual plantation establishment on the farm has been small compared to the area being farmed, but future development of a significant plantation estate including both hardwood and softwood species is part of the farm plan. Income from harvesting the native forest is included in the farm cashflow over four years between 1998 and 2001. Income from these future plantations is not included as the areas on which they will be established are currently being harvested and will not be developed for some time.

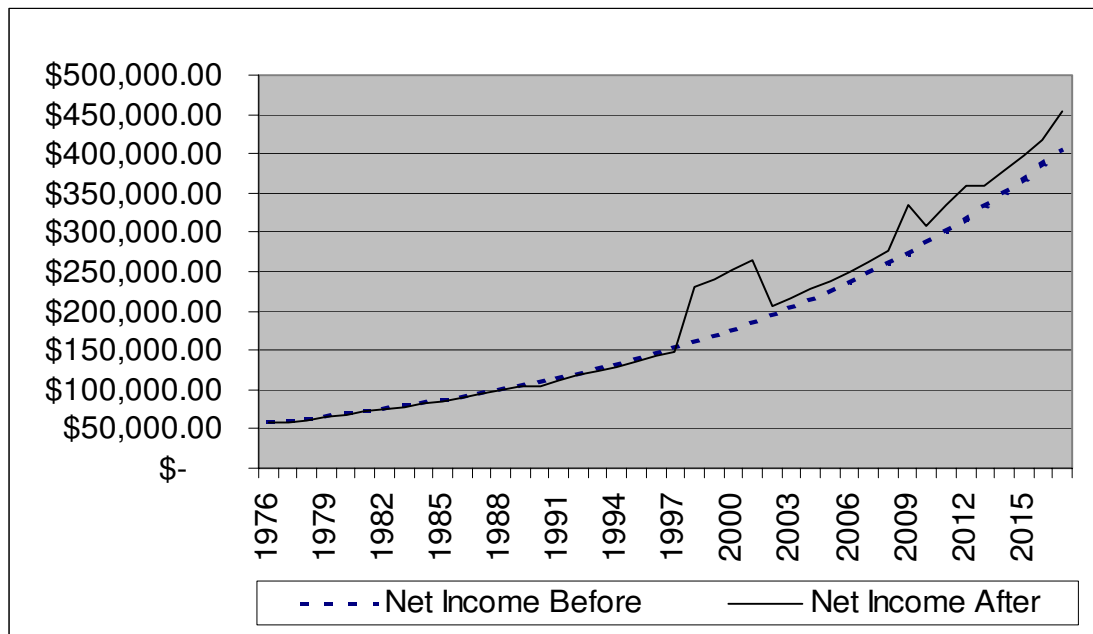


Figure 26: Farm Net Income (undiscounted) 1976-2017

Figure 26 displays net farm income with and without the forestry. Note that the cashflow without trees has been estimated as an average annual income, which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis. The graph above illustrates negligible reductions in income initially as the scale of establishment is minor compared with the overall size of the farm. However forestry income from harvest of the native forest resource in 1998 to 2001 is significant, as are returns in later years as the established plantations are clearfelled.

The present value of the cashflow (discounted at 5%) with trees is \$2,359,893 while the present value of the cashflow without trees is \$2,211,981. This indicates that given current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, the company will make a significant after tax profit (\$147,912 difference in NPV at a discount rate of 5%).

Figure 27 displays the nominal value of direct forestry costs and returns associated with each year of the evaluation.

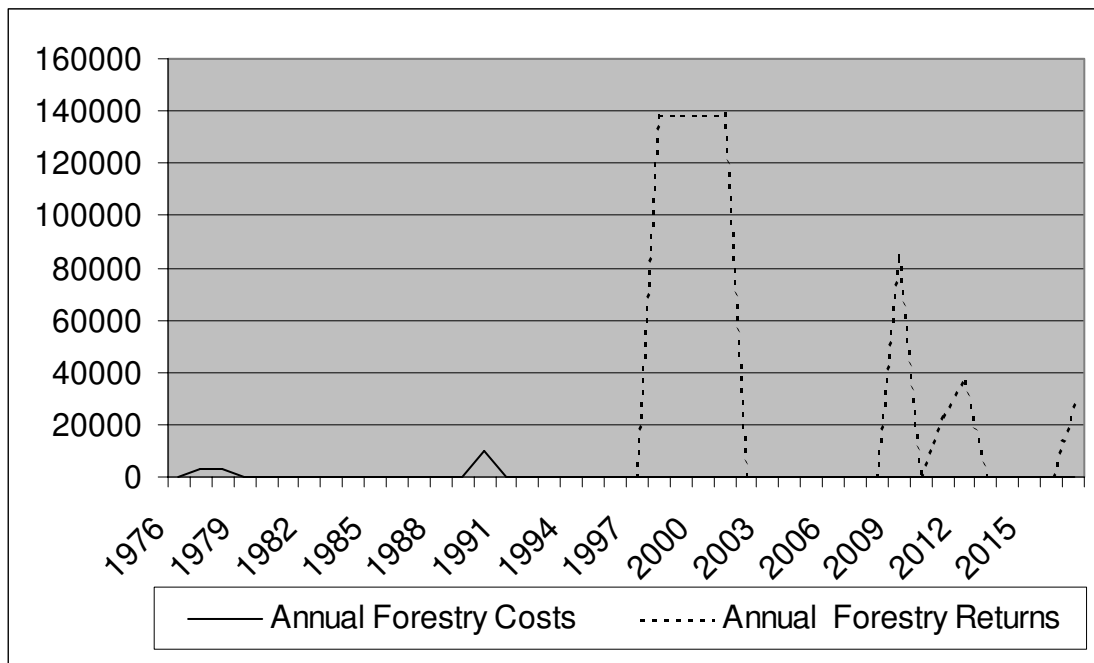


Figure 27: Annual Forestry Returns and Costs (nominal)

NPV is a scale dependent project summary statistic. It can sometimes be misinterpreted, as its results are absolute and give no information about the ‘relative’ profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project the BCR over the 41 year time frame is 17.30, indicating that for every dollar invested approximately \$17.30 will be returned by the end of the project period. The reason that the BCR is high is that much of the income attributable to the farm forestry is flowing from harvest of native forest. There are no establishment or management costs associated with the harvest. Therefore in relation to the returns side of the equation, the costs are very small. Ian believes that harvesting and developing the native forest will convert it to a more economically productive state, which is necessary for the survival of the farm. Despite this, Ian states that cutting the native forest has a negative impact on the ‘natural’ capital stock of the property and consequently its value.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV works out to an additional annual income stream of \$8,553 per year over the project period. This is an estimation of the annual contribution to farm income that involvement in forestry will contribute (when compared to the ‘without trees’ scenario). The proportional increase in farm income over the ‘without trees’ scenario is quite significant at 6.69%.

Table 12: Project Summary Statistics

NPV	\$147,912
BCR	17.30
Annualised NPV	\$8,553
Proportional increase/ decrease in Annual Income	6.69%

The profitability of farm forestry relative to agriculture is obviously dependent on the assumptions used to create the cashflows. A limited sensitivity analysis shows the extent

to which changing returns to grazing or to forestry will influence the outcome of the evaluation. The following graph displays the relationship between the difference in net present value under the 'with trees' (forestry) and 'without trees' (agriculture only) scenarios when assumptions relating to the income from agriculture and forestry are altered.

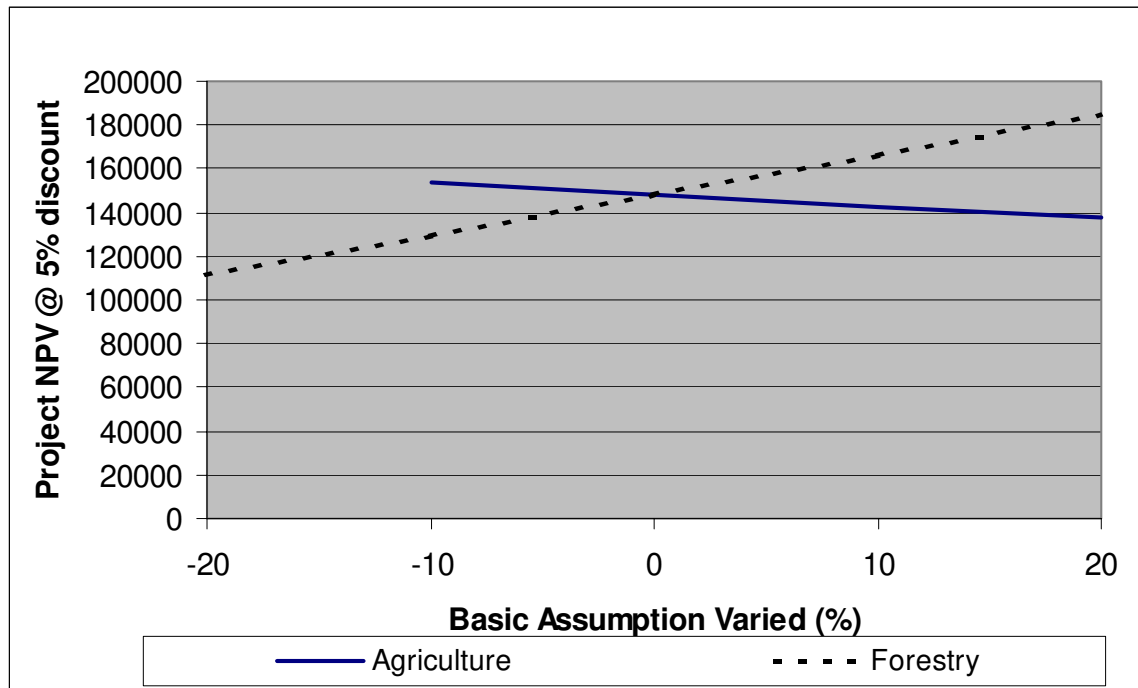


Figure 28: Sensitivity to Changes in Assumptions

The graph shows that project outcomes are more sensitive to changes in assumptions about forestry returns than those of agriculture. However, the project still produces a significant profit even if returns to forestry are 20% less than assumed (\$111,016) or returns to agriculture (which represents the opportunity cost of the land) are 20% higher than assumed (\$137,894). Under the assumptions that agriculture returns are 20% higher than assumed and forestry returns are 20% less than assumed, the project still returns an after tax profit of \$101,131. If agricultural returns fall to 90% of the assumed values and forestry returns are 20% above the assumed level, the project NPV rises substantially to \$191,304.

The reason that the project is relatively insensitive to returns to agriculture is that the bulk of income from forestry is coming from land which previously had no agricultural value. Ian believes that although there is no opportunity cost of this land from the point of view of agriculture, harvesting this area does impact on the capital value of the property. This reduction does have a negative impact on the value of the farm which is not reflected in this evaluation.

It important to note that Elverton and Old Whisloca are vulnerable to fluctuations in the returns received for agricultural produce. Given the cost structure of the enterprises, particularly cropping enterprises, a reduction in agricultural returns to 80% of their assumed values will yield a negative income flow for the farm over the whole project life, in effect making the whole operation insolvent.

Therefore, in this case, devaluation of the farm's natural capital through harvesting the native forest and its subsequent redevelopment into enterprises with a higher economic value can be defended on the grounds of creating a more sustainable farming enterprise. Given the positive environmental and social impacts detailed in the subsequent sections, the sustainability issue must be one of finding the appropriate balance between economics and the other facets of sustainability, i.e. environmental and social.

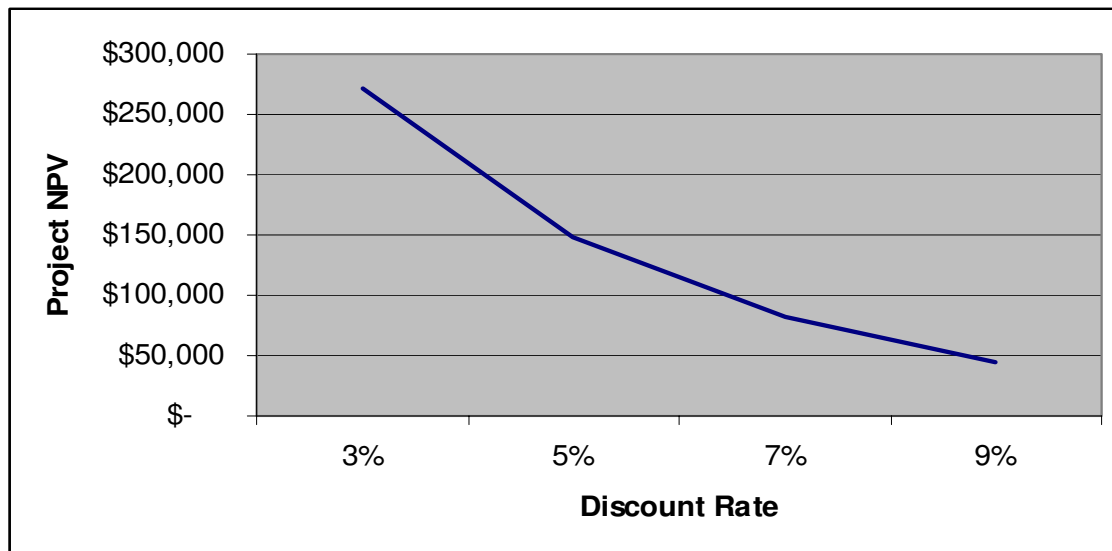


Figure 29: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make forestry projects less attractive economically because of the normal forestry pattern of costs and returns over time. However, the Dickensons' farm forestry is robust with respect to changes in the discount rate. It will generate a positive NPV even when the discount rate is 9%.

Environmental Impacts

There are two management regimes incorporated within the Dickensons' farm forestry enterprise. The first is the management of native forest, either for conversion to plantation, or for selective logging for sawlogs. The second is establishment of shelterbelts for stock and crops and eventual harvesting for pulpwood.

The environmental impacts of the first regime drive straight to the heart of a significant debate on private forest management that is currently occurring in Tasmania and other states in Australia. The debate focuses on the rights of private landholders to manage native forest on their properties and the environmental impact of managing private native forest for production of wood products. This is a microcosm of the broader debate around Australia at present related to native forest management on both private and public land.

Under current legislation in Tasmania, Ian has to submit a Timber Harvesting Plan in order to selectively log or convert native forest on his property to plantation. The plan is assessed under the Forest Practices Code, and evaluated with regard to water management and conservation values as outlined in the Forest Practices Act. It is illegal to cause environmental 'harm' as defined under the Environmental Management and Pollution

Control Act. This Act is referred to under the Forest Practices Act which in turn guides drafting of the Forest Practices Code.

The environmental impact of the second regime of forestry management (i.e. wide spaced shelter-belts) is also difficult to quantify, as no direct measurements of impact have been made. Anecdotal evidence suggests that the shelter-belts provide wildlife corridors between stands of native forest, in addition to the intended effect of providing shelter for stock and improving the aesthetic values of the property.

The two properties adjoin the main access road to the Ben Lomond National Park and ski fields, and there is a tourist bungalow on the 'Old Whisloca' property. This ensures that Ian gets immediate 'feedback' from the broader community if they perceive that he is doing anything 'wrong' in terms of environmental management of his forestry enterprises or the farm in general.

In line with the format of other case studies in this series, a basic evaluation of the possible economic scale of environmental impacts was carried out. This involves assuming that under the 'without trees' scenario the productivity of the land resource declines by 10% over the life of the project (41 years). Establishing and managing trees is assumed to halt this decline and maintain productivity. Under these assumptions the NPV rises very substantially to \$311,648. This represents an increase of over \$210,000. In this case it is considered unlikely that the forestry activities will confer this level of environmental benefit to the farms. However, it can be seen that any improvement or positive benefit of forestry on the adjoining agriculture has a major external positive benefit to the farm enterprise.

Social Impacts

The social impacts of the Dickensons' involvement in farm forestry management can be considered from two perspectives. The first is the impact on family relationships. The second is the impact on relationships with the broader community.

Because farm forestry is an integral part of the success of the whole farming business, it can be assumed that to the extent that the farm forestry has contributed to the business being sustainable economically, the impact on family relationships and well-being has been positive.

Another aspect of Ian's involvement in farm forestry has been his active involvement in various government advisory boards, committees and community groups. While this has had a positive impact on the broader community, he is the first to admit that it conflicts with the ability to spend time with the family. This is evidenced in recent years by his decision to reduce his previous commitments in these areas. Ian's efforts in promoting farm forestry to the broader community have been recognised by his being awarded the Order of Australia. In a one sense there has been a trade off occurring between family relationships and community relationships.

A second positive impact on the local community has been the employment generated through the farm forestry enterprise specifically, and the farm business in general. Elverton Pastoral employs three permanent staff and a number of casuals throughout the year. Previous evaluations of Elverton (TFGA Forestry Committee Field Trip Notes)

discuss the potential employment benefits to the local area as well as the additional important contribution to Tasmania's export revenue.

In addition, the Dickensons are involved in the local Landcare group as well as the 'Adopt a Farm' scheme, which sees school groups visit the farm each year. Similarly they run a tourist bungalow on the 'Old Whisloca' property, which provides opportunity for the broader community to enjoy the environment provided by the native and plantation forests on the farm.

Summary and Lessons Learnt

Ian started his farm forestry as part of the process of converting forested land to agriculture. He soon realised the need to maintain a viable timber resource on the property to ensure adequate long-term cashflow. His farm forestry management now involves selective logging of some of the native forest on the property and conversion of lower quality stands to higher value tree species for wood production. He also continues conservation and amenity plantings around the property.

He believes that it is essential for the viability of the industry to ensure harvest rights of private forest are protected, and that private forest management holds the key to future sustainability of the forest industry in Tasmania. He also considers that a process should be set in place that ensures a fairer deal for farmers when negotiating harvesting contracts. Most importantly this would include viable prices for wood products, especially pulpwood.

Ian runs his own harvesting operation, which allows him a great deal more flexibility in the management of his forest enterprise and the ability to maximise the returns received for the product marketed.

Lessons learned that could be of value to other farmers seeking to implement revegetation programs on their property include:

- Planning is essential. Much effort has gone into planning the development of the farms' physical resource and benchmarking their performance against nearby farms.
- Controlling the forestry operations as much as is practicable will give valuable experience and lead to better returns in the long run.
- Improvements in the quality of the forest produce should be sought. Professional silvicultural advice is invaluable.
- Economic, environmental and social benefits are all intertwined in the general sustainability debate.

The case study indicates that Ian's farm forestry management regime should see positive social, economic, and environmental impacts into the future.

Case Study 5

**Mal and Bev Darby
Trafalgar, SE Victoria**

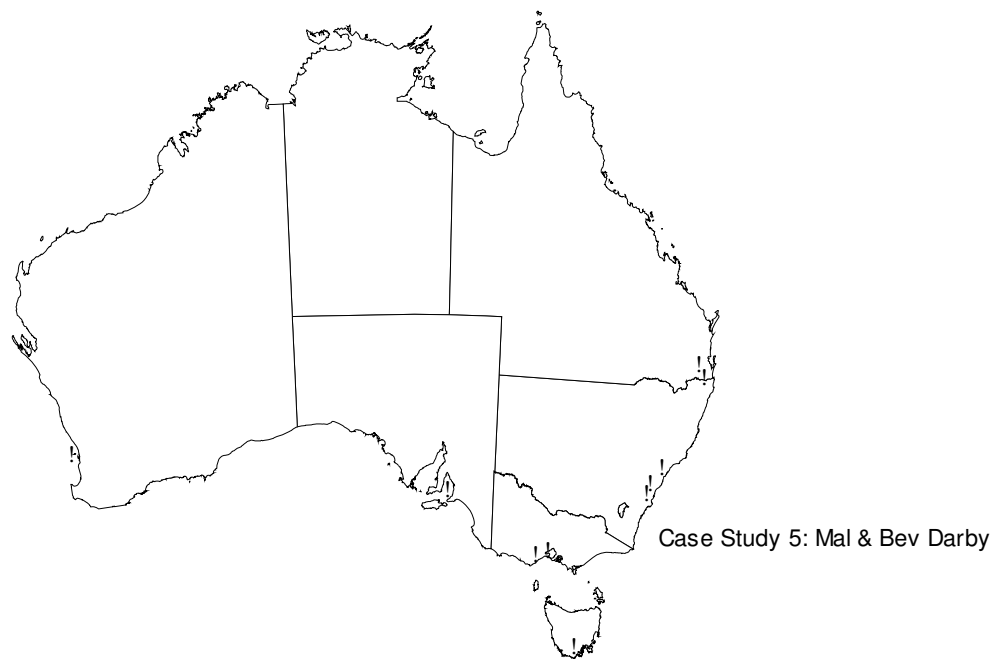


Figure 30: Location of Case Study Site

The Farm

Mal and Bev Darby purchased and moved onto their 140 ha property situated in the Gippsland region in South Eastern Victoria in 1984. Soils on the property are very productive volcanic clayey loams, supporting a current stocking rate of around 24 Dry Sheep Equivalents (DSEs) per ha. The average annual rainfall is 1100 mm. The key enterprises on the farm include beef cattle, fat lambs and farm forestry. There are a number of commercial plantations in the area, while farm forestry on private land totals 6000 ha over the whole of the Gippsland area. The high productivity of soils means that trees must compete with other high value agricultural enterprises such as potatoes and dairying.

When first purchased, the property had 35 ha of Mountain Ash (*Eucalyptus regnans*) and 5ha of *Pinus radiata* in plantations, with shelterbelts of cypress and pine around most paddock boundaries. Mal suggests that the tree plantations on the property actually decreased the sale price when he originally purchased the block, as the trees were seen as occupying some of the more productive soils on the property.

Objectives of the Farm Forestry Enterprise

Mal has always seen the trees on the property as an asset rather than a liability. They provide substantial environmental benefits by preventing land slippage and erosion on the medium to steep slopes that characterise the property. The trees also provide shade and shelter to the cattle and other stock. From an economic point of view, harvesting of existing plantations has provided useful cashflow as well as invaluable experience in management and harvesting.

Mal's objective is to continue with a program of planting and harvesting trees on the property. He is currently converting one of the recently harvested plantation blocks back to agricultural land for potatoes. This aspect of his management reflects his belief in the need to match land types with the most high value agricultural enterprises that they can sustainably support. He believes that too much of the high value land on the property has been planted to trees, and is concentrating future plantings to lower value land which is susceptible to slippage. These plantings will most likely use a shelter-belt style planting layout to concentrate plantings in rows, maximising shelter benefits and minimising land requirement.

Essentially Mal sees the farm forestry enterprise as an integral part of his farm business, providing economic as well as environmental and aesthetic benefits.

Implementation and Management of Farm Forestry

Mal first thinned a 12 ha block of 25 year old Mountain Ash in 1991. This yielded 1450 m³ all of which was sold for pulp. The same block was thinned again in 1994, yielding 1710 m³, again sold for pulp. The block was clear-felled in 1998, yielding 357 m³ of C grade logs, 852 m³ of D grade logs and 1830 m³ of pulp. This block will be returned to agricultural land to grow fodder crops and pasture.

There remain 23 ha of 25 year old Mountain Ash. This was thinned in 1995 (28 years old) yielding a total 3018 m³ of pulp. This block is on substantially steeper country than the 12 ha block, and Mal is unsure whether he will replant it to trees after clearfall in a few years, or whether he will return it to agricultural production.

Of the 5 ha of pine species on the property, 2.5 ha of *Pinus radiata* is in shelter-belt plantings and 2.5 ha is non commercial Cypress pine, also in shelter-belts, which will not be harvested. Mal clearfelled 1ha of 28 year old *Pinus radiata* shelter-belt in 1995. This yielded 101 m³ of A grade logs, 340 m³ of B grade and 549 m³ of C grade logs and was subsequently replanted by hand with 1000 superior *Pinus radiata* rootstock which are now three years old.

In 1996, a 1 ha block of 23 to 25 year old *Pinus radiata* was harvested, yielding 524 m³ of pulp and 250 m³ of sawlog.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Darbys' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 42 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1999. The evaluation examines one rotation for each stand established before 1999 and concludes when the last stand is clearfelled.

The benchmark scenario used for comparison is the hypothetical situation in which no plantation establishment is undertaken. In other words the scenario looks at farm management without the farm forestry enterprises that have been undertaken. The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted.

There is considerable uncertainty inherent in defining many of the production (both agriculture and forestry) parameters and extrapolating these out over a long time frame. All information used to model the 'with trees' and 'without trees' scenarios has come from interviews with Mal and Bev Darby and consultation with local forestry and agricultural personnel. Tree production information is generally drawn from Mal's harvest records, but, yield modelling results carried out by Mr Bill Loane (formerly of Department of Natural Resources and Environment, Victoria) have been used to estimate returns from the remaining 23 ha of *Eucalyptus regnans*.

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm on an individual paddock scale have been calculated. These have then been aggregated to the whole farm level and fixed costs have been subtracted to gain a measure of gross income. Taxation on income in each year is then calculated by the model and subtracted to give net income.

Figure 31 below illustrates the land use and stocking rate relationship over time for the farm.

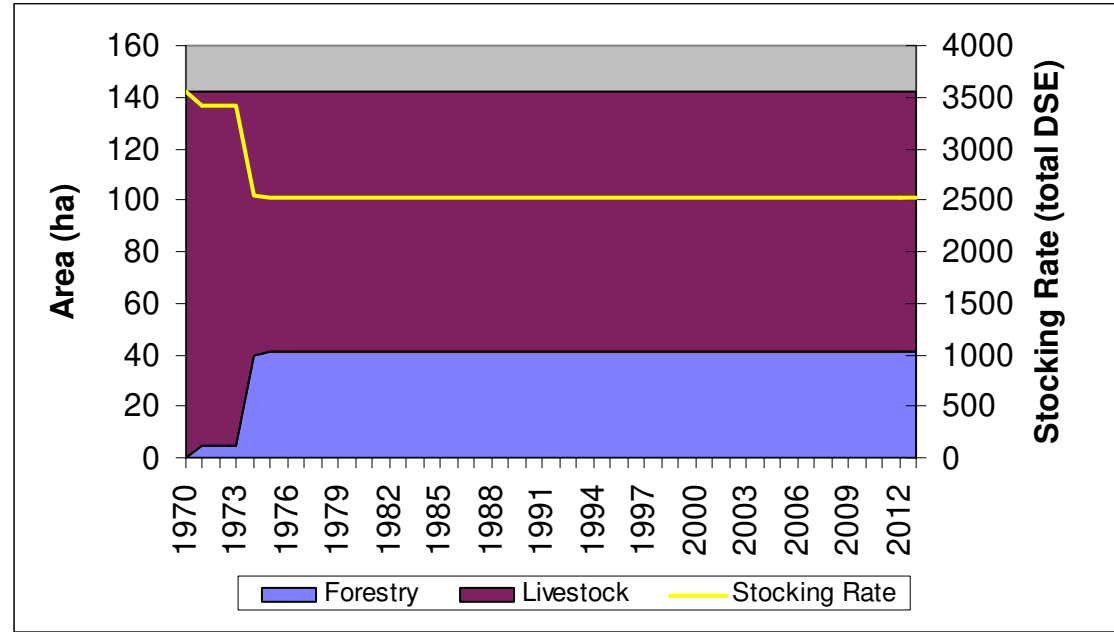


Figure 31: Land Use and Stocking Rate

Mal and Bev bought this farm in 1983 with the trees already established. At this time they were considered to be a liability. Mal is committed to continuing in the management and development of the forestry resource on his farm, but he believes that the scale of the forestry on the farm is inappropriate given the high value of the land which it occupies. Conversion of some areas currently under forest back to annual agriculture has already begun.

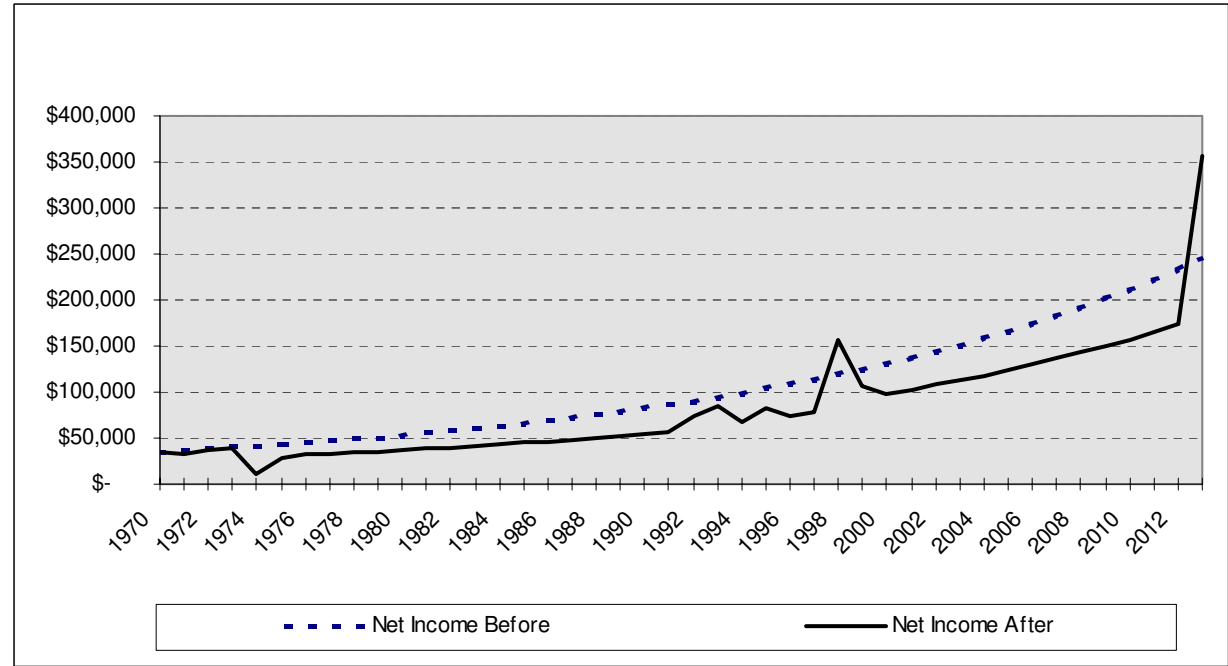


Figure 32: Farm Net Income (undiscounted) 1970-2014

In Figure 32 above, the cashflow ‘without trees’ (‘net income before’ in the graph) has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis, leading to the upward trend over time. The graph illustrates the impact on the farm income of establishing large areas of trees on land that has high agricultural productivity. Income ‘with trees’ (net income after) is below that of the ‘without trees’ (net income before) scenario in all years except those in which major forestry operations are taking place.

The present value of the cashflow (discounted at 5%) with trees is \$1,007,312 while the present value of the cashflow without trees is \$1,321,279. This indicates that given current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, the Darbys would have made a significant after tax loss (\$313,967) if they had undergone the expense of planting these trees themselves.

The adoption of forestry has had a strong negative impact on the farm cashflow. The reason for this is the high agricultural value of the land on which the trees have been established. Mal’s stated objective of ‘turning off 600 kgs of beef (worth on average about \$1.00 per kg) per annum per hectare’ implies that to be profitable, trees must compete with a land use that generates approximately \$600 of gross revenue per ha per year. Given the long rotation lengths of the trees that were established when Mal purchased the farm, it is extremely unlikely that such a forestry enterprise would exist. However, the plantings on this farm have been established for multiple purposes. Positive environmental impacts in the plantings, which were established to stabilise potential landslip areas, are not included within this evaluation. Nor are the shelter benefits from the trees. Mal believes that these are significant, though no quantified evidence is available to evaluate this claim.

The following graph indicates the scale of annual pre tax costs and returns for the forestry enterprises.

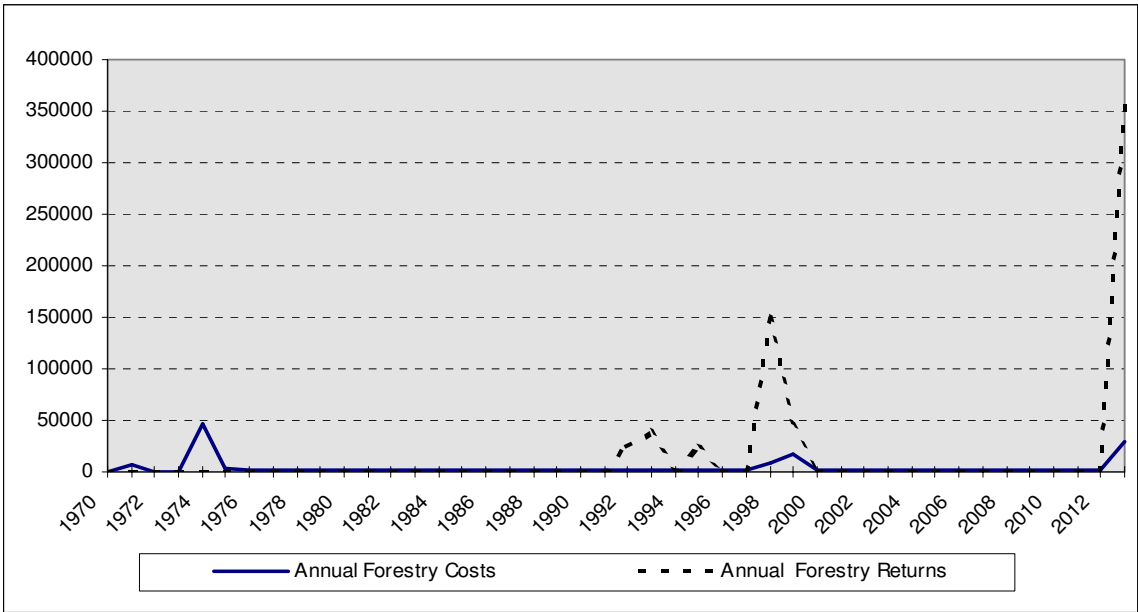


Figure 33: Annual Forestry Costs and Returns (nominal)

Even without having to pay for the cost of establishment, the high annual income foregone in beef production makes it unlikely a profit will result from this project. Future plantings and planning for farm forestry on this farm should attempt to identify those areas which have limited grazing or agricultural potential and establish these with perennial vegetation that will yield products sooner than the 30 to 40 year time horizon of most of the existing plantings.

The scale of the project in relation to the overall farm income is illustrated by the annualised scale of losses compared to the overall farm income in the 'without trees' scenario cashflow. When calculated as an annuity the difference in NPV works out to an approximate annual loss stream of \$17,894 per year over the project period. The proportional decrease in farm income over the 'before trees' scenario is substantial, being -23.76%.

Table 13: Project Summary Statistics

NPV	(\$313,967)
BCR	N/A
Annualised NPV	(\$17,894)
Proportional increase/ decrease in Annual Income	-23.76%

The uncertainty of both agricultural and forestry returns dictates that sensitivity analysis should be used to assess the impact of possible future price or yield variations to the profitability of forestry enterprises relative to the before establishment scenario.

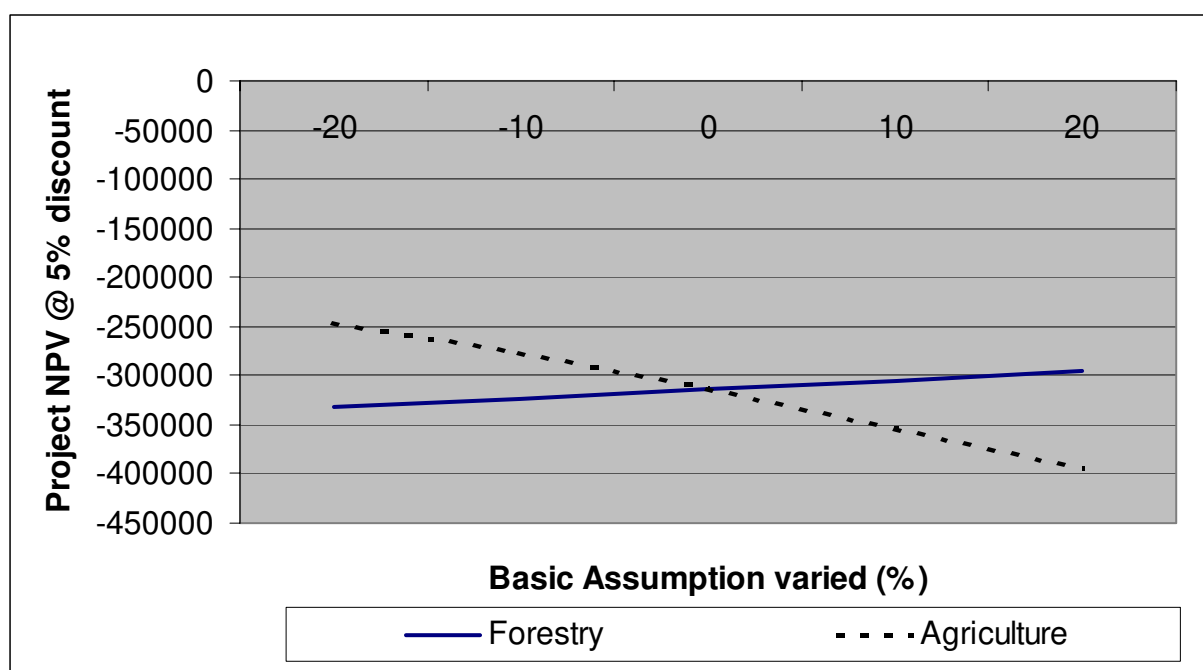


Figure 34: Sensitivity to Changes in Assumptions

The graph shows that it is very unlikely that this project will result in a profit. Even under the assumption that forestry returns are 20% higher than assumed and agriculture returns decrease by 20% the project will still yield a loss to the farm.

Table 14: Key Assumptions

Mal and Bev Darby	
Area of Farm (ha)	141
Arable Land (ha)	141
Current Value per ha	\$7500
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1971
Timeframe	42 yr
Interest Rate on Savings	5%
Interest Rate on Borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin(\$/DSE)	\$18.57
Tax Regime	5 year Averaging
<i>Eucalyptus regnans</i> (Mountain Ash) MAI	25.4 @ Age 26 15.5 @ Age 40
<i>Pinus radiata</i> MAI	32.3 @ Age 24 35.4 @ Age 28

Environmental Impacts



Figure 35: Cattle making use of shelter created by 25 year old Cypress Pine shelter belts

There are two key environmental impacts from tree plantings that are readily visible when visiting the Darbys' property. The first is the stock shelter that results from the extensive network of revegetated paddock boundaries. The cattle on the property spend a great deal of time sheltering under the tree belts. At the same time, plantings that are on steep slopes prevent serious soil slippage that can occur at times of high rainfall. Mal suggests that the greatest interest in trees from surrounding farmers comes from the impact trees have on soil erosion prevention and shelter benefits. Another key environmental benefit that Mal is keen to promote is the aesthetic benefits and habitat created for birds and other wildlife.

Social Impacts

The social impacts of the Darbys' farm forestry enterprise include impacts on the family relationships as well as those on relationships with the broader community.

Running and developing a viable business that has a sustainable cashflow over the long term has significant social benefits for the family. Financial security provides a strong basis to plan for the future. Mal and Bev enjoy the farming lifestyle, and Mal has gained a huge deal of experience in farm forestry that he otherwise would not have achieved. He believes he has a good understanding of the industry and is more confident in making management decisions with regard to the trees than he was when he first started. Future development of the forest resource will focus on gaining high returns from clearfell of existing trees, returning some of the land back to agriculture and targeting tree planting where it will make the greatest contribution to both agriculture and conservation of the land resource.

From a community perspective, Mal is involved with a number of community organisations relating to his farm forestry enterprise. These include being on the board of the Gippsland Farm Plantation Committee, Director of the Gippsland Wood Producers Co-operative and ex-chairman of the Gippsland Agroforestry Network.

Mal regularly hosts site visits from study groups, politicians, researchers and so on. He is keen to demonstrate the feasibility of trees to local farmers in the area, who are watching his farm forestry enterprise with interest.

Summary and Lessons Learnt

This case study highlights the need to plant trees on land that has the lowest opportunity cost. Mal and Bev Darby's property already had a significant plantation estate when they purchased it in 1983. As such, they have been able to harvest some of the plantation and gain revenue from that source. However, the economic analysis suggests that there is a significant opportunity cost involved with the plantations, because of the high value of agricultural production that could otherwise be undertaken on the land.

Mal recognises this and is in the process of converting back to agriculture some of the higher productivity land that was previously under plantations. At the same time he is introducing shelterbelt plantings on some of the less productive land to maximise both economic and environmental benefits.

Mal suggests that the greatest lesson he has learnt through his involvement with farm forestry has been in negotiating harvest contracts and overseeing contractors as they harvest trees on his property. He has a much better understanding of the harvesting process and is more confident in negotiating deals that suit him rather than the contractor. He points out that there is significant potential for landholders to miss out on the best possible deal due to insufficient research or knowledge about the tree harvest and marketing process. Mal is even considering setting up his own portable mill to ensure he gets maximum value from the timber resource on the property.

Case Study 6

**Noel and Kim Passalacqua
'Jayfields'
Wagga Wagga, NSW**



Figure 36: Case Study Location

The Farm

Noel and Kim Passalacqua's farm, 'Jayfields' is situated near Wagga Wagga in NSW. The property has a total area of 656 hectares, of which 436 ha is arable and 220 ha is native forest reserve. The average annual rainfall is 700 mm, with soil types on the property being red and grey granite/clay loams (400 ha), shale derived loams and stony ridges (256 ha).

The property was purchased in 1983, at which time it consisted of unimproved pastures with a stocking rate of 3-4 Dry Sheep Equivalents (DSEs) per hectare. Since that time, Noel has cleared 120 hectares of regrowth and sown 280 hectares of the better grazing country to improved pasture species. These now carry up to 18 DSE per hectare, while the non-improved country carries anywhere between 4-12 DSE per hectare, depending on soil type, slope and other factors. The poorer pasture country is the focus of his farm forestry plantings.

Jayfields runs a Merino wool enterprise based on Hazeldean blood sheep in a self-replacing flock. In 1987 they established the 'Jayfields Farm Tree Nursery', a large tubestock nursery, which has been built up to the stage where they currently supply approximately 2.7 million seedlings a year to the forestry industry and farmers. The objective of the tree nursery was diversification of income. As the nursery is managed separately from the farming enterprise, it is not included within the economic analysis for Jayfields.

Objectives of the Farm Forestry Enterprise

The original interest in trees came from planting trees on the farm for amenity purposes. The success of these led to an interest in commercial plantings for timber production. The Passalacquas also considered that by demonstrating the commercial viability of tree plantings, they would be able to encourage other farmers in the district to diversify into farm forestry. Farm forestry could complement commercial plantations in the local region and ensure a viable resource base for the local industries consisting of many mills and including a large softwood mill in Holbrook 25 kilometres from Jayfields.

Noel sees integrated tree planting as a way to tackle both environmental and economic problems faced by the farm. Some of the environmental problems facing the farm are soil acidification, rill and gully erosion, habitat decline, and wind effects on pasture and stock productivity. At the same time, Noel believes the long-term economic viability of wool grazing properties is in doubt due to high overhead costs and low prices for sheep and wool.

Noel believes that trees provide a viable option to produce reliable long-term income, while at the same time complementing the existing grazing enterprise. Trees can be planted on the poorer grazing country, as well as being strategically placed to maximise environmental benefits through surface and groundwater use, to provide shelter and improve habitat, and to enhance the farm aesthetics.

Implementation and Management of Farm Forestry

Noel has used the Agroforestry Estate computer model to assist him in planning the implementation of his tree-planting program. The model calculates the likely cashflow generated under different planting regimes over time and has allowed Noel to take greater account of the likely cashflow impacts of his forestry enterprise.

In 1993, Noel embarked on a program of planting an average 3.6 hectares of forestry timber a year. The program is set out in the following planting schedule:

Table 15: Planting Schedule

Year	Area (hectares)	Configuration	Species
1993	6.3	3 rows at 2.5*8 (between trees) with 40m between belts	Silky Oak (<i>Grevillia robusta</i>) & Spotted Gum (<i>Eucalyptus maculata</i>)
1995	6.0	5.5m x 4m	Pines (<i>Pinus radiata</i>)
1996	1.0	1400 sph	Silky Oak & Spotted Gum
1998-2002	3.0 per year	5m x 4m	Pines (<i>Pinus radiata</i>)
1999-2002	2.0 per year	4m x 3m	Spotted Gum

All of Noel's tree plantings have been focused on poorer grazing country. This strategy will see 26% of the arable land eventually devoted to forestry. More focused management of the remaining grazing country, together with the environmental benefits derived from trees, should see a net improvement in stocking rate and grazing income over the property.

The first planting in 1993 was 6.3 ha of wide spaced rows with 40 metres between belts and 2.5 metres between rows and 8 metres between trees in rows. The planting included Silky Oak (*Grevillia robusta*) and Spotted Gum (*Eucalyptus maculata*). The wide spacing was used to provide sheltered bays for grazing, though with hindsight Noel considers the single belt configuration is impractical due to high management costs (heavy branching, fencing, pruning and weeds) per area planted. Shelter from single row wide spaced trees is rather limited and in some cases the trees actually decrease shelter due to wind tunnelling effects around the base of the trees as they mature.

The second planting in 1995 was 6 ha of Pines (*Pinus radiata*) in 5.5m by 4 m rows planted around the contours on a moderate to steep sloping hill. In 1996, a 1 ha seed orchard of Silky Oak and Spotted Gum was established. This will be used to provide seed for future plantings and stock for the nursery.

In 1998, 7 ha of Pines (*Pinus radiata*) were planted in 5 m by 4 m configuration, again on exposed hilly country with poor grazing potential. Winter 1999 will see 2 ha of Spotted Gum planted on similar country.

Noel has also undertaken a number of conservation or landcare plantings of mixed species. These include revegetation and fencing of creek lines through the property and restoration plantings of a wetland. The impact of these has been significant, with erosion along the streamline being noticeably reduced.



Figure 37: Wetland regeneration with planting of native species.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Passalaguas' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 37 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 2002. The evaluation examines one rotation for each stand established before 2002 and concludes when the last stand is clearfelled.

There is considerable uncertainty inherent in defining many of the production parameters (both agriculture and forestry) and extrapolating these over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the scenarios has come from interviews with Noel and Kim and information drawn from the Agroforestry Estate Model runs conducted by Noel and Peter Stephens of the University of Melbourne.

The benchmark scenario used for comparison is the hypothetical situation in which no plantation establishment is undertaken ('without trees' scenario). In other words, the scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1993. The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1993 ('with trees' scenario).

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm have been calculated on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs have been subtracted to gain a measure of gross income. The model then calculates tax payable based on each year's income and subtracts this to give net income.

The baseline scenario looks at the likely outcome if the farm had continued under the management regime that existed prior to Noel’s implementation of farm forestry. This is compared to the scenario that exists currently with integrated tree plantings and sheep grazing for production of medium wool (21-22 micron) sheep (at reduced stocking rates).

Figure 38 depicts the land use and stocking rate relationships for the farm based on the planting schedule outlined by Noel and Kim.

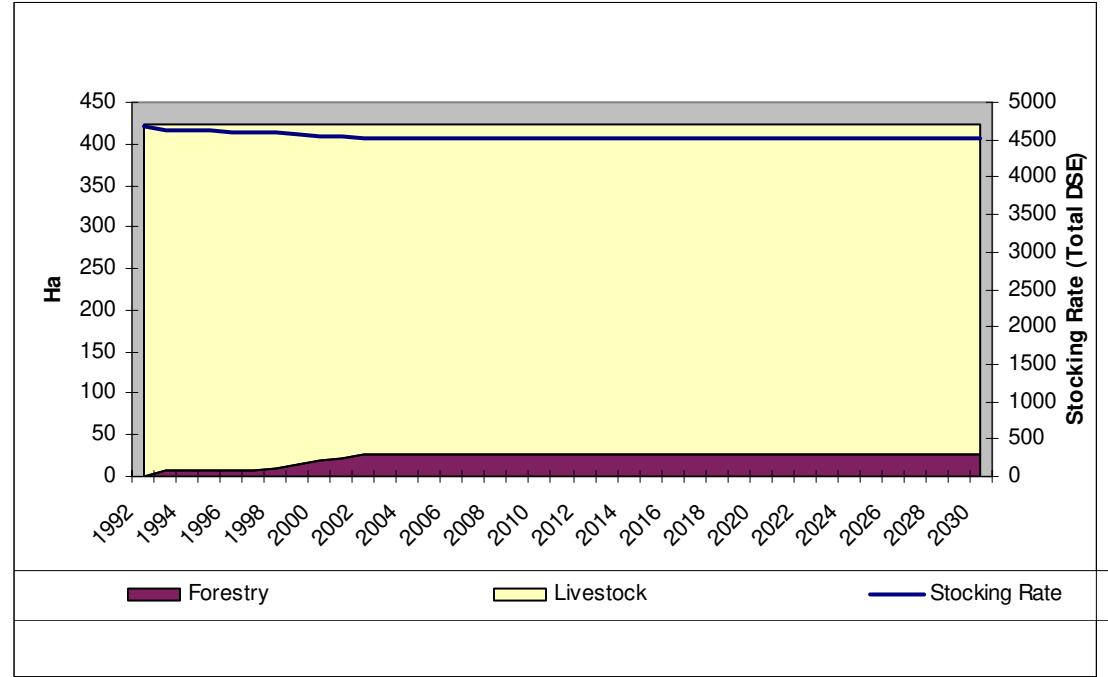


Figure 38: Land Use and Stocking Rate

Noel and Kim have focussed their tree planting on areas that previously had negligible value for grazing. Therefore, the costing of taking this land out of production is minor.

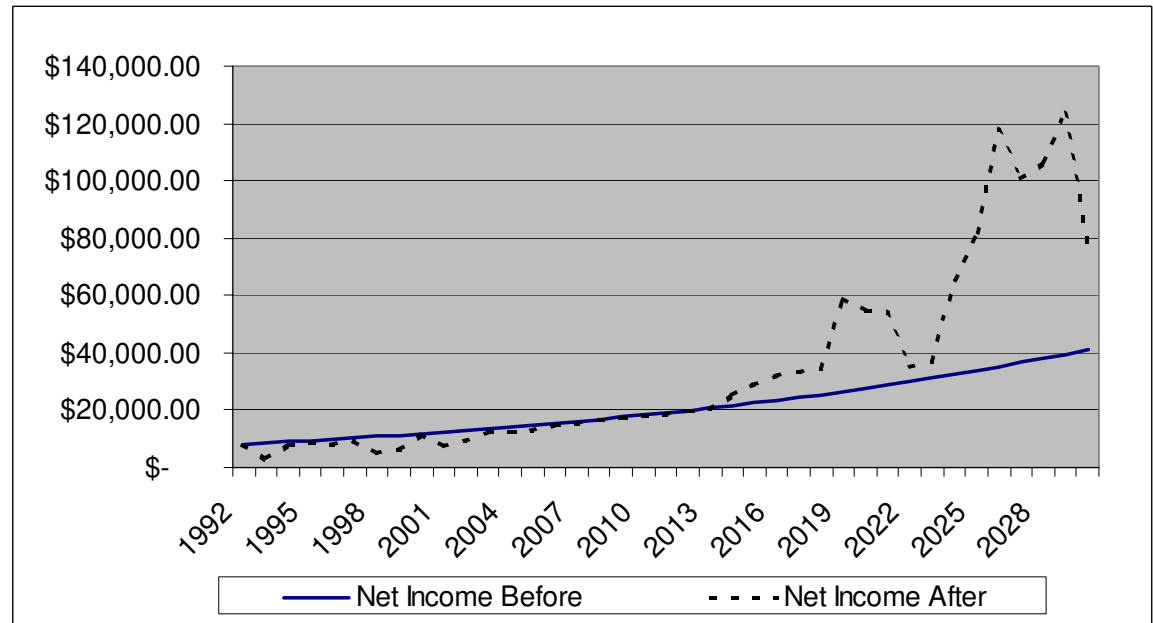


Figure 39: Farm Net Income (nominal) 1992-2030

Figure 39 above shows the income flow over time for the ‘with trees’ (net income after) and ‘without trees’ (net income before) scenarios. The graph of net income above illustrates the financial impact of farm forestry on the farm. Minor reductions in the farm net income are well compensated for by harvest returns after 2016.

Note that the cashflow without trees (Net Income Before) has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis leading to the upward trend in annual income. The graph illustrates only minor reductions in farm income initially as the scale of plantation establishment has been kept to manageable levels. Also because tree planting has been carried out in areas which do not have high value for grazing, the opportunity cost of land occupied by trees is low.

The following graph shows the scale of annual pre-tax costs and returns for the forestry enterprises.

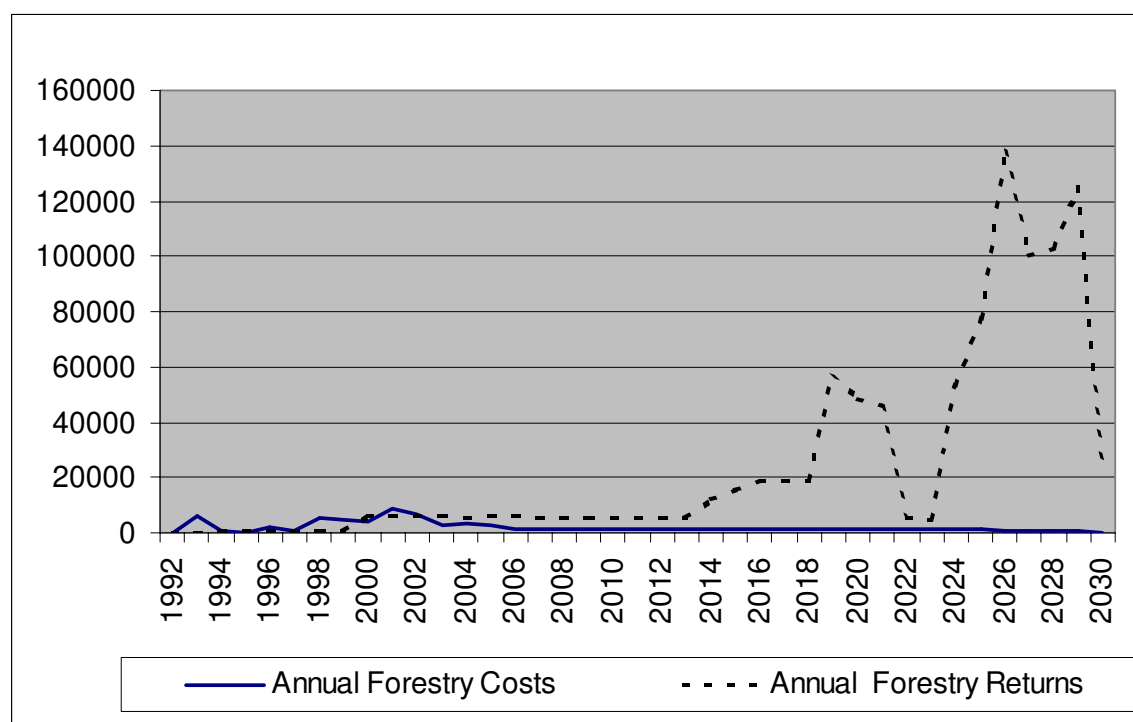


Figure 40: Annual Forestry Costs and Returns (nominal)

The present value of the cashflow (discounted at 5%) without trees is \$277,596 while the present value of the cashflow with trees is \$356,264. This indicates that under current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, the Passalaguas will make a significant after tax profit (difference in NPV is \$78,668 discounted at 5%).

Noel and Kim have doubts about the future viability of fibre production within their area. This has led to their searching out alternative land uses that can occupy their more marginal grazing land. In this case, establishment of a range of separate forestry enterprises should provide a significant future cashflow benefit to their farming enterprise.

NPV is a scale dependent project summary statistic. It can sometimes be misinterpreted as its results are absolute and give no information about the 'relative' profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project the BCR over the 37 year time frame is high at 4.54, indicating that for every dollar invested approximately \$4.54 (in today's dollars) will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV is \$4 664 per year over the project period. The proportional increase in farm income over the 'without trees' scenario is very significant at 28.34%.

Table 16: Project Summary Statistics

NPV	\$78,668
BCR	4.54
Annualised NPV	\$4,664
Proportional increase/ decrease in Annual Income	28.34%

The profitability of farm forestry relative to agriculture is obviously dependent on the assumptions used to create the cashflows. A limited sensitivity analysis shows the extent to which changing returns to grazing or to forestry will influence the outcome of the evaluation. The following graph displays the relationship between the difference in net present value under the 'with trees' and 'without trees' scenarios when assumptions relating to the income from agriculture and forestry are altered.

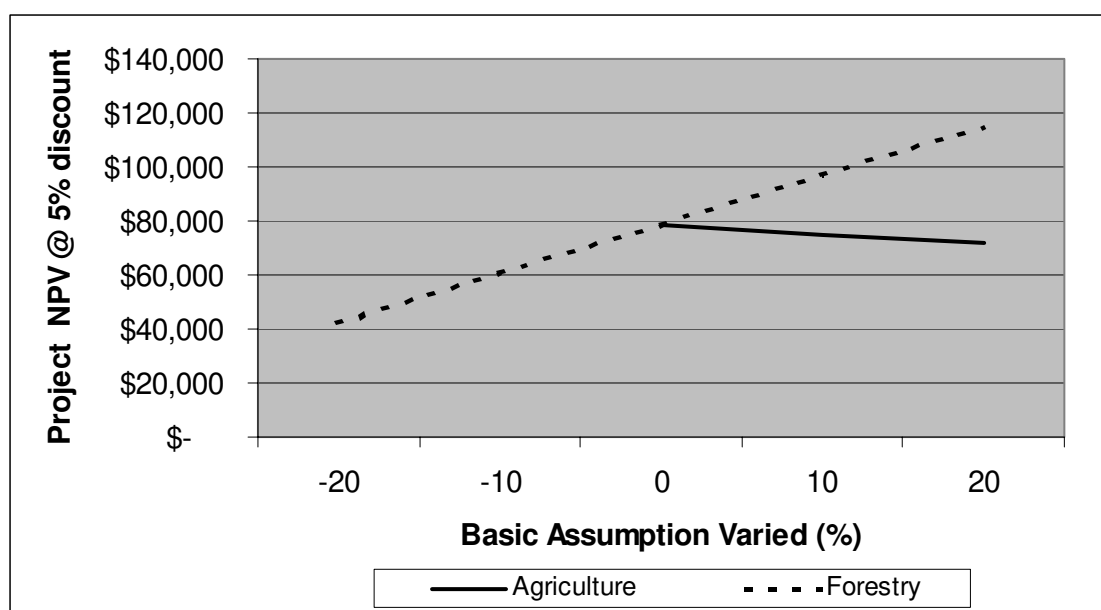


Figure 41: Sensitivity to Changes in Assumptions

The graph shows that project outcomes are more sensitive to changes in assumptions about forestry returns than those of agriculture. However, the project still produces a significant profit even if returns to forestry are 20% less than assumed (\$41,929) or returns to agriculture (which represents the opportunity cost of the land) are 20% higher than assumed (\$72,217). Under the very conservative assumptions that agriculture returns are 20% higher than assumed and forestry returns are 20% less than assumed the project still returns an after tax profit of \$37,947.

The reason that the project is relatively insensitive to returns to agriculture is that the bulk of income from forestry is attained from land which previously had little value under a grazing enterprise.

It is important to note that Jayfields may be vulnerable to fluctuations in the returns received for agricultural produce. Given the cost structure of the business, a reduction in agricultural returns below their assumed values will yield a negative net present value of income flow (both with trees and without) for the farm over the whole project life, in effect making the whole operation insolvent. The focus on diversification of income away from agriculture to reduce exposure to variability in agriculture markets in this circumstance is well justified.

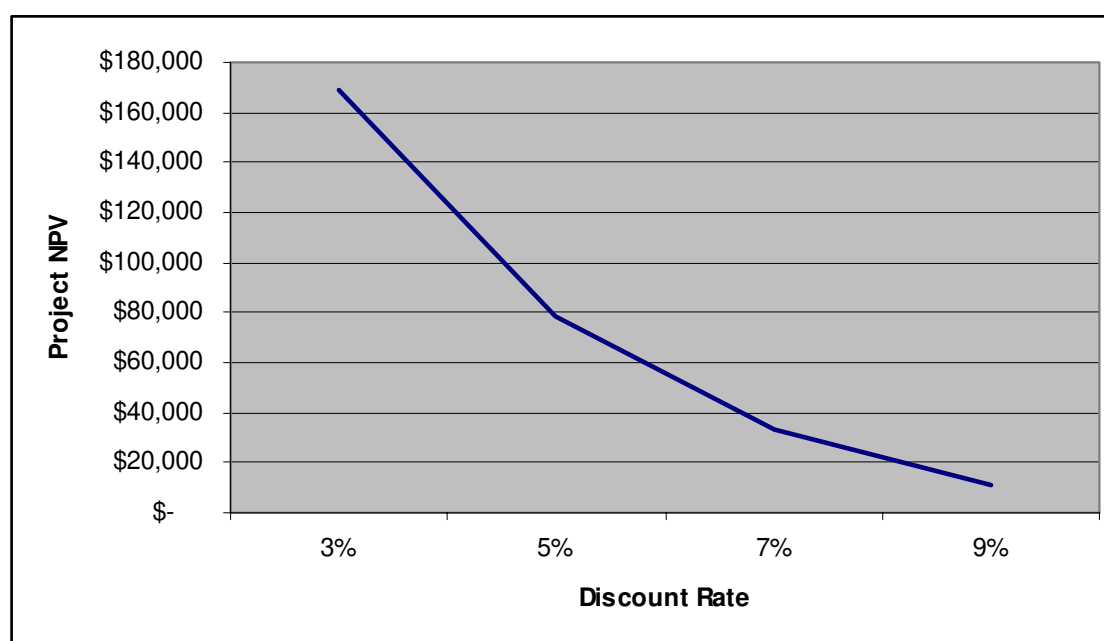


Figure 42: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make forestry project less attractive economically because of the normal forestry pattern of costs and returns over time. The Passalaguas' farm forestry is quite sensitive to the discount rate applied. However, it will generate a small positive NPV even when the discount rate is 9%.

Table 17: Key Assumptions

Noel and Kim Passalacqua	
Area of Farm (ha)	656
Arable Land (ha)	436
Current Value per ha	\$840
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1993
Timeframe	37 yr
Interest Rate on Savings	5%
Interest Rate on Borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin (\$/DSE)	\$14.12
Tax Regime	5 year Averaging
Agroforestry (<i>Grevillea robusta</i>) MAI	8.3
<i>Pinus radiata</i> MAI	12.7
Eucalypt MAI	6.1

Environmental Impacts

The environmental problems faced by the farm that trees are being used to address include:

- Groundwater and surface water management.
- Habitat and tree decline in parkland cleared paddocks.
- Acidifying soils under grazing management.
- Lack of shelter for stock.

A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting was assumed to stop a decline in land resource productivity. It was assumed, without the tree planting, that a 10% decline would accrue over the 37 years of the project as a result of the combined effects of the problems outlined above. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$78,668 to \$104,350, an increase of over \$25,000. It can be seen that any positive impacts of the trees on adjoining agriculture will have a strong impact on the profitability of the farm over the medium term.

To date, tree plantings have helped to reduce erosion caused by surface water runoff. This has been achieved through fencing off creek lines to prevent stock access, and planting along the banks to stabilise soils with the tree root systems. Contour plantings on hill sides have also helped to reduce rill erosion down slopes. This effect will be enhanced as the trees mature.

Habitat and tree decline has been addressed by increasing the percentage of tree cover on the property and integrating plantings with existing remnant trees in the same paddock. By devoting paddocks to trees, and allowing controlled grazing within these paddocks, it is possible to reduce stock pressure on isolated patches of remnant trees. Again as the trees mature, the pressure on existing remnant trees will be reduced.

Noel considers acidification of soils to be one of the most serious problems facing the farm. He believes it is uneconomical to lime paddocks with poor carrying capacity, given current prices for sheep and wool and cartage distances for lime. To overcome the problem, pines are targeted for the paddocks least able to justify liming, and higher carrying capacity paddocks are managed for grazing. Essentially Noel's management strategy is to match paddocks to enterprises (grazing or forestry) according to each paddock's land capability.

Lack of shelter for stock is overcome by increasing the total percentage of tree cover on the property. As the trees mature they provide significant areas of shade and shelter for stock. A final environmental benefit achieved is the improvement in the overall farm aesthetics. Noel firmly believes that every tree he plants helps to improve the overall value of the property, not just from the potential commercial benefit, but also from the improved look of the farm and the working environment.

Social Impacts

The social impacts of farm forestry include the impacts on relationships within the immediate family as well as the impacts on relationships with the broader community. The Passalaquas are involved with the local landcare group and hope to act as role models for other local farmers to adopt farm forestry on their properties. They have also hosted farm visits by Greening Australia, many other landcare groups, seed collecting groups, farm forestry groups, study tours from abroad and a revegetation study group.

Noel considers that the integration of trees into the farm landscape and the farm business is a form of succession planning. He believes that a viable farm forestry enterprise will help to ensure the long term financial viability of the property, which in turn will provide his children with the opportunity to continue the business if they desire.

In the longer term, Noel suggests that his forestry enterprise will help to employ more people from local areas. His nursery enterprise currently employs 1.5 people on a full time basis, with an additional 15 casuals at peak times throughout the year. This in itself provides a large social benefit to the local community. Noel believes that building a viable farm forestry enterprise throughout the region presents a realistic opportunity to enhance the long-term economic prospects of the community. This in turn should provide for greater social cohesion.

Summary and Lessons Learnt

Noel considers that the most important lesson he has learnt is to match farm enterprises with land capability. In economic terms this means minimising the opportunity cost of his tree plantings, or displacing the lowest value enterprises.

He also considers it to be important to plant manageable areas of trees each year to minimise the impact on short-term cashflow. He favours block plantings over single row windbreaks, due to the efficiency gained in management of the trees, although he integrates shelter blocks into the farm landscape to maximise environmental benefits.

The case study impact analysis suggests that Noel and Kim have been most successful in achieving their economic, environmental and social objectives through farm forestry.

Case Study 7

**Rod and Vicki Fayle
‘Rosebank’
Lismore, NSW**



Figure 43: Case Study Location

The Farm

Rod and Vicki Fayle bought their 20.2 hectare farm 'Rosebank' in 1987. The property is situated near Lismore on the north coast of New South Wales, with an average annual rainfall of 1735 mm. Soils on the property are red volcanic basalt to a depth of between 1.5 and 2 metres.

The property was settled and cleared around 1900, and along with most farms in the area, was run as a dairy farm. With the abolition of the NSW milk quota system in the mid 1960s the north coast dairy industry collapsed. Many farms moved into beef production, but with the proximity to the NSW north coast, and its growing popularity as a holiday destination, a large number of properties were subdivided (and continue to be subdivided) and sold as country retreats.

Prior to Rod and Vicki purchasing Rosebank, it was run as a beef farm with a stocking rate between 12 to 15 Dry Sheep Equivalents (DSE's). However Rod was keen to improve the economic viability of the property, and investigated a number of other enterprise options. After considering various alternatives, he decided to plant Macadamia trees for nut production. Macadamias were chosen because the trees are a local rainforest tree; consequently they grow well in the area. Macadamias are one of the few native food crops that are grown on a commercial scale in Australia. The Macadamia industry, while relatively small, is well organised and efficiently run. They have a peak body that represents growers, processors and marketers. Much of their research is self funded and they apply sound business management guidelines to the organisation. This was a major attraction for Rod to become involved, and he is currently President of the Macadamia Society. Rod also considered that the potential market for Macadamias was very large, given the increasing trend towards nut consumption world-wide.

Macadamias were established on the property in 1987, 3000 trees being planted on the sloping areas of the farm that were not susceptible to frost. The total area planted is 9 hectares (about half the farm). In the early stages of establishment, cattle were used to strip graze the prolific pasture growth on the property, but 'cattle and Macadamia trees don't mix' so all cattle were sold off the property 2-3 years after establishment of the trees. Macadamia nuts are now the principal enterprise on the farm.

The steeply sloped areas of the farm presented a management problem for Rod. They were badly degraded, too steep to work with a tractor, and not suitable for cattle grazing. One of the problems in the area is that land left unmanaged is quickly overrun by local weed species such as Camphor, Lantana and Bracken. Rod was looking for a suitable enterprise that could 'capture' some value for the site. A mix of local species was selected to reduce the management effort and to provide improved biodiversity to assist in the Integrated Pest and Disease Management Program for the Macadamias.

Objectives of the Farm Forestry Enterprise

In 1993, Greening Australia was advertising a project to assist farmers establish woodlots. In November 1993, Rod applied to plant 5 ha of his steeply sloped country to high value rainforest trees as well as Eucalypts. His objective was 'to create a wildlife friendly farm whilst not getting caught up in endangered species legislation'. He also wanted to develop a viable enterprise on the badly degraded and difficult to manage areas

of the farm. The area was ‘overgrown with metre tall weeds’ and was a significant management problem. Revegetation of the area aimed at solving this issue.

Some revegetation has also been carried out to provide some shelter plantings for the Macadamias, but it is unlikely that these shelter plantings will be managed for production of forest products (with the possible exception of firewood).

One of the problems faced in establishing farm forestry was that there was no guarantee that trees planted would be allowed to be harvested. Farmers have to apply for a harvest guarantee, but until recently could not obtain a guarantee until the trees had already been planted. There is still a large degree of uncertainty around this issue as the relevant legislation is being continually revised. This has been a major barrier to adoption of farm forestry in N.S.W. At issue is the fact that, by planting trees, farmers immediately provide habitat for a variety of native wildlife. Rod’s plantations already shelter numerous birds, koalas, possums, wallabies and other native fauna. Rod believes that his ability to harvest the trees is not guaranteed, because opposition by local groups to harvesting of natural areas can be strong.

Implementation and Management of Farm Forestry



Figure 44: Mixed species planting at age 5

Rod planted his trees in several stages during 1994. Under the Greening Australia scheme, landowners prepared the site and then trees were planted by hand using people involved in a local labour market scheme. 3000 trees were planted, including a mix of Eucalypts and a small number of rainforest species. The Eucalypt seedlings cost 50 cents each, while the rainforest trees cost between \$1 and \$2.

Eucalyptus were planted on the higher slopes, running down to transition species mid slope, while the rainforest species were planted on the lower areas. Species planted include Teak, Hoop Pine, Tallow Wood, Brush Box and Silky Oak. In addition to these plantings, Rod has also planted around 1000 trees of mixed species for rainforest regeneration. He has not applied for harvesting rights on these. Under current legislation, he is able to harvest 7 trees per hectare per year without a permit. Trees have been planted in an offset grid arrangement at either 2 x 2 metre or 2 x 2.5 metre spacing.

Some monitoring of tree growth on the property has been conducted and the current Mean Annual Growth Increment (MAI) is 18-20m³/ha. The intended management is to thin about 10% of trees at 5 years with most wood going to either pulp or firewood. At 15 years he will do his next major cut/thinning for telegraph poles which can be sold to Grafton sawmill at \$60/m³. He expects to cut 25% as poles and 10% to pulp or firewood. Following this he expects to cut young sawlogs to go to veneer at 18-25 years. Finally large sawlogs will be cut at age 25–35 years.

Rod spends approximately 2 man days/ha/yr in management and maintenance of the stand, which is mostly dedicated to form pruning the trees.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Fayles' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 26 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1999. The evaluation examines one rotation for each stand established before 1999 and concludes when the last stand is clearfelled.

There is considerable uncertainty inherent in defining many of the production parameters (both agriculture and forestry) and extrapolating these over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the 'with trees' and 'without trees' scenarios has come from interviews with Rod and Vicki and from information provided by Martin Novak of the Sub-Tropical Farm Forestry Association.

The benchmark scenario used for comparison is the hypothetical situation in which no plantation establishment is undertaken. In other words, the scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1994. The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1994.

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm have been calculated on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs subtracted to gain a measure of gross income. Taxation payable in each year of the project is then calculated and subtracted from gross income to gain an estimate of annual net income in each project year.

Assumptions used within this evaluation have been drawn from a variety of sources. Macadamia farm production estimates and costs come from an article ‘Profitability of Macadamia growing’, published in the Australian Macadamia Society News Bulletin. Forestry cost, production and price information was provided by Martin Novak of the Sub-Tropical Farm Forestry Association in Lismore (New South Wales).

Figure 45 depicts the land use allocation for the farm based on the planting schedule outlined by Rod and Vicki. The areas marked as amenity are lookout paddocks retained in pasture for visual amenity for the farm. They have no productive value in the analysis. The area planted to mixed eucalypt and rainforest species was previously used to graze some cattle. This grazing was not carried out for economic reasons; however, weed control in this area is a major issue. Unused land is rapidly overcome with weeds if no management is carried out. Part of the reason for the planting was to help control weeds in the difficult to access valley area. For this reason the evaluation does not reflect any cost of displaced agriculture on the land. Apart from establishment and management costs and the returns accruing from management and harvest of the woodlot, there is no difference between the ‘without trees’ and ‘with trees’ cashflows.

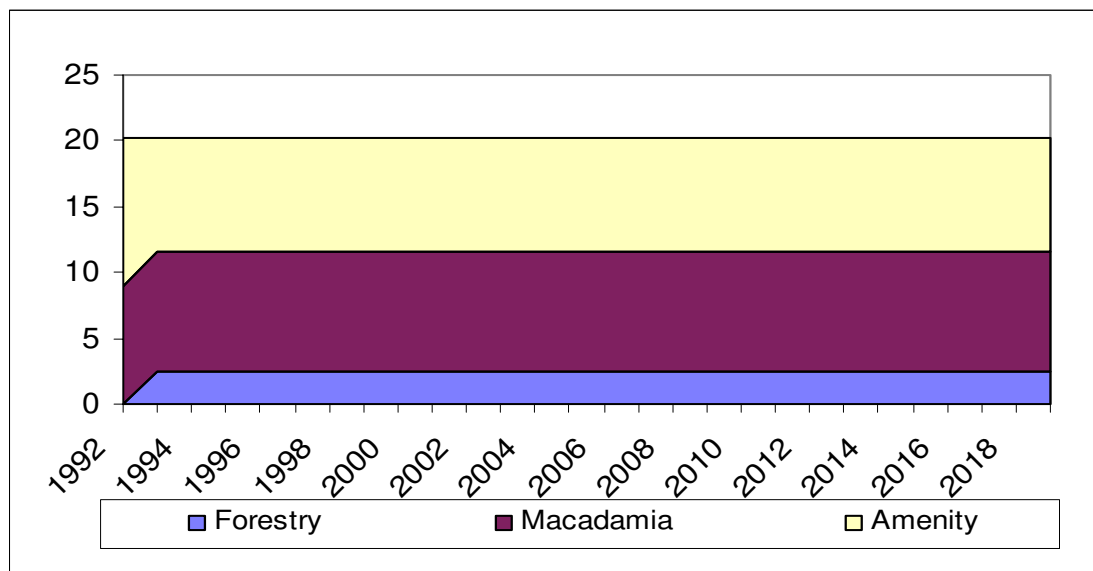


Figure 45: Land Use and Stocking Rate

Figure 46 displays the Net Farm Income for the ‘before trees’ and ‘after trees’ management scenarios.

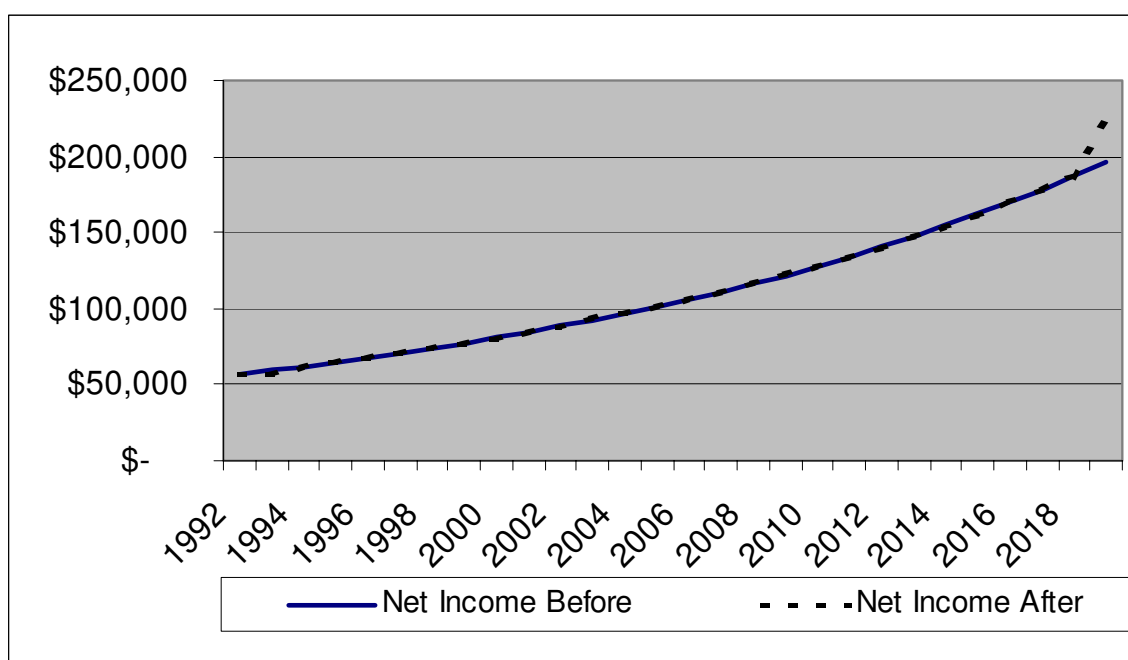


Figure 46: Farm Net Income (nominal) 1992-2019

Note that the cashflow without trees (net income before, in the graph above) has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis leading to the upward trend of the income relationships. The graph of net income above illustrates the negligible financial impact of farm forestry on the farm.

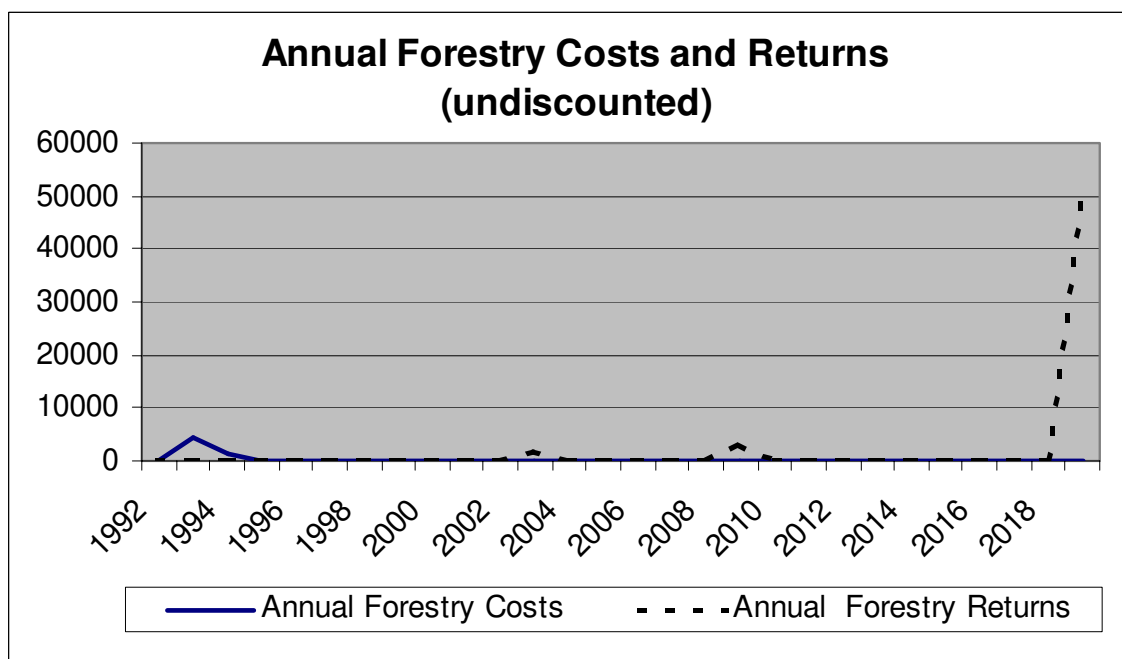


Figure 47: Annual Forestry Costs and Returns

The present value of the cashflow (discounted at 5%) with trees is just over \$1,441,201 while the present value of the cashflow without trees is \$1,440,139. This indicates that given current price assumptions for macadamia yield and prices and productivity of the forestry enterprise, the Fayles will reap a small profit in managing and harvesting their woodlot.

NPV is a scale dependent project statistic. It can sometimes be misinterpreted, as its results are absolute and give no information about the ‘relative’ profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project, the BCR over the 27 year time frame is 2.28, indicating that for every dollar invested approximately \$2.28 will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV works out to an approximate annual income stream of \$72 per year over the project period. The proportional increase in farm income over the ‘without trees’ scenario is insignificant at 0.07%. This may understate the reality, as potential benefits to the macadamia crop through improved management of pests and diseases have not been reflected in this analysis.

Table 18: Project Summary Statistics

NPV	\$1,062
BCR	2.28
Annualised NPV	\$72
Proportional increase/ decrease in Annual Income	0.07%

The uncertainty of both agricultural and forestry returns dictates that sensitivity analysis should be used to assess the impact of possible future price or yield variations to the profitability of forestry enterprises relative to the ‘without trees’ scenario. A limited sensitivity analysis shows the extent to which changing returns to agriculture or to forestry will influence the outcome of the evaluation. In the following graph the results of sensitivity analysis are presented. Returns to both grazing and forestry are altered by 20% both above and below their assumed values and the resulting difference in Net Present Values (discounted at 5%) between the ‘without trees’ and ‘with trees’ net income streams is presented.

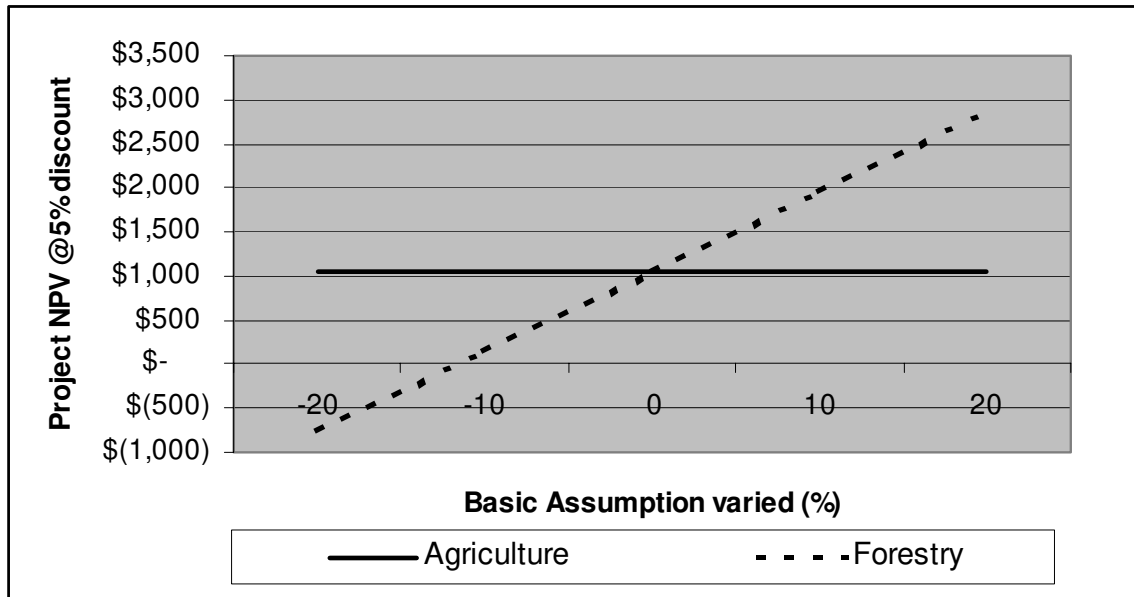


Figure 48: Sensitivity to changes in assumptions

Returns to the forestry enterprise are insensitive to any changes in the value of macadamia nuts or other agricultural land uses because the establishment of the forestry planting is displacing none of these enterprises. However, changes in the forestry returns obviously do have the potential to affect the profitability of this planting.

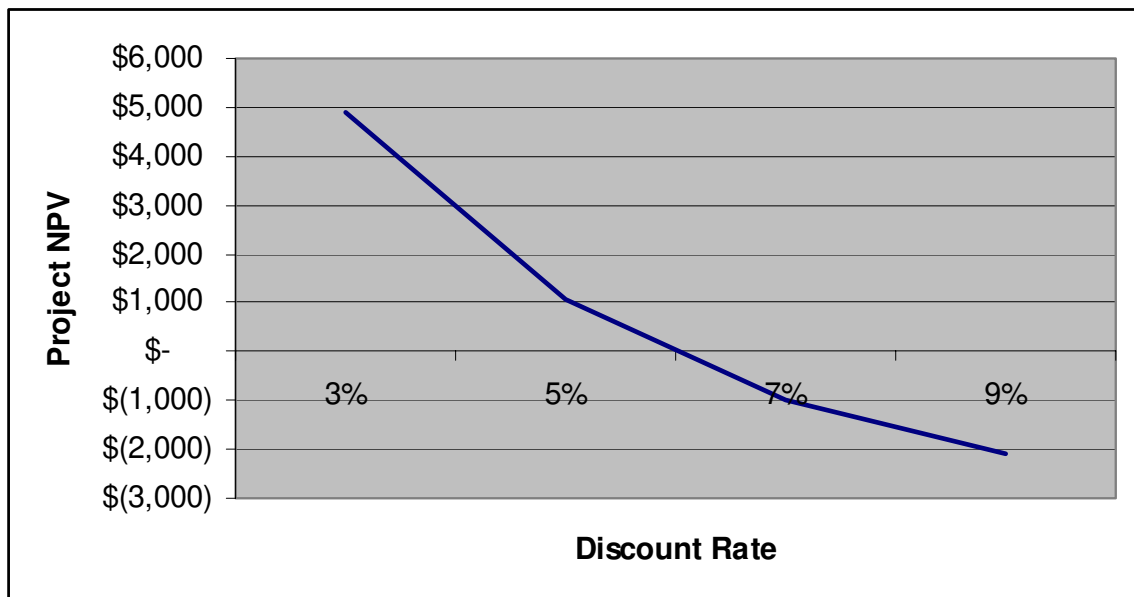


Figure 49: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make forestry projects less attractive economically because of the normal forestry pattern of costs and returns over time. The Fayles' farm forestry is very sensitive to changes in the discount rate due to the long rotations involved for species in the plantings. A rise in discount rate of approximately 1% is enough to cause this project to generate a loss.

Table 19: Key Assumptions

Rod and Vicki Fayle	
Area of Farm (ha)	20.2
Arable Land (ha)	20.2
Current Value per ha	7500
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1993
Timeframe	26 yr
Interest Rate on Savings	5%
Interest Rate on Borrowings	11%
Macadamia Gross Margin (\$/Ha)	\$10,164
Tax Regime	5 year Averaging
Mixed Planting (Eucalypt and Rainforest Timbers) MAI	19.8

Environmental Impacts

One of the immediate environmental impacts of the Fayles' farm forestry enterprise has been the revegetation of the steep slopes on the property that rapidly became degraded with local weed species and required regular intensive management. The trees have now significantly stabilised the soils and prevented further leaching of nutrients and soil runoff into local creeks. The trees also provide habitat for native wildlife in the area.

Ironically this positive environmental impact can lead to future complications, as discussed previously, due to uncertainty surrounding harvesting rights. In this lush sub-tropical region, it is often not easy to distinguish between trees that have been planted and natural regeneration, consequently any proposed harvesting is often opposed by local conservation groups. This problem is exacerbated by the fact that native wildlife quickly return to reforested areas, which makes any proposal to harvest seem a callous proposition, despite the fact that the plantation has been managed for this purpose from the start.

Despite these complications, Rod believes that farm forestry is a 'middle ground' in the forest logging debate that should be seen as a sustainable alternative to current practices.

A further benefit identified by Rod is that the increased biodiversity attracted by the revegetation is part of the integrated pest management strategy of the farm. Rod and Vicki believe that this will have a positive impact on the productivity of the main macadamia enterprise. A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting was assumed to stop a decline in productivity by decreasing the incidence of pests and diseases. It was assumed that, without the tree planting, a 10% decline would accrue over the 37 years of the project as a result of increasing plant stress brought about by insect or disease attack. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$1,062 to \$138,353. Clearly where forestry confers a positive influence on neighbouring land uses, the benefits of this can outweigh any costs of implementation, particularly where the agricultural land uses are very profitable.

Social Impacts

Rod retired from the Royal Australian Navy in 1987 after 30 years as a submariner. His family had a farming background and making the move ‘back to the country’ was quite a natural progression.

Macadamia nuts are the key to Rod’s farm business, with other trees really being an environmentally friendly way of getting productive use out of badly degraded land. The main social impact of the tree enterprise has been through involvement with the Sub Tropical Rainforest group, and through that, the Fayles have been exposed to many local forestry management issues. Rod points out that management of land (in this area) can be a lot more challenging than people realise when they buy property as a holiday get away. Unmanaged land quickly (in a couple of months) becomes overgrown with metre tall weeds. Rod believes that farm forestry presents a viable option for sustainable land management on some of the poorly degraded land in the district. It also generates employment for local community members through maintenance, harvest and value added products from locally grown rainforest timbers.

Summary and Lessons Learnt

Rod believes that there are three major factors holding back the expansion of farm forestry. His key message is the need for sensible legislation that ensures harvest rights of private plantation timbers. He believes that without this it will be an uphill battle to encourage farmers to adopt farm forestry to any significant extent in northern NSW. He also considers that the process of applying for planting and harvest permits needs to be greatly simplified, again to encourage farmers that would otherwise consider the whole process ‘too hard’.

The second issue of importance is the prices received for farm grown timber products. Rod believes that competition with low royalties payable on timber sourced from crown land is responsible for holding the price of farm grown forestry products at an artificially low level.

The third constraint is the well known difficulty of forestry in comparison with annual agricultural enterprises. The establishment costs are high, and the projects are generally very long term investments.

Rod has planted small areas of high value timber on otherwise unproductive land. This ensures that he will gain an economic benefit from future harvest income, while also benefiting from the positive environmental impacts of his plantings and possibly enjoying increased yields from the main farm enterprise (through improved pest and disease management). If these benefits do occur, the payoff in terms of increased macadamia production will be many times his initial investment in establishing the trees. Rod and Vicki’s involvement in farm forestry has been a learning experience, and they hope that in the long term their farm forestry enterprise will prove a demonstrable ‘middle ground’ for the wider community as they debate sustainable forest management practices.

Case Study 8

**Roy and Lurline Davies
‘Ellenbank’
Yarraman, QLD**



Figure 50: Case study Location

The Farm

Upon marrying in 1953, Roy and Lurline Davies bought their mixed dairy farm, 'Ellen Bank' from Lurline's father G.H. Cox. Lurline was 'born and bred' on the property, so management has passed down through the generations. Subsequent to buying the property in 1953, they added three more portions to their holdings.

The 210 hectare property is 2-3 km north of Yarraman, approximately 120 km north-west of Brisbane, towards the eastern edge of the region known as South Burnett. The average annual rainfall is 900 mm, but in dry years may be less than a third of the average. Soils on the property range from red loams on the higher slopes to clay boggy soils in low lying swamp areas. Dairying has been abandoned on the property in favour of beef production and agroforestry. The stocking rate averages 1.2 Large Stock Unit (LSU) Equivalents per hectare, and they currently run a crossbred herd of around 130 breeders for weaner calf production, using Herefords, Murray Grey and Angus. One LSU is equivalent to about 6 Dry Sheep Equivalents (DSEs) making the farm stocking rate equivalent to 7 DSE.

Table 20 Management areas on the property.

Management	Area (ha)
Naturally forested	2
Plantation	10
Agroforestry	41
Cultivation	40
Un-treed	117
TOTAL	210

Objectives of the Farm Forestry Enterprise

Roy and Lurline's first plantings of Hoop Pine were in 1956, and these were principally for aesthetic purposes. In the mid 1970s, the Davies recognised that the property was beginning to suffer from declining productivity. Problems included waterlogging in gullies, with associated salinity beginning to encroach in some areas. Another significant problem was Lantana choking out pasture in some paddocks. To combat these problems, they implemented a program of pasture renovation, building contour banks and strategic planting of trees for water use and potential forestry.

It wasn't until 1982 that Roy began a yearly tree planting program as he became more impressed with the successful growth of earlier tree plantings. Since 1982, all plantings have been multipurpose, continuing to address land degradation problems, but also planting to provide stock shelter, and managed for long term wood production.



Figure 51: Revegetation has been used to reclaim areas that were boggy and susceptible to development of secondary salinity

Implementation and Management of Farm Forestry

Table 21: Planting history of the property.

Plot No	Year planted	Description
1	1956	Amenity planting, mainly conifers around the homestead (30 trees)
2	Jan. 1968	Driveway and forest plot planting of 40 conifers; and 1ha (1200 trees) of native conifers, mainly hoop with some bunya pine to rehabilitate eroded cultivation areas.
3	Dec. 1982	1.6 ha planted with hoop (1400 trees) and bunya (200 trees) pines with some native red cedar. Plot used as shelter belt.
4	Aug. 1983	0.5 ha of hoop pine (500 trees) planted on poorer grey soils.
5	Sep. 1983	1.6 ha planted with hoop pine (1600 trees) together with a few bunya pine, southern silky oak, crows ash, yellowwood, black bean, native kauri pine, red cedar and native figs.
6	Sep. 1983	0.8ha of scrub regrowth planted hoop pine (250 trees). Intended for Lantana control.
7	Nov. 1983	0.8 ha established as a test of 34 eucalypt and rainforest timbers (350 trees)
8	Sep. 1984	0.7 ha planted to hoop pine (700 trees)
9	Oct. 1984	0.2 ha extension of plot 3 (225 trees)
10	Nov. 1984	0.6 ha planted with spotted gum (300 trees) and Gympie messmate (300 trees)
11	Nov. 1984	0.8 ha planted to river red gum (500 trees) and other species (50 trees) including Sydney blue gum, Tasmanian blue gum, candle bark, white gum, and sheoaks. Planted to reduce water table rise.

12	Dec. 1984	2.4 ha of eroded gully planted with hoop pine (120 trees) on high ground and on low ground, Sydney blue gum (120 trees) and a few each of crows ash, yellowwood, kauri pine, radiata pine and spotted gum.
13	Dec. 1984	A double row windbreak of hoop pine (300 trees) planted along roadway.
14	Nov. 1984	Sheoak (30 trees) planted at 10m x 10m spacings in wet area.
15	Aug. 1985	Small poplar trial (20 trees) planted in wet area.
16	1985	0.7 ha planted with spotted gum and a variety of other eucalypts (400 trees).
17	Oct. 1987	3.2 ha planted with hoop pine (320 trees).
18	Sep. 1988	5 ha of hoop pine planted (500 trees).
19	Oct. 1989	7.4 ha planted to hoop pine (700 trees) and kauri pine (40 trees).
20	Oct. 1990	12 ha of hoop pine (1200 trees).
21	Nov. 1991	10 ha planted to hoop pine (2000 trees) for sale as advanced Christmas trees.

Roy plants as far as possible to a square grid layout when establishing his plots, typically at 10 m x 10 m spacing. Planting spots are sprayed with glyphosate and ring tending is continued for 3 years. Trees are watered in, and watering is repeated as necessary during dry periods following establishment.

Young trees are protected from animal grazing (domestic and native/feral) by placing hollow-log sections over each plant. Trees are protected from fire through grazing/slashing or spraying of surrounding grass species. A 500L spray unit and 3200L trailable tank are available for fire suppression as well as for watering and spraying. All areas are readily accessible except under extremely wet conditions; no roading has been necessary for the forestry plots.

Native conifer species are pruned to 3-4 m at age 6-7 years, and then one whorl is removed annually to a final pruned height of 6 m.

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Davies' farm forestry project. Unfortunately, there is insufficient data available on the farm to be able to model the economic impacts of the establishment and management of the forest resource.

Economic Impacts

Generally, a whole farm economic model is applied to assess the impacts of implementing farm forestry on Ellen Bank. The evaluation compares farm net income in a situation where no trees were established to that where establishment occurs. The costs in establishment, management and reduced agricultural production are then balanced against forestry incomes. Unfortunately, the modelling process is data intensive and unless production and management records for both the agricultural and forestry enterprises on the farm are available, it is not possible to carry out the evaluation. Ellen Bank has good historical records of the process of establishment, but there is insufficient

data available at this stage to construct the two cashflow projections required to compare the ‘with trees’ and ‘without trees’ scenarios.

The Davies have extracted some income out of their plantings. Markets for hoop pine include the sale of young trees at approximately age 10 for use in landscaping. These trees may be worth up to \$150 each (Guijt and Race, 1998). Sawn timber from well pruned hoop pine trees may also attract a price premium of up to \$20 per cubic metre over other woods (Centre for International Economics et al., 1996).

As the stands mature and harvesting begins, there is a well developed forestry infrastructure to purchase and process the resource. Locally there are two mills - one plywood mill and a log depot at nearby Kilcoy approximately 60 kilometres away.

The following diagram illustrates the land use changes that have occurred over time on Ellen Bank.

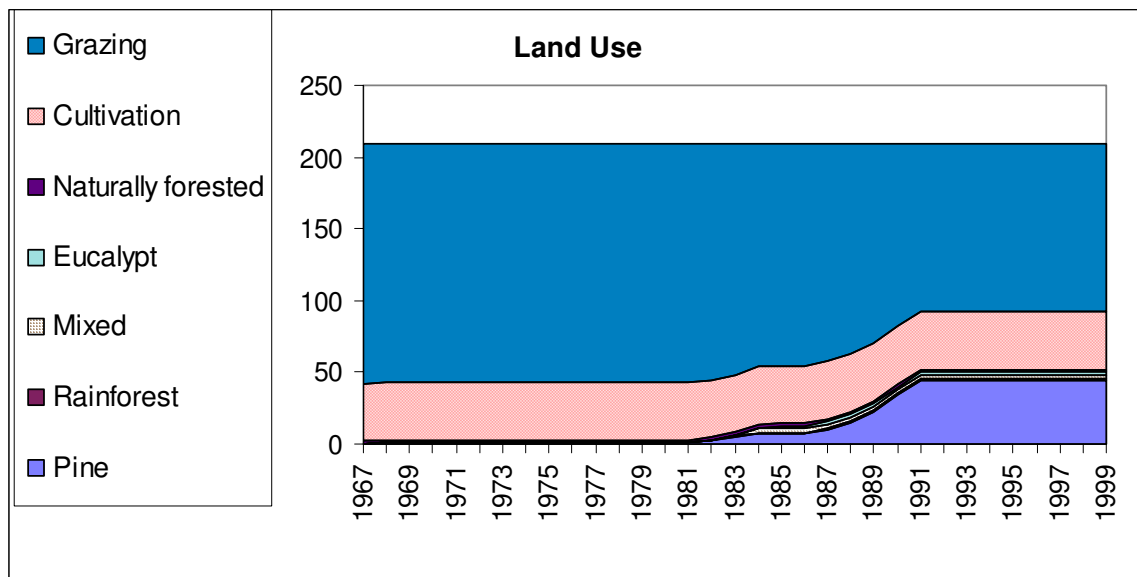


Figure 52: Land Use Change over time

Environmental Impacts

The environmental issue that the Davies were most keen to impact upon through planting trees was the rising water table and resultant salting of land. Provision of shade and shelter for stock, as well as prevention and control of soil surface erosion by wind and water, were other considerations.

To date, over 25% of the Davies’ property is under tree cover. Roy and Lurline believe they have achieved what they set out to do with their tree planting program, especially with regard to achieving their environmental goals. Previously low-lying boggy areas of the farm have been planted out to reasonably dense tree stands. The mid-slope country has been planted using a wide-spaced grid layout that allows cattle to easily graze between trees and minimises competition effect on grasses. These plantings also play a significant role in water table control and protection from wind and soil erosion.

Social Impacts

Planting trees has been an integral part of the Davies' farm management over many years. The aim of tree planting has been principally environmental but economic benefits have also provided an incentive to continue with the program. Essentially, planting trees and integrating them into the farm landscape has become a 'way of life' for the Davies.

As a flow on from their efforts at farm forestry, the Davies have had the opportunity to host a number of interesting visitors, ranging from overseas tertiary students to local primary school children and numerous government agency representatives with an interest in farm forestry.

Roy and Lurline have won the following awards:

- 1984 – Greening Australia Award – Highly commended.
- 1988 – Greening Australia Queensland Award – Winner in the individual category.
- 1990 – Queensland Landcare Council 'Focus on Landcare' photographic competition – Winner in the Agroforestry section.
- 1991 – Focus on Landcare photographic competition
 - Queensland Department of Primary Industries Award
 - Winner of the major award for the best Landcare image
 - Open section – 1st prize and also a special Australian Institute of Landscape Architects (QLD) Award for the use of landscape planning in the environment.

Roy and Lurline consider that the actual and future income, as well as the environmental benefits that are derived from the trees, will leave their children and grandchildren in good stead if they wish to follow in the family farming tradition.

Summary and Lessons Learnt

The key to Roy and Lurline's farm forestry enterprise has been a 'steady as she goes' approach. They have consistently planted small areas of trees over a long period of time. This has ensured that implementation costs have been kept at a minimum and planted areas are manageable.

The integration of trees into the farm landscape has produced the desired environmental benefit. Returns from trees have also supplemented farm income as small blocks are harvested or young trees are sold for landscape plantings in Brisbane and other major cities.

Their farm forestry attracts a great deal of interest from local conservation groups, natural resource agencies and education groups. Their efforts have been recognised by a number of awards, and they are seen as innovators in the field.

Case Study 9

**Keith, Elva and
Peter Rolinson
'Hillman Park'
Kalannie, WA**



Figure 53: Location of Case Study Site

The Farm

Keith, Elva and Peter Rolinson's property 'Hillman Park' is situated 12 km east of Kalannie, in the North–Central wheatbelt area of WA, approximately 300 km north east of Perth. Keith's father settled the original 1000 hectare block in 1925. Since then the property has gradually expanded to its current 5500 hectares through purchase of surrounding properties higher in the watershed.

The property has duplex soils ranging from red clay to light sands. The average annual rainfall is 275 mm but in the past 10 years the average has increased to over 300 mm. The principal enterprises on the farm are wheat, pulses (as a disease break and for soil fertility) and grazing sheep. On average they plant 2500 ha of wheat and 320 ha of lupins. The remaining 2180 ha of arable land supports 4000 sheep at a stocking rate of around 1.5 DSE (Dry Sheep Equivalents) per hectare. The sheep enterprise is a self-replacing Merino flock, producing 22-23 micron wool. Rams have been purchased for 30 years from Manunda Merino Stud at Tammin.

Objectives of the Farm Forestry Enterprise

A major problem facing the farm has been surface and groundwater management. Water management was one of the motivations to purchase the neighbouring properties higher in the watershed. The long-term aim is to have control over water management across the farm catchment.



Figure 54: Mid slope planted mallees to dry out seasonally inundated area. A small amount of ponding occurred this year after several extreme rainfall events.

Salinity was first identified as a problem in the area in the early 1960s, with groundwater rise being the major cause. The Rolinsons were aware of an emerging salt problem on their property from the mid 1970s (currently affecting 5 to 10 percent of the property). Treatments including contour banks on heavy soils, deep ripping on the contour on heavy soils, and some landcare planting of trees aimed at minimising erosive damage caused by surface water runoff.

The landcare tree plantings included River Gums (*Eucalyptus camaldulensis*), saltbush (*Atriplex amnicola*) and other local eucalypt species. However, since the early 1990s, the Rolinsons have become involved in establishing significant plantings of Oil Mallees (*Eucalyptus kochii*) to combine achievement of their environmental objectives through a commercial enterprise.

Keith and Elva's interest in Oil Mallees was sparked in 1993 through association with their neighbours and other farmers in the district. At the time, John Bartle who works for the Department of Conservation and Land Management (CALM) and researchers from Murdoch University believed that there was potential to establish a Eucalyptus Oil industry in WA by establishing six 'cells' of Oil Mallee plantations across the lower rainfall regions of the state. The Kalannie district was selected as the location for one of these cells due to the enthusiastic adoption of the idea (and significant plantings undertaken) by several farmers in the region. These farmers have been closely associated with the development of the Oil Mallee industry in Western Australia. Elva is the treasurer of the Oil Mallee Association (OMA) and is a Director of the Oil Mallee Company (OMC).

To date the Rolinsons have established a total of 35 hectares of Oil Mallees. These plantings range from row plantings along contours, to alley and block plantings on recharge areas that have been identified on the lighter soils. The plantings are spread through 10 paddocks and exert a positive water use influence of 1000 ha of land.

Implementation and Management of Farm Forestry

It is believed that the oil mallees will require minimal ongoing management. Future management requirements include some insect and weed control and grazing management within the plantations immediately after harvest. After planting and allowing several years for the development of the lignotuber, the OMA believes that it will be possible to harvest biomass by cutting the trees at ground level and allowing regeneration through coppicing. No management of the coppice is expected to be required. The Rolinsons have established the oil mallees in both block and contour configurations to suit the conditions at each particular site on Hillman Park. There are various species available, which allow growers to match species to individual site conditions.

The OMA in conjunction with CALM runs testing and selection programs to ensure that the genetic material is continuously improving both in terms of its ability to produce biomass and foliage with a high oil content. The following research and development projects funded by the RIRDC/LWRRDC/FWPRDC Joint Venture Agroforestry Program (JVAP) are currently being undertaken by the Oil Mallee Company and the Oil Mallee Association:

- Silviculture and water use of short rotation coppicing tree
- Evaporation cell techniques for field based extraction of eucalyptus oil
- Integrated mallee processing for carbon products, eucalyptus oil and electricity

Analysis of Impacts

This study is different from other studies in this series, as the primary product of the farm forestry enterprise is not wood fibre (although this may be a potential market). The development initially aimed to produce eucalyptus oil at low enough cost and large enough volume to be able to penetrate markets for industrial solvents. More recently the potential to complement this with products derived from the residue, including wood products (panel board, charcoal and activated carbon) and bioenergy has shown promise. Marketing of carbon credits may also have commercial potential. As yet, commercial harvest and distillation operations have not been implemented, but, the industry is organised, and research and development are well underway. For this reason, costs of production and prices for oil have been estimated for this analysis from information developed by the OMA of Western Australia.

This section describes the economic, social and environmental impacts of the Rolinsons' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 48 year time horizon. Although it is possible that the oil mallee plant may continue to provide income up to 100 years of age, a shorter time period was chosen to provide some comparability with other case studies in this series. Oil mallees are assumed to finish their economic life at age 40. The assumption is justified because, after the effects of discounting, cashflows occurring after the 48 year time period would have a minor effect on the results. Nevertheless, the potential benefits from oil will be understated in this analysis,

There is considerable uncertainty inherent in defining many of the production parameters (both agriculture and forestry) and extrapolating these over a long time frame. A basic sensitivity analysis to changes in assumptions for agricultural returns and forestry production assumptions is presented in the following section. However, all information used to model the 'with trees' and 'without trees' scenarios has come from interviews with Keith, Elva and Peter and consultation with John Bartle of CALM.

The benchmark scenario used for comparison is the hypothetical situation in which no planting is undertaken. In other words, the first scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1993 (the 'without trees' scenario). The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1993 ('with trees' scenario).

The Western Australian Oil Mallee Association coordinates the supply and planting of seedlings to farmers and promotes the industry, whilst the Oil Mallee Company is commercialising harvest, processing and marketing. The Company is currently involved in a commercial feasibility study in partnership with JVAP and Western Power on the integrated production of eucalyptus oil, activated carbon and electricity from oil mallee feedstock. Pledges for the \$5 million required to build a 20% scale pilot 'integrated mallee processing' plant are being assembled. It is projected that this plant would generate 60% of its revenue from activated carbon, 20% from eucalyptus oil and 20% from 'green' electricity. Carbon sequestration within the lignotuber of the mallee is a possible marketable commodity that is not considered within this analysis.

Economic Impacts

The economic impacts are assessed using a spreadsheet-based whole farm model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows for the farm on an individual paddock scale have been calculated. These have then been aggregated to the whole farm level and fixed costs have been subtracted to gain a measure of gross income. Taxation is then calculated for each year of the analysis and subtracted from gross income to give a measure of net income. Data used for this evaluation has been developed from the paddock and accounting records of Hillman Park.

Because there is currently no harvesting or marketing of produce from the oil mallees, it is necessary to derive the enterprise production and cost information from analyses provided by the Oil Mallee Association of Western Australia.

This evaluation only considers the production of oil from the mallees, which are first harvested at four years of age and every two years thereafter. The lifetime of an oil mallee managed in this way may be as much as 100 years. However, for the reasons given above, the analysis runs over a 48-year time frame.

The key assumptions relate to the biomass produced and the oil content within this biomass. It is assumed, that from first harvest at age four, production is 10 kg of biomass per mallee over the two year rotation. Oil content is assumed to be 1.5% of biomass at the first harvest and 1.75% for each harvest after this. The oil is assumed to be valued at \$1 per kilogram to the grower net of harvesting costs.

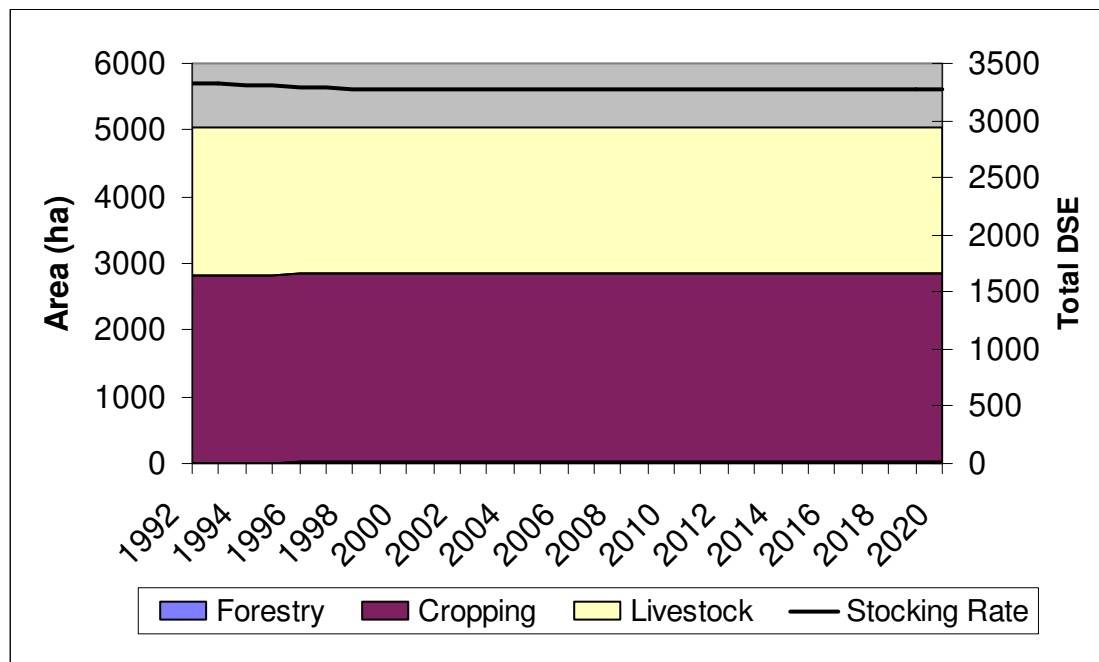


Figure 55: Land Use and Stocking Rate

Figure 55 above illustrates the farm program and the impact on the carrying capacity of the farm from establishing the oil mallees. All establishment is assumed to occur on land that would have been used for grazing only. It can be seen that establishment of the mallees does not have a significant impact on overall farm carrying capacity due to the

difference in scale of the plantation in relation to the large size of the farm. Nevertheless, establishment has been targeted at ‘drying up’ downslope areas that in some cases were ‘white with salt’. Some of these areas now produce good pasture and limited cropping is possible in some cases. The analysis does not include the additional increases in agricultural production that may occur on previously unproductive areas. However, a limited evaluation of the possible economic scope of environmental benefits is included in the following section.

The area established to oil mallees is small in comparison to the total farm area. It is difficult to put the economic contribution of the mallees to the farm business in perspective due to this difference in scale. Current advice from the State Salinity Action Plan implies that an area of at least 15% of the total would be required to make a significant regional impact for salinity and waterlogging control. Although the area revegetated to perennial vegetation on Hillman Park is much smaller than this, anecdotal evidence shows that the Rolinsons have had some success in managing ‘problem sites’ using a combination of strategic revegetation and other surface water management practices.

Figure 56 illustrates the net farm income that results under the ‘with trees’ and ‘without trees’ scenarios.

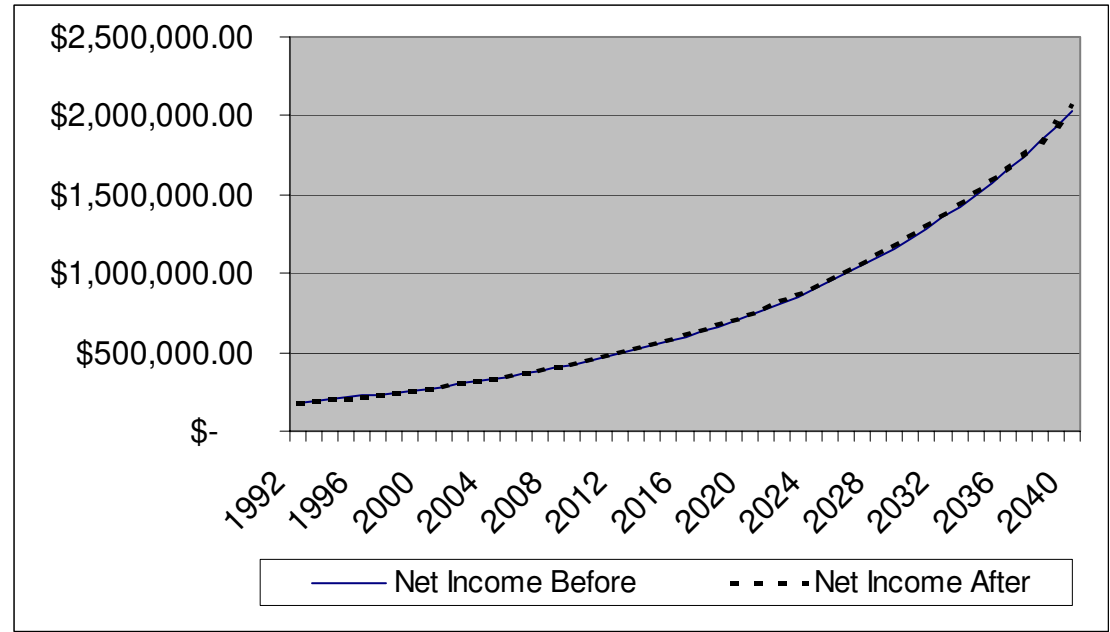


Figure 56: Farm Net Income (nominal) 1993-2040

Note that the cashflow without trees has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis. The graph of net income above illustrates the financial impact of farm forestry on the farm.

As stated above, the scale of the farm makes the financial impact of the oil mallee small in comparison with the rest of the farm. The graph shows a slight positive improvement in net farm income over the project cycle.

The following graph shows the scale of annual pre tax costs and returns for the oil mallee enterprises alone. The productive life of the oil mallee tree has been assumed to be over at age 40 although there is potential that they may have a harvestable lifetime of 100 years.

The present value of the cashflow (discounted at 5%) with trees is just over \$8,761,866 while the present value of the cashflow without trees is \$8,746,837. This indicates that the Rolinsons would make a small profit (\$15,029) over the life of the project if assumptions about price and production hold true. Although the returns are small in comparison with income on the rest of the farm, the Rolinsons are keen to point out that investment in establishment of Oil Mallees on farms in low rainfall areas may well provide a profitable way of incorporating perennial vegetation back into the agricultural landscape. This is significant because commercial forestry operations for low rainfall areas are scarce. Ongoing management is also relatively simple and cheaper than for other revegetation options because there is no need to fence areas for stock exclusion as long as sheep are kept off young or regenerating mallee plants. The Rolinsons have found that stock do not find Oil Mallee foliage palatable and will not choose to graze oil mallees in preference to pasture.

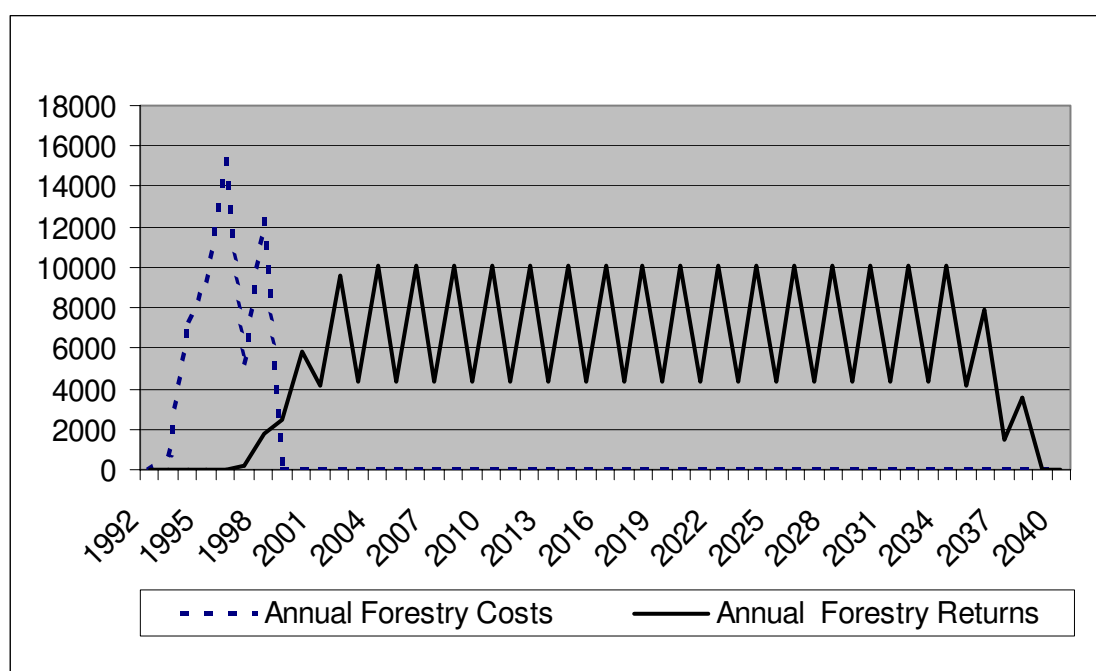


Figure 57: Annual Forestry Costs and Returns (nominal)

Figure 57 shows the expected annual income stream resulting from existing plantings over the life of the project. The ‘lumpy’ income stream will flatten out as more mallees are established. Commercialisation of products apart from the Eucalyptus oil may also have a significant positive impact on the income. However these returns are uncertain at this point.

NPV is a scale dependent project statistic. It can sometimes be misinterpreted as its results are absolute and give no information about the ‘relative’ profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project. For this project the BCR over the 48 year time

frame is 1.70, indicating that for every dollar invested approximately \$1.70 will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity the difference in NPV works out to an additional annual income stream of \$831 per year over the project period. The proportional increase in farm income over the ‘without trees’ scenario is minor at 0.17%.

Table 22: Project Summary Statistics

NPV	\$15,029
BCR	1.70
Annualised NPV	\$831
Proportional increase/ decrease in Annual Income	0.17%

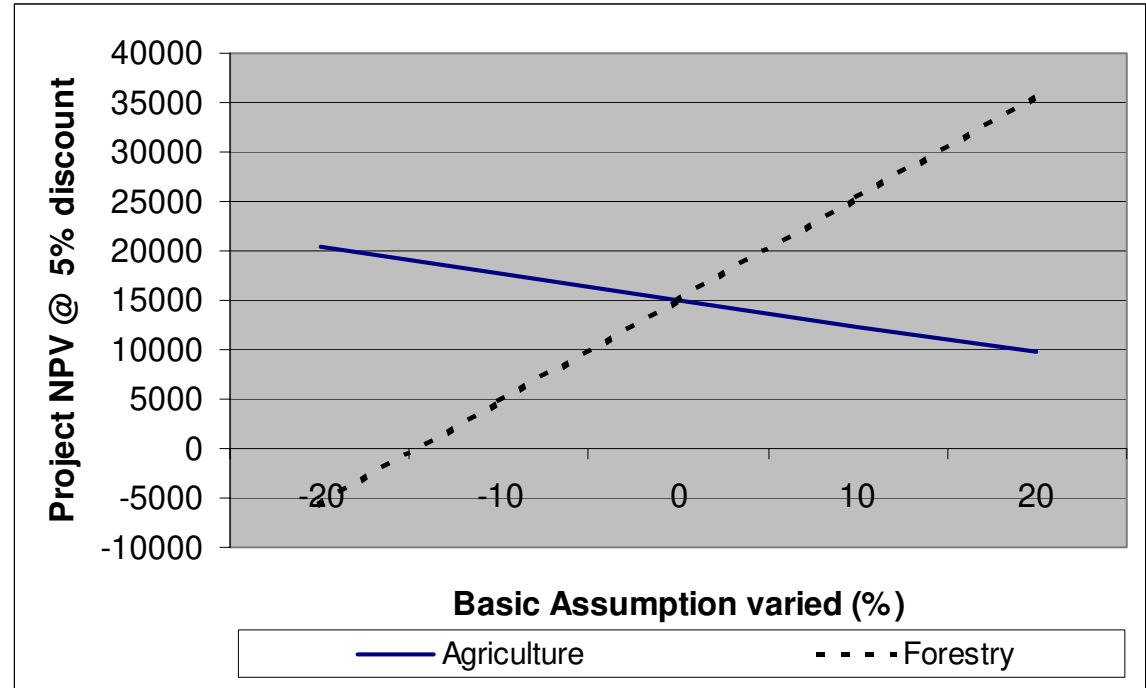


Figure 58: Sensitivity to Changes in Assumptions

Figure 58 highlights that project outcomes are sensitive to changes in assumptions relating to the oil mallee enterprise. A large decrease in the returns to the oil mallees has the potential to result in a negative income being generated by the project. However, assumptions used to generate these results are considered by the industry to be conservative and it is therefore unlikely that assumptions will fall to the level required to generate a negative return. Project returns are relatively insensitive to agricultural returns. This is due to the fact that the land occupied by the oil mallees would have been occupied by grazing which has a lower opportunity cost than that of cropping enterprises.

Under the less conservative assumptions that agriculture returns are 20% lower than assumed and forestry returns are 20% higher than assumed the project returns an after tax profit of \$33,900.

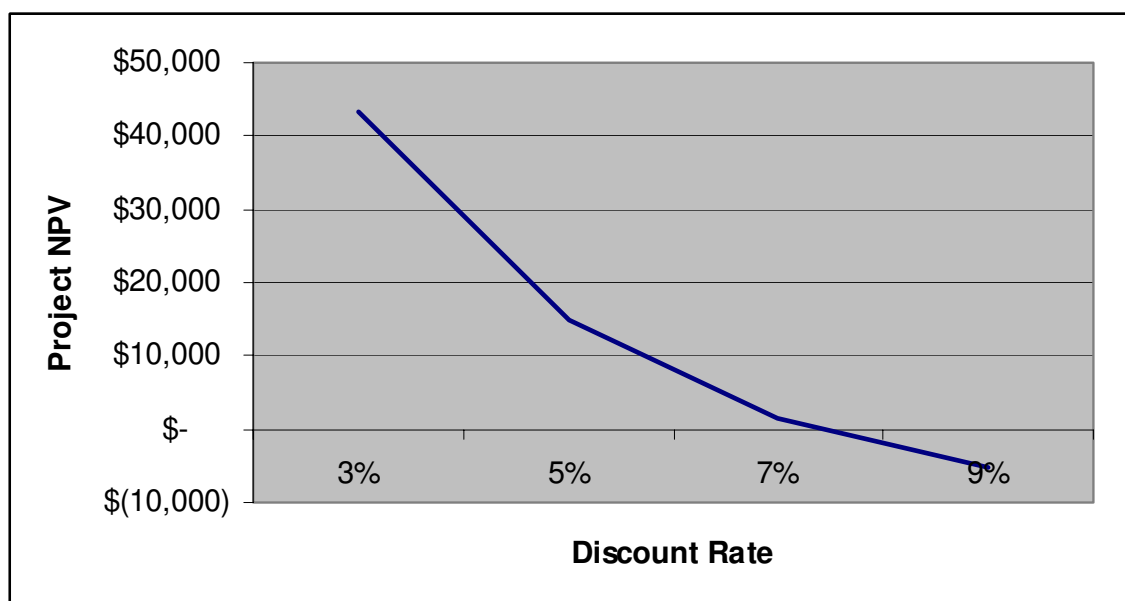


Figure 59: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make the forestry project less attractive economically because of the normal forestry pattern of costs and returns over time. Oil mallees are not affected so much by changes in the discount rate because they provide a bi-annual income stream. The project is still sensitive to discount rates; an increase to over 7% will lead to a small negative NPV accruing to the project.

Table 23: Key Assumptions

Keith, Elva and Peter Rolinson	
Area of Farm (ha)	5500
Arable Land (ha)	5036
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1993
Timeframe	47
Interest Rate on Savings	5%
Interest Rate on Borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin(\$/DSE)	21.99
Wheat Gross Margin	\$151.83
Lupin Gross Margin	0
Tax Regime	5 year averaging

Environmental Impacts

Current advice from the State Salinity Action Plan states that an area of at least 15% of the total would be required to make a significant impact on waterlogging and salinity control. This figure is speculative and dependent on a range of factors. Keith and Elva have had some success in achieving land conservation objectives by careful planning of the sites established to make use of both available soil moisture and appropriate soil

types. Their plantings in a range of configurations are situated within 10 separate paddocks and have a positive influence over up to 1000 ha of land.

A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting was assumed to stop a decline in productivity on the 20% of the farm for which the oil mallees exert a positive influence. It was assumed that, without the tree plantings, a 10% decline would accrue over the 48 years of the project as a result of saline encroachment and increased waterlogging on this area. This is consistent with a 2% decline in productivity over the whole farm over a 48 year time period. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$15,029 to \$190,818. Clearly, where forestry confers a positive influence on neighbouring land uses, the medium to long term benefits can produce a significant payoff to the enterprise when viewed as a whole business.

Keith and Elva's motivation to become involved in Oil Mallees was born out of a desire to find trees that would help to manage their groundwater recharge and surface water run-off problems. The positive impact that the tree plantings and the other surface water management practices have had in reducing saline discharge areas as well as controlling surface water run-off is apparent when visiting the property. The farm visit occurred several days after an extreme rainfall event (the second in the 1999 season) that had seen significant erosion and damage to a number of properties in the district as well as massive flooding on a regional scale. Keith and Elva reported that they had only one small site across the whole farm that had suffered from surface water erosion. They believed this was directly due to their 'package of water management practices' in which tree planting, level banks and deep ripping on the contour played an integral role.

All of the saline discharge areas on the farm have been fenced off and have Oil Mallees successfully established upslope to control recharge to saline susceptible areas. Similarly, areas of lighter sand subject to waterlogging have been targeted for Oil Mallee plantings. These areas have shown dramatic reductions in groundwater discharge (in most cases completely drying up any sign of waterlogged soils) leaching salts from areas that were previously 'white' and returning these areas to grass production and some limited cropping (Elva Rolinson, pers comm).

Social Impacts

The main social impacts that the Rolinsons suggest from their Oil Mallee experience stems from Elva's involvement in the Oil Mallee Association and the Oil Mallee Company. Elva considers that her involvement has given her the desire to see the Oil Mallee industry succeed, while at the same time allowing her insight into broader aspects of the industry that she otherwise would not have experienced and that she finds stimulating. She attends two meetings a month in fulfilling both her roles as treasurer and director of the Association and Company respectively.

More than half of farmers in the Kalannie district have planted oil mallees. Several farmers from the district are active contributors to the development of the industry through participation in the Oil Mallee Association and the Oil Mallee Company. There is a strong community commitment to the undertaking as evidenced by cost sharing of equipment such as the tree planters.

The Rolinsons see the long term viability of their operation as being directly dependent on the success of development of tree crops such as oil mallee to achieve control of land degradation.

Summary and Lessons Learnt

Keith and Elva consider that their main lessons learnt are in establishment of the trees. They believe it is important to put the effort into establishing the trees properly, including excluding stock, ensuring appropriate weed control, and spacing at up to 2 metres to reduce competition effects.

They also consider that plantings need to be targeted at areas where they can have maximum effect in 'soaking up' recharge. This is borne out by the significant growth advantage displayed by their plantings on recharge areas as opposed to those planted in areas with lower water availability. Because the siting and planning consideration have taken account of managing water and endeavoring to dry up any areas that were previously subject to waterlogging, it is likely that a significant economic benefit will accrue to this project through its positive environmental impact on adjoining land uses.

Case Study 10

**Wade & Angela Anderson
'Willow Springs'
Boyup Brook, WA**



Case Study 10: Wade & Angela Anderson

Figure 60: Case Study Location

The Farm

‘Willow Springs’ was purchased by Wade and Angela Anderson in 1985 and consists of 1250 hectares in the Orchid Valley area, 50 kilometres west of Kojonup in South Western WA. The property has a 570 to 600 mm rainfall, with a gently undulating, predominantly gravel loam soil base. The farm is a mixed Merino sheep and cropping enterprise. Sheep are grazed at a stocking rate of 7.5 Dry Sheep Equivalents (DSEs) and produce 20 micron wool. The cropping program is an annual average of 100 ha of Barley for manufacturing, 70 ha of canola and 70 ha of oats for feed. In addition to the grazing and cropping programs the farm also supports 170 ha of *Eucalyptus globulus* in an integrated configuration, 4 ha of *Pinus radiata*, approximately 10 ha of mixed species and approximately 150 hectares of remnant vegetation.

When the property was purchased, rising water tables or secondary salinity did not seem to be a problem. However, after a short time it became obvious that salinity and waterlogging would become a serious land management problem. The recharge ability of the deep gravel loams is far greater than those that have a clay base, but the deep gravel loams are also ideal for growing trees. This presented both a challenge for farm management as well as an opportunity to establish trees as an integral enterprise on the property.

Objectives of the Farm Forestry Enterprise

The Andersons started planting trees soon after they first purchased the property in 1985. The principal objective of the early plantings was the management of an increasing area of salinity in the gully areas that occur through the farm. However, it became clear that the only real benefit was an improvement in the aesthetics of the property, as the problems were being hidden but not impacted on by the revegetation effort. Salinity associated with the rising water table became apparent in the gully areas within the first 5 years of purchasing the property.

The first plantings were undertaken within gully areas and were ‘screening’ plantings using various tree species. While these plantings did little to address the problems associated with a rising water table, they served to demonstrate the potential for tree growing as a commercial proposition. After the initial plantings, the focus shifted to planting larger areas of trees further up-slope and in the wetter areas of the farm where cropping was unprofitable or difficult. Some of these plantings were less successful than hoped due to the presence of a shallow clay sub soil and some areas of granite rock which stunted growth of the trees. The final plantings have been targeted at the gravelly loam soils on the recharge areas of the property.

These plantings, whilst helping to address water table rise and associated salinity problems, were undertaken principally as a commercial enterprise.

Implementation and Management of Farm Forestry

When the farm was purchased, the previous owners had established 4 ha of *Pinus radiata*. This 17 year old stand was thinned from 1350 stems per hectare down to 450 stems per hectare in 1998, yielding 260 cubic metres of preservation material for which the Andersons received a stumpage rate of \$29 per cubic metre. The Andersons plan to further thin the stand within the next several years and clearfall at age 30.

The first planting by the current owners occurred between 1985 and 1990 and occupied 10 ha. Gully areas were fenced and planted in four to six row belts on either side of the gullies, using a mix of species. The impact of these plantings was considered to be 'cosmetic' as it became apparent that the trees were treating the symptom rather than the cause of the rising water table.

In 1991 and 1992 a sharecropping agreement was established with the Department of Conservation and Land Management. This enabled the extension of the original gully plantings further up-slope using *Eucalyptus globulus* (Blue Gums) established at 800 stems per hectare (4m x 2m spacing) and occupying 40 ha. The Andersons contributed to the establishment of these trees which increased their equity in the project to 60%.

In 1997 the Andersons entered into a lease arrangement with the Western Australian based plantation company Integrated Tree Cropping Pty Ltd (ITC). A total of 115 ha of *Eucalyptus globulus* was planted in this project. These trees were planted mid-slope at 900 stems per hectare. Prior to planting, rows were deep ripped to 1m and rows were mounded using a 10 disc mounder/cultivator. After establishment, the area between rows was sprayed for weed control for the first two years. Trees were also fertilized for the first two years.



Figure 61: 2 year old *Eucalyptus globulus* planted mid-slope

Analysis of Impacts

This section describes the economic, social and environmental impacts of the Andersons' farm forestry project. The economic impacts of establishing and managing the forest resource are identified by comparing two farm management scenarios over a 35 year time horizon. The time horizon is determined from the time when the first trees were planted on the property to when the final harvest will occur for those trees planted in 1997. The evaluation examines one rotation for each stand established before 1997. Because of the 2 rotation contract with Integrated Tree Cropping Pty Ltd, it is assumed that annuity cashflows from these stands will continue for 20 years.

There is considerable uncertainty inherent in defining many of the production parameters (both agricultural and forestry) and extrapolating these over a long time frame. Where possible, the impacts of this uncertainty will be evaluated. However, all information used to model the 'with trees' and 'without trees' scenarios has come from interviews with the Andersons and consultation with local forestry and agricultural advisors.

The benchmark scenario used for comparison is the hypothetical situation in which no plantation establishment is undertaken ('without trees' scenario). In other words, the scenario looks at farm management without the farm forestry enterprises that have been undertaken since 1983. The second scenario, which is compared to the hypothetical baseline, looks at the actual farm management including farm forestry enterprises that have been conducted since 1983 ('with trees' scenario).

Economic Impacts

The economic impact assessment is developed from a spreadsheet-based model. The model compares farm net income with and without the forestry enterprises. To do this, enterprise cashflows have been calculated for the farm on an individual paddock scale. These have then been aggregated to the whole farm level and fixed costs have been allocated to enterprises as appropriate. Annual cashflow is presented net of tax.

Figure 62 depicts the land use and stocking rate relationships for the farm based on the planting schedule outlined by the Andersons.

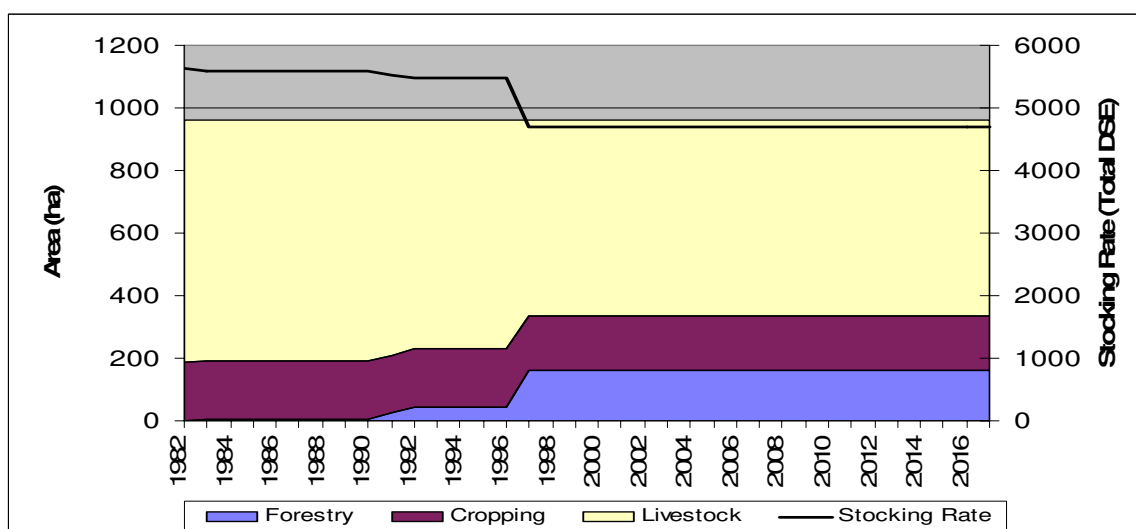


Figure 62: Land Use and Stocking Rate

The impact on the total farm stocking rate of early plantings is not great, although that of the later contract plantings is fairly significant with a decrease in total farm stocking rate of approximately 15%. This does not impact negatively on the farm cashflow because the farm will receive a guaranteed annual income for each hectare of land taken out of grazing and established to trees (the return to trees is higher than that earned through grazing, consequently the impact is positive).

This annual income reduces the farm manager's uncertainty with regard to future cashflows and removes a significant barrier to the adoption of farm forestry, i.e. the long wait between investment and return for forestry projects that are established and managed by the farmer.

Figure 63 illustrates the long term cashflow of the farm.

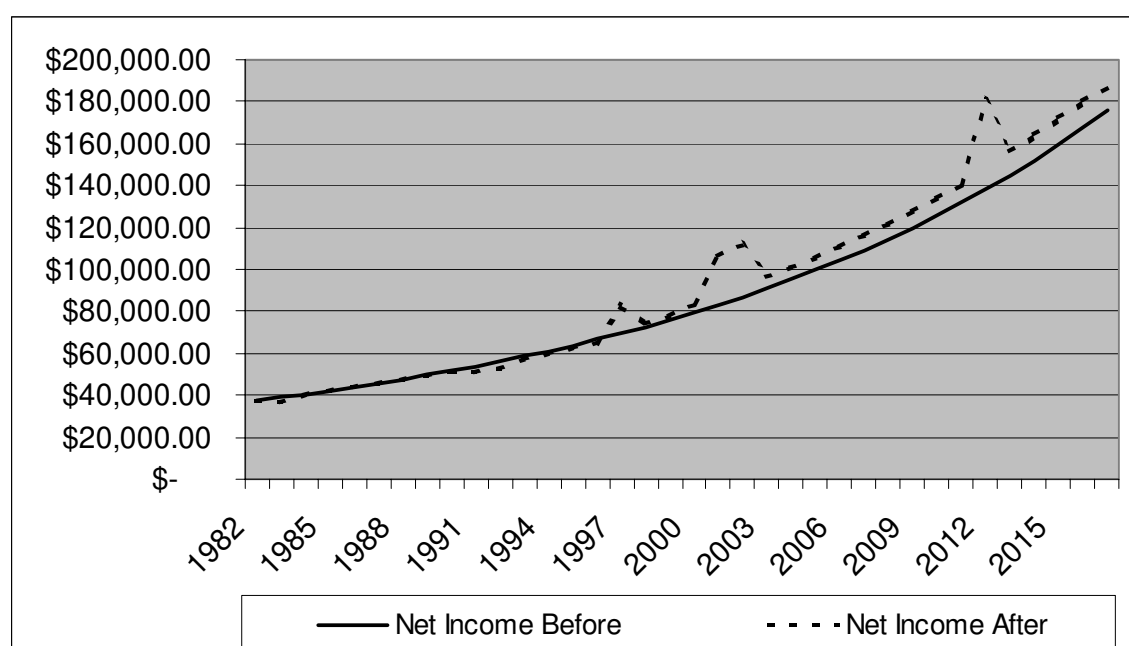


Figure 63: Farm Net Income (undiscounted) 1983-2017

The graph above shows that impacts of early plantings have been negligible, due mainly to the small area of pines established and the fact that the larger area of CALM sharefarmer Bluegums did not incur significant establishment costs to the business. Clearfelling of the CALM bluegums in 2001 and 2002 leads to the first income 'spike', whilst the second is due to clearfall of the *Pinus radiata* stand in 2012. The impact of the annuity with Integrated Tree Cropping is evident from the sustained higher income evident from 1998.

Note that the cashflow without trees has been estimated as an average annual income which remains constant over time. Interest on the cash balance accruing to each enterprise is included within the analysis, leading to the upward trends of the graph.

Figure 64 below shows the scale of annual pre tax costs and returns for the forestry enterprises.

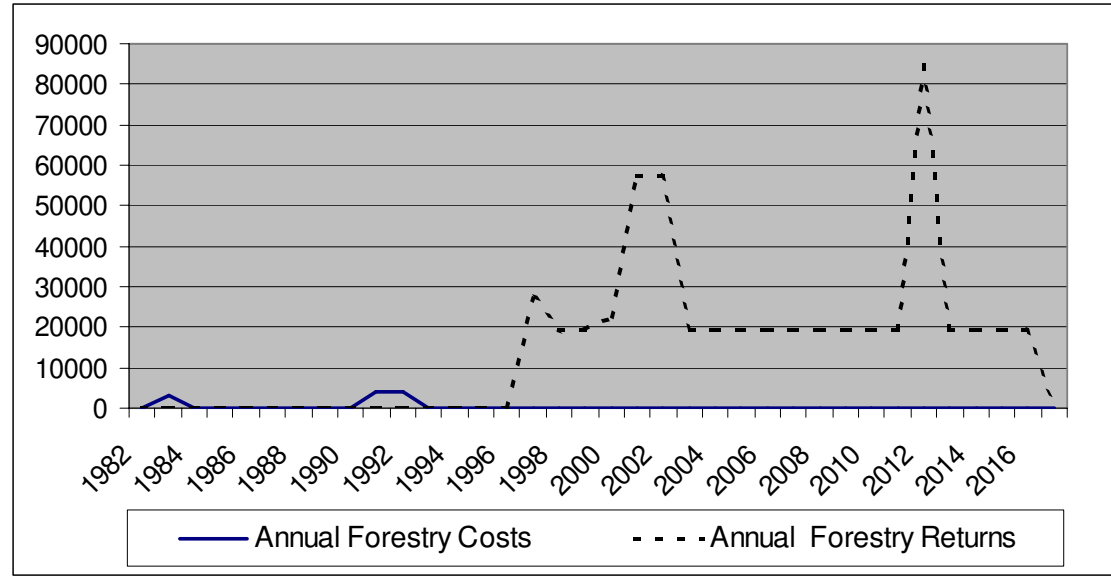


Figure 64: Annual Forestry Costs and Returns (nominal)

The present value of the cashflow (discounted at 5%) with trees is \$1,207,494 while the present value of the cashflow without trees is \$1,153,350. This indicates that given current price assumptions for grazing enterprises and yields and productivity of the forestry enterprise, the project will yield a net profit of \$54,143 in today's dollars (1999).

Net Present Value (NPV) is a scale dependent project summary statistic. Larger projects will generally be chosen over smaller projects without regard to their relative profitability. NPV can sometimes be misinterpreted as its results are absolute and give no information about the 'relative' profitability of the project. The benefit cost ratio (BCR) has the advantage of providing information about the relative profitability of the project (compared to the 'without trees' scenario). For this project the BCR over the 34 year time frame is 3.47, indicating that for every dollar invested approximately \$3.47 will be returned by the end of the project period.

The scale of the project in relation to the overall farm is shown by its contribution to increased cashflow. Displayed as an annuity, the difference in NPV works out to an additional annual income stream of \$3,307 per year over the project period. The proportional increase in farm income over the 'without trees' scenario is significant at 4.69%.

Table 24: Project Summary Statistics

NPV	\$54,143
BCR	3.47
Annualised NPV	\$3,307
Proportional increase/ decrease in Annual Income	4.69%

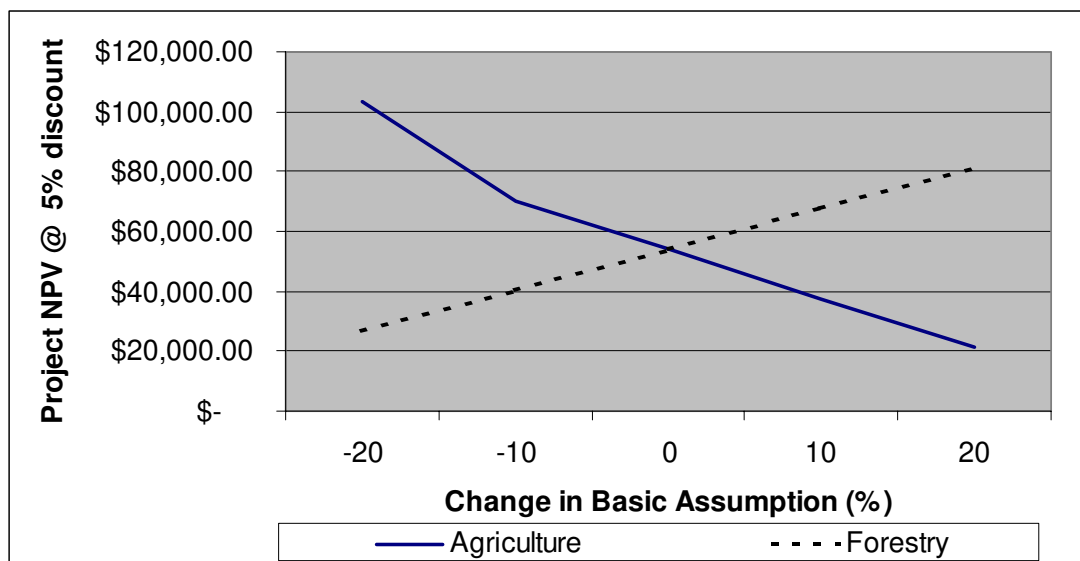


Figure 65: Sensitivity to Changes in Assumptions

The graph above shows that the forestry project is fairly robust with respect to changes in both agricultural and forestry assumptions. The line showing sensitivity to forestry assumptions significantly overstates the actual variability of the project as the majority of income is not subject to changes in market conditions or productivity of the site. The Andersons are under contract with Integrated Tree Cropping Pty Ltd for a fixed annual amount per hectare.

Breakeven calculations define the extent to which tree returns must be lower than assumed (or returns to agriculture higher) before the project 'breaks even' with the 'without trees' scenario, i.e. the difference in NPV for the two scenarios equals zero. Under the assumptions used for this analysis, forestry returns must fall to 60% of their assumed values or returns agriculture must be 133% higher than assumed before the project breaks even.

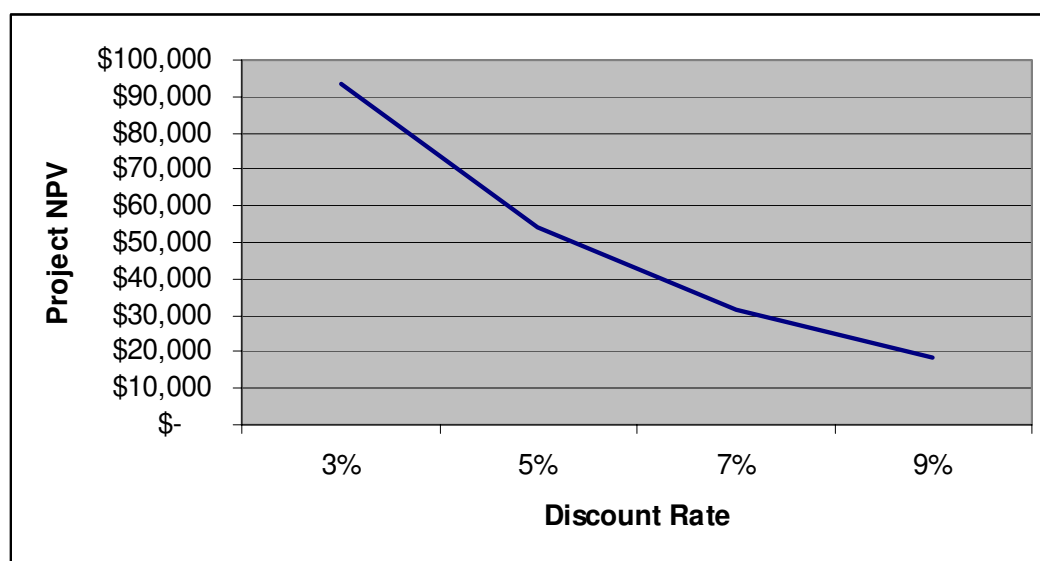


Figure 66: Sensitivity of NPV to Discount Rate

The graph above illustrates the extent to which project NPV is sensitive to the discount rate applied. Higher discount rates effectively make the forestry project less attractive

economically because of the normal forestry pattern of costs and returns over time. However, the Andersons' farm forestry is quite robust with respect to changes in the discount rate. It will generate a positive NPV even when the discount rate is 9%.

Table 25: Key Assumptions

Wade and Angela Anderson	
Area of Farm (ha)	1214 ha
Arable Land (ha)	971 ha
Current Value per ha	\$700 ha
Discount Rate	5%
Current Year	1999
Start Year (First Forestry Investment)	1983
Timeframe	34 yr
Interest Rate on Savings	5%
Interest Rate on Borrowings	11%
Displaced Livestock Sales (\$/DSE)	\$15
Livestock Gross Margin(\$/DSE)	\$13.64
Cropping Gross Margin(\$/ha)	\$203.90
Tax Regime	Averaging
<i>Pinus Radiata</i> MAI	14.7
<i>Eucalyptus Globulus</i> MAI	14.5

Environmental Impacts



Figure 67: A large dam downslope of main plantings has not filled this year despite above average rainfall.

Although there has been no quantitative assessment of the environmental impacts of the tree plantings, Wade suggests the following benefits have been observed:

- reduction of waterlogging and protection from wind has improved crop yields between belts of trees;
- sheep seek shelter between tree belts;
- areas that were previously untrafficable due to heavy waterlogging have now dried to the point where bogging of vehicles or machinery in winter is unlikely.

The main environmental objective of the tree plantings was to reduce water table rise and the onset of secondary salinity. The trees have reduced localised waterlogging of paddocks, and appear to have had a significant effect in reducing water table rise. Evidence of this can be seen on one site where a large dam is situated down stream from the tree plantation. The dam was built just prior to establishing the trees and overflowed in the first few years. Since the trees have matured the dam has ceased to overflow despite above average rainfall years.

A basic sustainability analysis was carried out to evaluate the possible scale of economic benefits on the remainder of the farm if tree planting was assumed to stop a decline in productivity by decreasing the onset of the land degradation issues discussed above. It was assumed that, without the plantings, a 10% decline would accrue over the 35 years of the project. The implementation of tree planting was assumed to prevent this decline from occurring. These assumptions raised the NPV for the project from \$54,143 to \$162,454. Water use benefits of tree planting and its impact on adjoining land uses should not be underestimated, particularly if this allows the conversion of land that previously could not be cropped to areas that can be put into profitable cropping rotations.

The other obvious benefit of the trees is the improvement in farm aesthetics. Gullies have been revegetated and large integrated plantings of trees have been networked through the farm landscape.

At the catchment scale, the Andersons' property is situated in the Warren Catchment, which is a focus catchment for the Western Australian Water and Rivers Commission (WRC). Water flowing from the Andersons' property runs into the Tone River which supplies 10% of the water and 50% of the salt to the Warren River (Anderson, pers comm.). The WRC has lead responsibility for managing salinity in the Water Resource Recovery Catchments (i.e. for the Collie, Warren, Kent, Denmark and Helena rivers) under the Salinity Action Plan. The primary aim is to achieve and maintain potable water quality (the target set is 500 mg/L). The Andersons have planted 25% of their property to trees which should have a positive impact on reducing the salinity problem and helping the WRC to achieve its water quality target.

Social Impacts

There is some tension in the south west of WA surrounding the establishment of tree plantations. Some communities feel that tree plantations have the potential to displace 'traditional' farming. The Andersons have not directly experienced any negative community pressure against establishment of their tree plantations, but they do note that initially their neighbours were 'suspicious' of what they were doing, and at one stage a rumour was circulating that they had planted the whole farm to trees. As a result of a

number of field days, the local community is now a lot more informed and generally supportive of tree projects.

The regular annuity received from the tree plantations provides the family with a higher degree of certainty when predicting farm cashflow. This has a positive social impact on the family to the extent that it removes pressures associated with financial uncertainty.

Other trees planted under the original CALM sharefarming schemes have been selected for use as sawn timber in a separate cabinet making workshop on the farm which Wade manages with a partner. In the future these trees will provide an on-farm resource for conversion by local labour into high value furniture pieces. The workshop and associated sawmill enterprise is not included within this evaluation but does contribute a considerable annual income to the farm business and allows Wade to indulge his interest in cabinet making and production of high value furniture pieces.

Summary and Lessons Learnt

Wade summarises the key lessons learnt as follows:

- Tree belts should be laid out in such a way that room is left for boom sprays to be able to turn at the end of the belts without having to fold the booms. This requires around 25m to be left between the end of tree belts and any fences.
- If trees are being used to address water table problems, then sufficient areas need to be planted to have an effect. The original plantings have demonstrated that ‘tinkering at the edges is a waste of time and money.’
- There is a trade-off between integrating trees into the farm landscape to achieve environmental objectives and positioning trees on appropriate land to ensure commercially viable yields.
- When planting, regular shapes should be used to ensure ease of management of other farm tasks such as cropping and mustering stock.

Wade is reasonably satisfied with all the aspects of his tree farming enterprise. He considers that he is achieving his environmental and economic objectives.

12. Conclusion

The detailed case study reports presented in the previous 10 chapters of this report are the primary outcome of this project.

The motivation behind farmers getting involved in farm forestry is the first issue that each case study addresses. All of the case study farmers considered the long-term viability (both economic and environmental) of their farming business to be the key motivating force in adopting farm forestry. They also recognised that long-term viability was dependent on achieving the maximum sustainable production from their farm business. There are two facets to this issue. The first, and most important, is ensuring that the underlying resource base – the land – is protected from degradation to enable sustained levels of production (essentially addressing any environmental issues to ensure economic viability). The second is to ensure land use is matched to the highest value enterprises (addressing economic management issues through the most efficient use of resources).

In most of the case study properties, trees were being used to address economic and environmental issues simultaneously. However, the emphasis on environmental or economic motivation varied depending on the current physical and financial state of the farm, as well as on individual perception of the challenges that faced the farmer and the tools available to address these challenges. In simple terms, some farmers were more interested in addressing environmental issues, content in the knowledge that this also helped to ensure long term economic viability. Others saw farm forestry as an effective means to address economic issues of effective land use, and environmental benefits were a bonus.

Attempting to assess or summarise the primary objective of the participants does not do justice to the farm forestry or the farmer. In each case study a wide range of issues have been considered, and competing objectives were weighed up in the design and implementation of each project. At the most basic level, six of the 10 studies had a primarily commercial focus, two were focussed primarily on tackling environmental issues, whilst in two cases it was not possible to form a value judgement about whether the main focus was commercial or environmental. However, in every case both environmental and economic issues were considered. The following table lists the main environmental objectives of each participant.

Table 26: Environmental objectives of farm forestry

	Shelter	Erosion Control	Salinity and Waterlogging	Biodiversity
Case Study 1	Y	Y	Y	
Case Study 2	Y			Y
Case Study 3	Y	Y	Y	Y
Case Study 4	Y	Y		Y
Case Study 5	Y	Y		Y
Case Study 6		Y		Y
Case Study 7		Y		Y
Case Study 8	Y		Y	Y
Case Study 9		Y	Y	
Case Study 10	Y		Y	

The second section of each study addresses the various methods used to implement farm forestry. The method of implementation of farm forestry is closely linked to the original motivating factors. Typically those with a more commercial focus have implemented farm forestry in block configurations on land with low agricultural productivity (from an economic perspective – the land with the lowest opportunity cost). In many cases this land is well suited to growing trees. Those whose principal motivating factor has been environmental have made more effort to integrate the trees into the farm landscape in a way that maximises environmental benefits. However, most have also ensured that the trees are managed in a way that will maximise their future commercial potential, e.g. through thinning and pruning.

Another interesting, but perhaps not surprising, trend in implementation of farm forestry is that in all case studies individuals have quickly adopted planting regimes that suit their specific needs and resources. This often involves planting small areas on a regular basis. None of the case study participants is disappointed with the outcome of their efforts, and in many cases the transformation of properties is spectacular.

The following table summarises some of the basic physical features of the farms and the farm forestry projects they have implemented.

Table 27: Physical features of farm and farm forestry projects.

Case Study	Arable Area	Reveg Size	% Planted	Species	Funding of Establishment	Farm	Rainfall	Start Year
1	400	225	56%	Euc. glob	Self and Annuity	wool	650mm	1993
2	1052	249	24%	Euc. glob and P. rad	Self	graze and cabernet	700mm	1975
3	249	23	9%	Mixed	Self, some JV	prime lambs and cattle	700mm	1993
4	2082	271	13%	Mixed	Self	mixed	850mm	1977
5	142	41	29%	Euc. nitens and P. Rad	Previous owner	cattle	1100mm	1971
6	448	35	8%	Mixed	Self	wool	700mm	1993
7	20	2.5	13%	Mixed	Self	macadamia	1735mm	1993
8	210	91	43%	Mixed	Self	Beef	900mm	
9	5000	35	1%	Oil Mallee	Self	mixed	300mm	1993
10	971	160	16%	Euc. glob	Annuity	mixed	570mm	1983

The size of the revegetation project shown above is not necessarily the full extent of vegetation on the property; remnant vegetation and purely non-commercial revegetation are not included. Many of the farmers are also partially through the implementation of whole farm plans. The evaluations only included revegetation that will be established by 2000.

Eucalyptus globulus featured strongly on all of the ‘broadacre’ farms. This is perhaps due to the short rotations and relatively simple management requirements for producing a chip or pulp product.

Each property was different in terms of the physical factors guiding implementation of farm forestry, and this study highlights the diversity of opinions and experience that exists across Australia when the issue of ‘trees on farms’ is broached.

12.1 Economic Impacts

One of the key factors determining the economic viability of trees is where they are placed in the landscape. This is often not dictated by the best soil type for growing trees. The income earning capacity of the trees and the income earning capacity of whatever they displace from the land determines the economic impact of revegetation. If trees can earn more income in real terms than an alternative enterprise over the length of the rotation, then it makes sense to plant trees. If however trees earn less income than an alternative enterprise on the same piece of land, then to be economic they must make up the difference through environmental and social benefits to the farm. Despite the fact that these impacts are very difficult to quantify, they cannot be ignored. Ample evidence of the importance of environmental and social factors in determining revegetation strategies was encountered in this project. The very limited sustainability analysis carried out for this project has shown that environmental benefits from the trees may translate to significant economic benefits that will be realised through increased agricultural production. The analysis shows that where these accrue over a long period and benefit profitable agricultural enterprises, the scale of economic benefits to agriculture can be many times the initial cost of implementation or the actual returns received through sale of forest produce. These results should be viewed with caution however, as the external impact of tree planting on adjoining agricultural land uses is in no way certain. The assumptions used in this analysis are somewhat arbitrary because of the lack of monitoring data available for review.

Nevertheless, the opportunity cost of the investment (the land use displaced by farm forestry) drives the need to match farm enterprises to the land capability. The farmers in the case studies that have planted trees on land with the lowest opportunity cost are getting the best economic performance from the farming system as a whole because they are endeavouring to match land capability with enterprises that maximise the per unit return on that land.

The other economic characteristic of investment in trees is the long-term nature of the investment. Investment in trees is characterised by significant establishment costs, some small annual management costs and often a minimum of 10 years before any income is derived. The establishment costs, combined with cost of taking land out of annual agriculture, has a doubled effect on farm cashflow. Farm cashflow can be significantly reduced in the first few years, followed by sustained lower annual cash incomes until harvest (ignoring any productivity gains on adjoining enterprises).

Another issue which must be considered is the tax implications of receiving large lump sums of income when significant stands are clearfelled. These are all cashflow management problems and good financial planning is required if the maximum benefit of the forestry investment is to be attained. However, the most practical solution that case study farmers have adopted is to match the area planted to their cashflow constraints. Income averaging for tax is a common solution adopted by nearly all of the farmers studied.

Table 27 shows that three of the ten farmers have made use of joint venture or profit share arrangements. Such ventures are available from third party companies and can significantly reduce the establishment cost and management risk of tree planting in return for a share of the harvest proceeds or payment of an annual income. This is due particularly to the restricted operations of these companies which can only operate in areas highly suitable to commercial forestry. However, in some cases farmers expressed a preference to do all of the work themselves, to have a greater degree of freedom on which areas would be established and to fully own the fruits of their labour.

Table 28: Summary of economic results (discounted at 5%)

	Project NPV	BCR	Annualised NPV	Prop. inc/ decr. in Annual Income	Economic Impact	Environmental Impact
Case Study 1	\$154,068	3.93	\$13,180	29%	++	+
Case Study 2	\$160,912	2.35	\$8,525	32%	+	=
Case Study 3	\$(28,889)	1.37	\$(1,746)	-4%	=	++
Case Study 4	\$147,912	17.30	\$8,553	7%	+	+
Case Study 5	\$(313,967)	N/A	\$(17,894)	-24%	--	++
Case Study 6	\$78,668	4.54	\$4,664	28%	++	+
Case Study 7	\$1,062	2.28	\$72	0%	=	+
Case Study 8	\$15,029	1.70	\$831	0%	+	++
Case Study 9	N/A	N/A	N/A	N/A	+	+
Case Study 10	\$54,143	3.47	\$3,307	5%	+	+

+ = positive impact, - = negative impact, = neutral impact

Table 28 provides a summary of the results of the economic analysis for the nine farms on which this evaluation was carried out. Eight of the ten farms can expect direct positive returns of varying significance to accrue from their farm forestry enterprise. In three of these cases the economic value of forestry to the farms is very significant with annualised value of income (at 5% discount rate) being greater than 25% above that which would have resulted without the tree planting.

Benefit Cost Ratios (calculated before tax) ranged from 1.37 to 17.30. The conflicting message from Case Study 3 (a negative NPV and a BCR greater than 1) is the result of complex interactions between the taxation system and the real value of income arising from the trees. The value of 17.30 presented in Case Study 4 results primarily from harvest of native forest for which no establishment or management costs have been paid. The ratio of returns to costs in this situation is high.

The two cases where the farm forestry projects yielded negative economic results both suffered from the problem of trying to generate large enough cash incomes over a long time period to compensate for the loss of agriculture on land which was highly productive. In Case Study 3, the results are not strongly negative. A basic environmental impact in halting the rate of land productivity decline (total of 10% decline over 36 years) was modeled for this evaluation. The farmer has a strong conviction that additional shelter benefits and tree water use would convey at least this level of external benefit to adjoining enterprises. The case study results revealed that if the incorporation of the trees was successful in halting the decline in productivity, then the project would break even.

The worst result in economic terms was from Case Study 5 in which 29% of a very highly productive farm was planted to species with rotations in excess of 30 years. Although the trees were already established on this property at the time of purchase, exclusion of establishment costs for the forestry enterprises still results in a negative NPV totalling -\$245,763. The farmer recognises that the forest resource on the farm is affecting its economic performance and is concentrating on maximising the returns from the trees at the time of clearfelling, before re-establishing at reduced levels and in a more strategic configuration.

Sensitivity analysis with respect to the discount rate was carried out for each case study, using rates of 3,5,7 and 9%. Of the seven 'profitable' projects all showed declining profitability as the discount rate increased. This result is intuitively correct. The higher the discount rate applied, the smaller is the real value of future income. Therefore forestry projects, which tend to have higher returns further into the future than the predominantly annual agricultural enterprises, will always be less attractive economically the higher the discount rate. Three of the projects became unprofitable at discount rates of 9% or greater.

12.2 Environmental Impacts

The environmental impacts of trees include: increased groundwater use; soil stabilisation through root systems; provision of shelter from the elements; provision of habitat for birds, insects and other animals; and aesthetic benefits in the landscape.

On some of the case study properties, trees were planted specifically to take advantage of one or more of these beneficial impacts. Often these environmental plantings were along creeklines or contours, in a shelter belt configuration or in small block plantings on specific sites according to the environmental problem being addressed. On other properties where environmental impact was less of an issue, plantings were guided more by economic factors, but positive environmental benefits were still enjoyed.

12.3 Social Impacts

The social impacts of farm forestry are meant as a 'catch-all' for the impacts on personal, family and community development. Typically the case studies have shown that the extent of success of the farm forestry enterprise dictates the extent of positive impact on personal, family and community development. This is not surprising, given that setting out to achieve a goal and then being successful in that endeavour has a positive impact on many aspects of personal development.

The success at a personal level in turn often has positive impacts with relationships at the family level. At the same time the economic success of the farm forestry enterprise may impact positively at the family level through added financial security and the attendant benefits. Similarly community development is benefited through both economic flow-on from the farm forestry, as well as the increased interrelationship with community that often occurs with farm forestry. This increased interrelationship with community is often demonstrated with case study farmers in their active participation in farm forestry groups, landcare groups, and local, state, or even federal government advisory groups.

For all case study properties, there was a positive social impact at the personal and family level. The most common community level impact came through increased involvement

with the community, but in several instances farm forestry was producing positive economic flow on to the community as well. However, the pressure of maintaining outside commitments is high when farmers are trying to manage a farm, plan for the future and lead an enjoyable lifestyle. The pressure this exerts can lead to a decrease in social welfare if the commitments are not kept to a manageable level.

12.4 Further Comments

The 10 participants (and experienced farm foresters like them) are a very valuable asset to those who wish to promote the greater integration of trees within agriculture. In some cases the participants are actively involved in providing information and time to help develop of the industry. All of the participants were extremely helpful and interested in the process of evaluating the work they had done in establishing farm forestry on their properties. The farm forestry community must be mindful of the pressure under which they place 'role model' farmers. Spiralling commitments combined with the pressure of running a complex business and trying to maintain an enjoyable lifestyle can place more pressure than is desirable on individuals. Farmers as a group can tend to keep working stoically through these difficulties, with the result that personal relationships, health or lifestyle may suffer.

A key difficulty in carrying out this project has been in the collection of data. Whilst in many cases economic data regarding the agricultural enterprises and farm costs was available through accounting and general farm records, data relating to tree yields, management costs and prices was in some cases difficult to access. Having locally appropriate 'role models' is a key strategy to increasing the uptake of farm forestry. It is therefore surprising that the participants in this project (who were chosen as key local role models) do not receive more agency or research corporation support in developing and implementing effective monitoring and evaluation plans. For example, where anecdotal evidence suggests that shelter belts yield a benefit in terms of allowing flexibility in lambing times or faster gains in condition, relatively simple data collection over a period of several years would allow economists to place a more concrete value on this benefit.

Another issue that has been strongly apparent throughout this project is that effective planning and ex-ante (before implementation) evaluation at the project and the whole farm level can prevent costly mistakes. Effective planning and basic economic evaluation can be used as tools for fine-tuning the economic aspects of a plan against those which have a conservation objective. In effect, farmers can decide the total cost (including implementation and opportunity cost) they are able to incur in order to protect the resource base in the long term. Economics is a harsh tool; the process of discounting discriminates against long term projects in favour of enterprises that have an annual income. The farmer must trade off short term costs for long term gains in an environment which is highly uncertain. Anything that can reduce this uncertainty will allow more effective decision making. It is clear from this limited sample of the farming population that land managers are very keen to manage and protect the natural resource base from which they derive their income and lifestyle. However, they must be reassured that they will not be forced into bankruptcy by doing so.

This project has demonstrated that the Australian farm forestry industry is dynamic and vibrant. Commercial options for revegetation are available across southern Australia.

When combined with the positive impacts that revegetation can have on the environment and even social aspects of farming, the future of the industry is very positive.

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Despite various policy initiatives over the past six years, the uptake of farm forestry in Australia has been slow, lagging behind that in countries such as Finland, the USA and New Zealand. One major factor identified as a reason for this slow development is uncertainty.

This report seeks to contribute to the growing body of information that can be used to support farmers in their decision making, decrease uncertainty and promote the faster development of the industry.

The project team examined ten case study farms across southern Australia and found a multitude of approaches to the solution of common land resource management and economic challenges. In every case the objectives of the individual combined with commercial opportunities and environmental attributes to produce a forest resource which was achieving many benefits simultaneously.

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