EVALUATION OF REVEGETATION WITH COMMERCIAL TREE CROPS IN SOUTH WESTERN AUSTRALIA

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ABSTRACT

Tree crops potentially offer a solution to the problem of rising groundwater in much of the woolbelt of South Western Australia. We examine the impacts of extensive revegetation with eucalypts on farm profit, by documenting the performance of a farm where this has been pioneered in the 1980's, and using a spreadsheet model to examine the likely profitability of a range of timberbelt designs. The results point to the profitability of integrating commercial trees and drains with grazing for landcare. A multiple objective framework is then suggested as an appropriate and complementary decision aid for farmers considering such a major change in their system.

The economic and ecological values of much farmland developed from virgin bush within the last 50 years appear to be threatened by rising saline groundwater and the decline of remnant native vegetation. This concern applies over a large area including a 250 km arc between Darkan and Wellstead. An encouraging outlook for wood markets and the observed growth rates of Tasmanian bluegums (*E. globulus globulus*) in the high rainfall zone of South Western Australia, point to commercial tree crops as a solution (Bartle 1991). However, forestry is unfamiliar to most farmers. The traditional view of trees is as competitors with agriculture.

Recent studies (Stapleton 1995, Eckersley 1994) have examined the impacts of extensive revegetation with commercial tree crops on farm profit. One approach was to document the performance of the few farms on which extensive revegetation has been pioneered, by analysing detailed farm records and projecting cash flow 25 years into the future. A second approach has been the development of a spreadsheet model to examine the likely profitability of a range of timberbelt designs and to provide a decision aid.

The adoption of farm forestry is seen as a relatively major change to the farming system. Significant issues arise in more than one dimension in a decision to adopt integrated farm forestry, so a multiple objective framework is favoured for project appraisal. Externalities such as effects on regional groundwater, local infrastructure and employment are potentially significant. It is desirable that farmers better equip themselves for negotiations with other stakeholders, by considering the magnitude of these effects.

Case Study Approach

A Mt Barker farm, of which 10% has been planted to trees since 1983, was studied to trace the known and likely impacts of revegetation on cash flow over 35 years. A network of surface drains was constructed as part of the project. Trees planted were predominantly Tasmanian and Sydney bluegums (*E. globulus and E. saligna*).

The farm is situated centrally within Plantagenet Shire, and average annual rainfall on the property, which covers 896 hectares, is about 700 mm. A further 13% of the farm is remnant native vegetation. Land use is primarily grazing with merino sheep on annual pastures for wool production, with some cereal cropping and beef cattle.

Most of the trees have been planted along valleys. There is now evidence that plantings dispersed more widely and higher in the landscape would be more beneficial (McFarlane & George 1994).

Using likely growth rates and returns for wood production, and estimates of the effects of the trees on agricultural production through shade, shelter and hydrological benefits, farm business cash flows with and without the revegetation project were derived from actual data and projected over 35 years. The difference between the summed with and without scenarios after discounting is the net present value (NPV) of revegetation. A benefit cost ratio (BCR) and equivalent annual value (EAV) is also calculated to measure tne benefit from farm revegetation.

Gross income per hectare for the property over the past 11 years was compared to the Shire average on the basis of total area (Figure 2). The managers of the case study farm appear to have maintained a superior level of farm income per hectare despite the fact that the trees planted on 99 hectares have yet to be harvested.

It is hypothesised that revegetation increases farm cash flow, due to wood production and increased grain and livestock production, resulting from decreased salinity and waterlogging and likely shade and shelter effects.

Results and Discussion

Values for wood, grain and livestock production indicate the potential magnitude of the net income stream for different aggregate farm enterprises (Table 1).

Table 1: Net Present Value of Aggregate Farm Enterprises

	Farm Enterprise			
	Wood	Grain	Livestock	Total
NPV ($)	167 751	41 232	500 767	709 751
EAV ($)	4 660	1 145	13 910	19 715

When anticipated income from wood production is taken into account, in addition to anticipated shade and shelter effects, and hydrological benefits from the reduction of waterlogging and salinity due to revegetation, the net present value (NPV) of revegetation increases significantly. Wood production in the high rainfall zone (above 700mm) can represent up to 24% of the total value of revegetation, while grain represents 6% and DSE's 70%.

Budgeted cash flows for the with and without revegetation scenarios are shown below for the case study farm with the difference indicating the total value of revegetation (Figure 1).

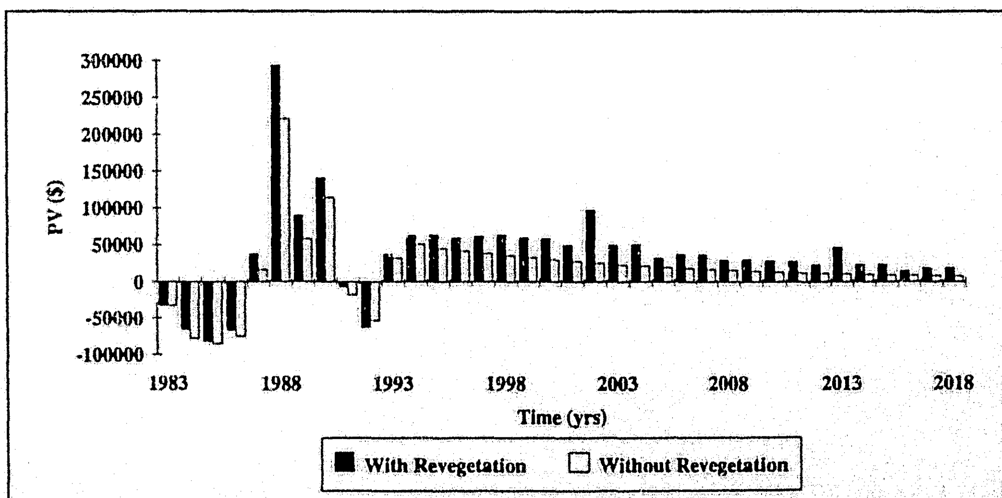

Figure 1: Present Value Cash Flows, With and Without Revegetation.

From 1983 to 1986 the with and without revegetation farm cash flows are negative, the with revegetation scenario showing a greater loss due to the increased spending resulting from establishent of revegetation. That trend was reversed between 1987 and 1990, with a surplus cash flow recorded, while the latter trend of increased costs for the with revegetation scenario continues.

A second cycle of deficit and surplus cash flow occurs between 1991 and 1994, with the costs of establishing revegetation showing in most years. From 1995 to 2018, average seasons are assumed for every year. Annual surpluses are greater for the with revegetation scenario resulting from wood harvests, and increased grain and livestock production, as salinity and waterlogging are reduced and shade and shelter take effect due to revegetation.

Financial indicators also show that increased agricultural yields and wood products derived from revegetation increase farm profit (Table 2).

Table 2: Financial Measures of Profitability.

	Financial Measures		
Real Discount Rate	NPV ($)	BCR	EAV ($)
7%	709 751	2.18	19 715

The NPV of revegetation represents the foregone profit or the opportunity cost of not implementing a revegetation program. The BCR and EAV show a positive outcome for revegetation. A BCR of 2.18 indicates the ratio of benefits to costs is high, i.e. large return from capital outlay. The EAV reflects the equivalent annual return over the analysis period if the benefits were received over the life of the project as an annuity.

Over the last 12 years the case study farm (Farm A) has remained above the district average for agricultural production per hectare on a whole-of-farm basis (Figure 2).

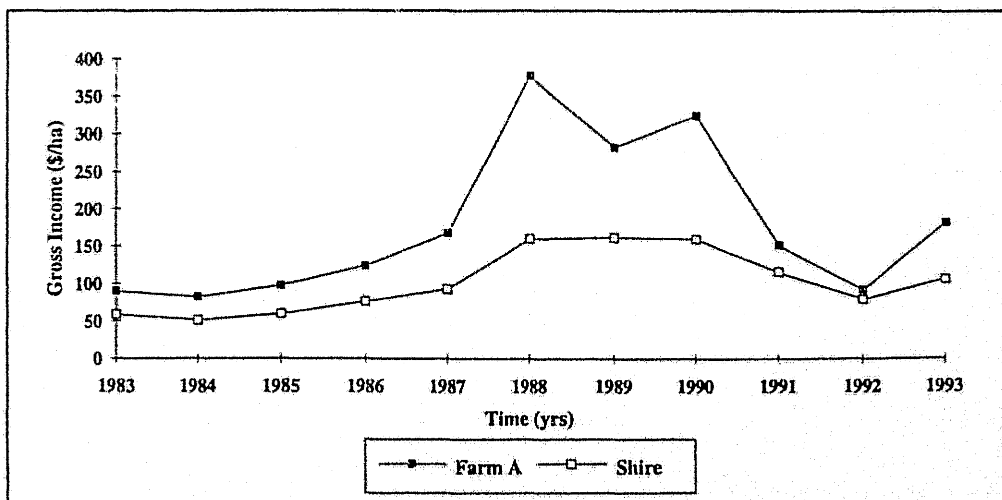

Figure 2: Comparison Between Case Study Farm and Plantagenet Shire for Gross Income Per Agricultural Hectare

The trends of gross income between 1983 and 1993 on the Mt Barker farm matched those of the surrounding Shire, reflecting movements in the wool market.

Conclusions

The hypothesis of revegetation improving total farm cash flow appears to be correct. Revegetation with commercial tree species has economic value, both as a cash crop and as a means to reducing degradation in the form of salinity and waterlogging. Reduced degradation, together with shade and shelter adds to the farm cash flow through increased grain and livestock production per hectare.

Design Approach

Observing the success of 3 row bluegum timberbelts established in 1987 at Bridgetown (850 mm average annual rainfall), Peter Coffey, a farmer some 50 km to the east (600 mm rainfall), saw the opportunity to combat rising groundwater by establishing timberbelts which would produce marketable pulp logs.

A spreadsheet model (BLUEBELT) was used to test the likely profitability of a range of designs. In addition to establishment costs, the opportunity cost of land and revenue from log sales, the model takes account of the expected values of shelter and groundwater control for agriculture between the timberbelts.

Very few measurements of shelter and competition effects of trees on crops and pasture have been made in Western Australia. However, the overwhelming majority of research indicates positive responses to shelter for a wide variety of crops (Kort 1988). It was decided to use the curve adapted in the FARMTREE model (Loane 1994) from New Zealand results (Sturrock 1981) but to remain conservative about the effects in this situation (see Figure 3).

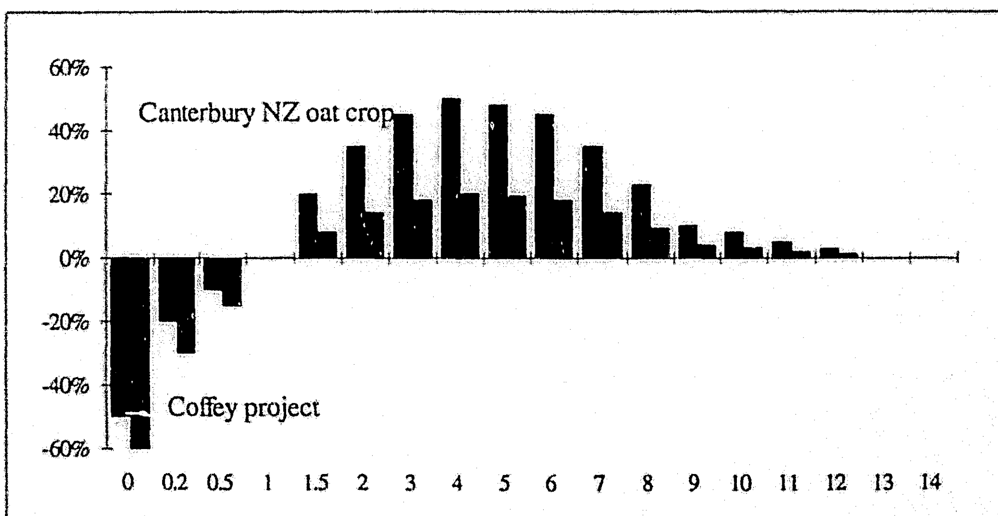

Figure 3. Change from normal yield at various tree heights downwind from a windbreak.

Although hydrogeological research in the area is in its infancy, current understanding of local hydrological processes was used to generate a simple model within the spreadsheet (R. J. George pers comm). This portrays a predicted decline in the areas of saline and/or waterlogged land in response to the amount of tree planting (i.e. relative to the "do nothing" scenario).

Using a sigmoidal function setting minimum and maximum proportions of crown cover required on the landscape, the protection of land from salinity and/or waterlogging starts 3 years after tree planting and reaches a maximum 20 years later (Figure 4). A ceiling is also placed on the proportion of the landscape thought to be at risk.

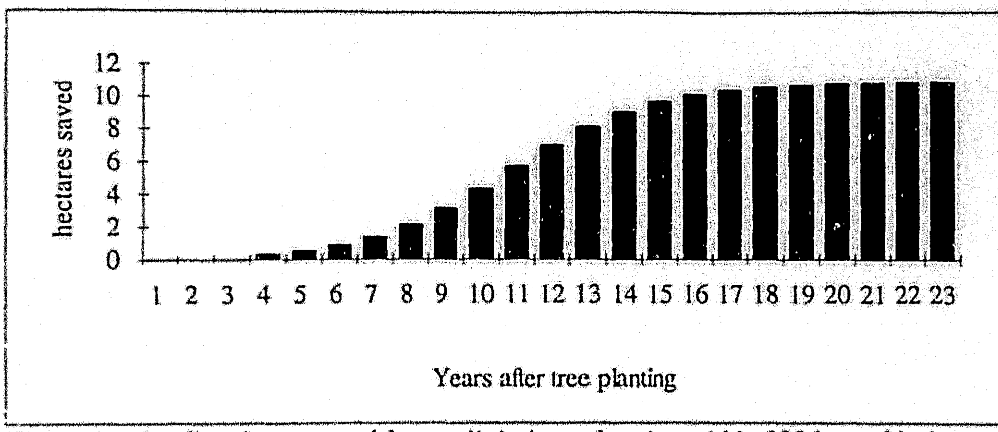

Figure 4. Predicted area saved from salinity/waterlogging within 130 ha paddock.

Results and Discussion

Under the assumptions documented (Eckersley 1994), the project is expected to have a NPV of $34,000 and an IRR of 13 per cent. The Equivalent Annual Value is $26 per hectare per year for the 130 hectare block.

These measures were thought to be the best way to express results to farmers in general, but the response to presentations suggests that many farmers prefer to see results in straightforward cash flow terms. It is contended that farmers prefer to integrate costs and returns over time intuitively rather than rely on a computer and a standard discount rate. The cash flow presentation also highlights the financing issue which faces most who would embark on large-scale revegetation.

Figure 5 shows four separate cash flow effects of the timberbelt project

- direct costs and log revenue,
- opportunity cost of land used for trees,
- competition/shelter effects and
- effects of groundwater control, over the first 18 years of the project.

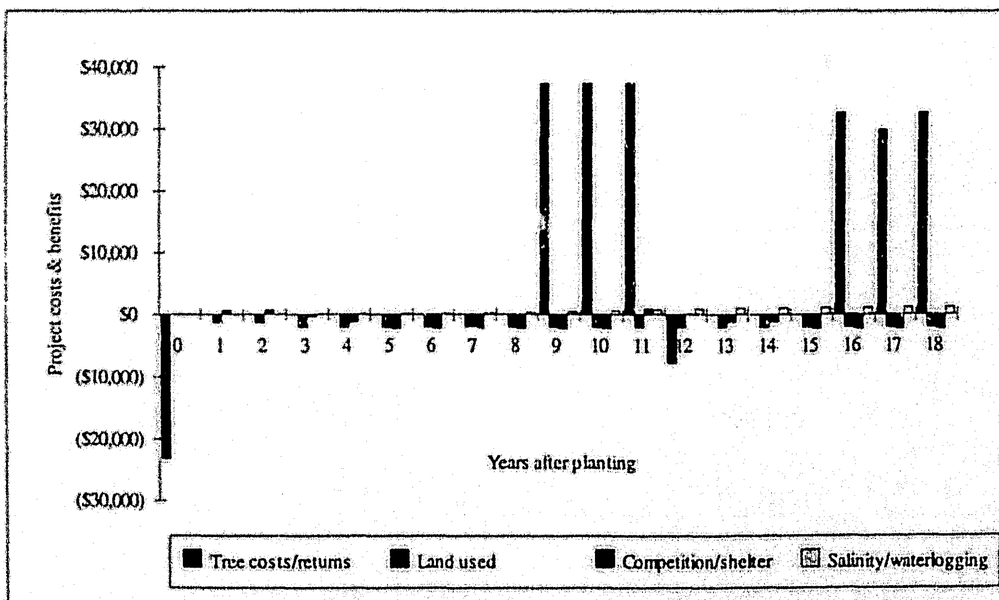

Figure 5. Component costs and returns as calculated for the timberbelt project.

The log harvest is shown as being spread over 3 years for presentation purposes, which may be the case in practice.

The model thus helps our understanding of the relative magnitude of the most obvious economic effects of such a project. Within the plausible range of assumptions, salinity and waterlogging effects appear to be relatively insignificant, but they are expected to be maintained as long the tree cover is retained. Even so, the landcare aspect appears to be a major motivating factor in the decision to proceed.

It is argued that ethical considerations are significant in the decision to invest in the project. This would support the general proposition that ethical considerations enter into the objective functions of economic agents (Colman 1991).

Other anticipated effects may also be considered important by farmers, but are not practical to value in dollar terms. These include off-site hydrological effects, increased biodiversity and landscape effects. A high proportion of these are externalities.

In the context of a rural community where neighbours rely on each other for support, "doing the right thing" by neighbours can be very important in the long run. However it is not practical to quantify this consideration, especially in generic analyses. As we become more aware of the global implications of our individual behaviour, costs and benefits remote in time and space are more likely to be factored into our decisions.

Group decision making is becoming important in rural Western Australia as individual farm planning becomes more entangled with catchment planning. The debate on resource-use conflicts raises issues of diverse and changing ethics and the value of participatory processes in resource-use decisions (Hohl and Tisdell 1993). We economists should broaden our perspective if we are to remain relevant in the development debate.

It also makes sense for the decision aids proffered by farm advisory services to allow for these dimensions rather than ignoring them.

One such aid for analysing the decision to adopt farm forestry on a significant scale is a tabulation of subjective ratings of alternative projects to reflect their appeal according to specified criteria, together with the above quantified effects. An example is Table 3. The values shown are for illustrative purposes only.

Table 3: Rating options according to their expected satisfaction of important criteria.

Options	**Decision criteria**				
	EAV ($/ha/yr)	Extra capital needed	Managerial flexibility	Biodiversity and landscape	Impacts on neighbours
Grazing	100	0	++	-	+
Lease for plantation	120	0	-	+	-
Timberbelt sharefarming	120	$10,000	+	++	+
Own timberbelts	120	$40,000	++	++	++

Some of these criteria can also be addressed in the design and implementation stages (e.g. landscape appeal).

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