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Economics of oil mallees : report

Allan Herbert

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Marketing Economics and Rural Adjustment Services

Economics of oil mallees

Allan Herbert

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### Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Brief</td>
<td>2</td>
</tr>
<tr>
<td>Background</td>
<td>2</td>
</tr>
<tr>
<td>Key issues for oil mallee profitability</td>
<td>3</td>
</tr>
<tr>
<td>(a) Area and planting density</td>
<td>3</td>
</tr>
<tr>
<td>(b) Costs of planting</td>
<td>3</td>
</tr>
<tr>
<td>(c) Time of harvest</td>
<td>3</td>
</tr>
<tr>
<td>(d) Biomass harvested per tree</td>
<td>4</td>
</tr>
<tr>
<td>(e) Price</td>
<td>4</td>
</tr>
<tr>
<td>Method of assessing oil mallee profitability</td>
<td>5</td>
</tr>
<tr>
<td>The Model</td>
<td>6</td>
</tr>
<tr>
<td>Variables and standard assumptions – General</td>
<td>6</td>
</tr>
<tr>
<td>Variables and standard assumptions - Existing enterprises</td>
<td>6</td>
</tr>
<tr>
<td>Variables and standard assumptions - Oil mallees</td>
<td>7</td>
</tr>
<tr>
<td>Profitability of oil mallees 1: Without salinity impact</td>
<td>8</td>
</tr>
<tr>
<td>Graph 1: Break even production values from non-tree area (15% oil mallees)</td>
<td>8</td>
</tr>
<tr>
<td>So .... Is it profitable or not?</td>
<td>9</td>
</tr>
<tr>
<td>Profitability of oil mallees 2: With salinity impact</td>
<td>10</td>
</tr>
<tr>
<td>(a) Toolibin landscape medium impact strategy (incl. Graph 2)</td>
<td>10</td>
</tr>
<tr>
<td>(b) North Baandee landscape medium impact strategy (incl. Graph 3)</td>
<td>11</td>
</tr>
<tr>
<td>(c) North Baandee landscape low impact strategy (incl. Graph 4)</td>
<td>12</td>
</tr>
<tr>
<td>The message in summary</td>
<td>13</td>
</tr>
<tr>
<td>Reference. Acknowledgements. Address of OMA. Obtaining the spreadsheet</td>
<td>14</td>
</tr>
<tr>
<td>Glossary of terms</td>
<td>15</td>
</tr>
</tbody>
</table>
In Brief ...

The profitability of oil mallees has been assessed for a range of sites where farmers might invest on their own land. A 15% planting (i.e. 15% of the paddock in trees) appears generally to be a profitable option if current expected harvest regimes (4 years to first harvest then every second year thereafter) are achieved and an expected price of $15/tonne on-farm for the biomass is received. Longer rotations will reduce profitability but this will usually only occur where conventional crops are also less profitable. Furthermore, profitability may not be the prime reason for tree establishment.

This analysis was done in March/April 2000 while the industry is still in its early development stages. No harvest or processing infrastructure has yet been established. Potential investors should obtain a current assessment of industry development prospects before embarking on levels of investment beyond what they would undertake for landcare reasons alone.

The on-farm price for oil mallee biomass is crucial to profitability with a substantial impact in the $10 to $15/tonne range. The higher on-farm price is likely to be a key to increasing the scale of plantings. However, all this first requires that commercial processing operations get underway.

Farmers taking a cautious estimate of yield and who have relatively good returns from existing enterprises may need to partly justify plantings on the basis of collateral benefits — such as water use, aesthetic appearance of the farm, etc. Proponents argue that trees on the farm will preserve asset values, especially if they reduce the development of saltland. They may also enhance the production from the land between the trees – reduced waterlogging, less frost risk, improved lambing. These issues have not been accounted for in this analysis.

Background

Establishment of the oil mallee industry is progressing and research is advancing with the industry still in its developmental stages. In year 2000, a pilot biomass plant at Narrogin to process material from tree harvesting is being keenly discussed. However, in common with all infant industries, there continues to be uncertainty about supply/demand issues, market outlets and prices, and development of infrastructure.

Farmers are keen to assist the process by planting more trees but want to know “whether there will be a dollar in it”. While major areas of trees on farms have been planted over the last 10-15 years for landcare reasons, profitability of the oil mallee enterprise will be an important factor in more extensive on-ground plantings. A farmer will look at planting oil mallees from the perspective of – “Will I be better off, or at least no worse off?” That is, the combination of returns from both the trees and production from the rest of the paddock needs to be at least equal to returns without the trees. This document attempts to answer this question using the best available information. Changes will occur with further industry development and potential investors need to do their own up-to-date research for best decision making.

Research and development so far indicates that in the majority of agricultural areas, oil mallees will be harvestable 4 years after planting, and then be able to be reharvested every 2 years thereafter. However, plantings will inevitably also go into less suitable sites where
there will be longer delays until first harvest and greater intervals between subsequent harvests with consequent lower returns. On first principles, it appears it will be more difficult to justify oil mallee plantings in these circumstances because low tree returns might not compensate for the profit foregone from normal enterprises. However, yields for the enterprise it is replacing might not be all that high anyway (e.g. wodgil soils) so the opportunity cost could be low – hence the trees option might still be more profitable.

Many plantings to date have been done by farmers for water use and other landcare benefits. There have been numerous comments to the effect that “if they also turn a dollar it will be a bonus”. The influence of the trees on landcare benefits are difficult to quantify in financial terms – however some recent modelling (R. George et al) has provided some clues and 3 scenario analyses are supplied in this document.

Key issues for oil mallee profitability

There are a number of important factors to consider in assessing a potential investment in an oil mallee enterprise:

a) Area and planting density

Mallees are typically planted in 2 row hedges with the rows 2m apart and trees 1.5m apart within the rows. This equates to 1333 trees per km of hedge. Allowing a ‘buffer’ of 1.5m on each side of the hedge means that 2km of hedge occupies 1ha of land.

The arrangement of hedges in a paddock is flexible and may vary from block plantings where hedges are only 5m – 10m apart to low density alley layouts where hedges are up to 100m apart. One scenario used by the Oil Mallee Association is to plant 400 trees per hectare of paddock in hedges which would occupy 15% of the land. The arrangement of hedges could vary from single hedges spaced at 33m intervals to double hedges spaced at 67m intervals to triple hedges spaced at 100m intervals.

b) Costs of planting

Many farmers and contractors have now gained planting experience to ensure survival rates of 90% or better. Cost per tree planted (i.e. after spraying, ripping, and planting) has varied from around 55 cents under full contract down to 45 cents for a farmer preparing the site and planting himself. Natural Heritage Trust funds have been used to subsidise this cost for some sites which meet certain criteria - but has not been factored into this analysis.

Most sites will benefit from post-planting follow-up and second year weed control. Fencing might be an additional cost, although most farmers find that a small adjustment in grazing management can avoid these costs.

c) Time of harvest

The number of years from establishment until first harvest will vary according to quality of establishment work, weed control, and growth conditions at each individual site. Recent data shows that with good establishment, the threshold average yield for efficient harvest of 15 kg/tree (or 19 t/km of twin row hedge or 38 t/ha) will commonly be met by age 4. However,
there will be some low yield sites (e.g. shallow or salt affected soils) where first harvest might not be possible for 5-6 years.

Similarly, the period between harvests can vary according to site conditions and planting layout. It is expected that harvest every second year will be most common, but again there will be situations where longer intervals are necessary.

The standard results presented in this analysis reflect a harvest schedule of 4/2 – that is 4 years to first harvest then successive harvests at 2 year intervals. It is expected that around 60% of sites will achieve this cycle of production.

Two lower yield sites are also presented for comparison:
- 5/3 - First harvest at 5 years then every third year (possibly around 30% of sites)
- 6/3 - First harvest at 6 years then every third year (around 10% of sites)

Time of harvest and harvest interval are critical factors in determining how soon planting costs are retrieved and the overall profitability of the venture.

**a) Biomass harvested per tree**

Site characteristics determine biomass production which in turn determines optimum harvest intervals. Development of harvest machinery under research programs by the industry has been targeted at average yields per tree of 15 kg for efficient operation – although actual yield per tree will vary significantly, even within the same row. The times to first harvest and subsequent harvest intervals (refer previous section) have been chosen to approximate an average harvest yield of 15 kg/tree in each case. Some sites in southern regions have been yielding an average 20 kg/tree.

**b) Price**

The long term industry plan is for deliveries of harvested ‘whole chipped’ mallee biomass from farms to central processing plants positioned strategically throughout rural areas. The bulk material will be separated into leaf material for oil production in a distillery, wood chip for production of activated carbon, and the other fractions (and spent leaf) will go into electricity generation. Price paid for the bulk material will reflect processing costs and prices received for its components.

At this early stage of industry development, careful estimates indicate a price of around $30/tonne for the biomass delivered at plant. Contract harvesting (using machinery specially developed for the purpose) and cartage costs, within a 50 km radius of the processing plant, has been estimated to cost around $15/tonne, resulting in an on-farm price of around $15/tonne.

A ‘pool’ price is being discussed for initial processing plants, where a proportion of the biomass will most probably need to be sourced from large distances until greater tree areas are available closer to the plant. Freight costs are likely to be high due to the low bulk density of the harvest material. Additional costs for long haulage distances of $7-8/tonne could halve the return for farmers more distant from the processing plant. Hence there is discussion about growers outside the 50 km radius being paid an ‘average’ price – say...
$10/tonne – regardless of distance from plant. In effect, closer suppliers would be subsidising those from further away but it might be necessary to attract sufficient supply for efficient operation of plant capacity. Seasonal conditions will make it difficult to supply any factory 52 weeks per year from the immediate surrounds and a balance will need to be struck between stockpiling and longer hauls.

No price is yet guaranteed. A 'standard' price of $15/tonne has been used in this analysis on the assumption that the grower is within 50 km of the plant and steady progress is made on improving harvest and transport infrastructure. Pessimistic and optimistic scenario testing could use $12/tonne to $18/tonne respectively. Investors need to stay abreast of industry development and possible prices when planning their individual projects.

Method of assessing oil mallee profitability

Like many investment strategies, oil mallees require expenditure 'up-front' to establish the trees in the ground but returns are not received until harvests in later years. To assess the profitability of such a venture from a farmer perspective, cash flows need to be looked at over a number of years.

A 20 year period was chosen to track successive cash flows. There is less chance of profitability for shorter time horizons given the establishment and growth stage of 4 years before first harvest - even longer for poorer sites. Running the analysis over longer periods (30 years, 50 years) is not appropriate for most people’s planning horizons, and discounting means that values in the later years contribute very little to the overall result anyway.

The following graph represents the conceptual framework for the analysis and shows the differential cash flows from a 50 ha paddock. For the ‘do nothing’ approach, it is assumed there is a (nominal) 10% deterioration in productivity – perhaps due to increasing waterlogging or saltland development or wind erosion, etc. This is contrasted with 15% of the area planted to oil mallees - which are assumed to prevent the deterioration occurring. Existing enterprise production value is $40/ha.
The “without trees” line shows a positive net cash flow slowly declining over the 20 years. On the other hand, the “with trees” line shows a cash flow deficit in the initial years due to the cost of establishment - followed by improved returns in later years as the oil mallees are harvested. The investment analysis sorts out whether the sum of the future improved returns where the farmer is better off are sufficient to make up for the early years when the farmer is actually worse off. (In this case, under the assumptions used, the benefits are one-and-a-half times the costs so it is a profitable situation.)

**The Model**

An Excel spreadsheet ([Oilmallees biomass BCA.xls](#)) was prepared as a calculator. This can be used either for plantation style tree blocks where oil mallees completely replace an existing enterprise, or where the oil mallees will only be part of a paddock (e.g. hedge rows).

It uses a discounted cash flow framework where all costs and future returns over the 20 years can be discounted back to present day values. This then allows comparison of 2 different streams of cash flow with results expressed as a Benefit Cost Ratio (BCR). If the returns from the “with trees” strategy are greater than the returns from the “without trees” strategy minus the costs of putting the trees in place, then the strategy is profitable and BCR will be greater than 1.

The spreadsheet allows analysts to change a number of variables depending on the particular circumstances under investigation.

**Variables and standard assumptions**

**General**
- **Discount rate:** 7% was used as the discount rate.
- **Area planted:** Analysts can choose size of paddock and area of oil mallees to be planted. The standard analysis uses a 15% area of mallees (e.g. 15 ha in a 100 ha paddock) but variations to this look at potential impacts on saltland.
- **Saltland:** The standard analysis in section 1 does not involve differential saltland outcomes. However, analysts can nominate current level of saltland (as % of the paddock), % in 20 years time without the trees, and % in 20 years time with the trees. The assumption is that saltland has nil production and therefore does not contribute to income. Three saltland scenarios are presented in section 2.

**Existing enterprises**
- **Production value:** A production value must be nominated to simulate the profitability of existing enterprises. It should be net of fixed costs (e.g. net margin) given that the oil mallees will have a cost of establishment. The actual number nominated is not as important as testing a range of values appropriate to the site of interest in the analysis. The production value is assumed to apply to the production land (i.e. not on the saltland nor on the land planted to trees) for the whole 20 years. It can be adjusted if there is reason to suggest that production value will decline over the
period – for example, due to progressive land degradation without the trees being in place. Similarly, the production value can be increased over the period – for example, due to tree planting perhaps having a beneficial impact on adjoining land. (Refer “production value” in glossary of terms at end of this document)

Oil mallees

Year of planting: While most farmer investors will probably only want to look at the implications from a single year planting, the spreadsheet allows plantings to be spread out over a 4 year period if there is a progressive establishment plan. The standard analysis allows for all planting to be done in year 1.

Cost of planting: Analysts can choose tree density, survival rate, and cost per tree planted. The standard analysis uses 2667 trees/ha with a 90% survival rate to establish a harvestable stand of 2400 trees/ha. Standard cost per tree planted was 50 cents. (Variations in cost of planting from 45 cents to 55 cents had relatively little effect on profitability compared to biomass price.)

Subsequent costs: Costs in addition to the cost per tree planted can be added – for example where later weed invasion threatens the young tree. The standard used is $20/ha of trees in each of the following 2 years. This section can be used as a proxy for any other additional cost (e.g. insect control) on top of, or instead of, weed control.

Harvest times/yield: The spreadsheet allows a choice of time to first harvest, the year of second and third harvest, and harvest interval thereafter, together with the yield at each harvest in whatever combination is appropriate for the particular site under investigation. Yield and harvest periods are important variables in the analysis with a significant impact on results.

Price: Price per tonne of biomass must be entered. This is an on-farm price net of harvest costs and transport to the plant. Standard analysis uses $15/tonne.
Profitability of oil mallees 1: Without salinity impact

The critical question is not whether oil mallees are profitable but whether having oil mallees in a paddock is more profitable than not having them. It is the returns from the whole paddock - trees and non-tree area - which are important. Potential cash flows from the paddock both with and without the trees need to be compared to see which course of action will make the farmer better off financially. A number of model runs were done to look at “break-even” scenarios.

Graph 1: Break even production values from non-tree area (15% oil mallees)

(a) Standard (i.e. 4/2 harvest regime) sites

- If production value is $50/ha, the biomass price would need to be at least $13/tonne for the introduction of 15% oil mallees to be more profitable than staying with the existing enterprises.

Alternatively,

- If biomass price was $15/tonne (as is forecast), the introduction of oil mallees would be profitable on land which had existing production values of $79/ha or less. This is significant given that there would be many paddocks in the wheatbelt with expected average production values at or below $79/ha. (Refer Bankwest benchmarks in the “Glossary of Terms” at the end of this document.)

(b) Low 1 (5/3 harvest) and Low 2 (6/3 harvest) sites

- With the lower profitability of oil mallees due to the longer times to first harvest and longer intervals between later harvests, the trees will only be more profitable in a $50/ha production value situation if biomass prices are greater than $20/t and $24/t respectively.

Alternatively,
• If biomass price was $15/tonne, Low 1 trees (5/3 harvesting) would only be more profitable if introduced into land with production values of $9/ha or less. Low 2 trees (6/3 harvesting) are not more profitable in any situation — unless current production values were actually negative (i.e. the land is making a loss).

So .... Is it profitable or not?

The critical finding from the above for potential investment on farms is for the farmer to know or estimate what current/future production values are/will be and the expected biomass price. The above graph can then be used to read off whether there is a reasonable chance that at least break even can be achieved.

If the current production value is $50/ha and the expected on-farm biomass price is $15/tonne, then there are good prospects if a 4/3 harvesting regime is achieved.
Profitability of oil mallees 2: With salinity impact

Research data that quantifies the effect of trees on salinity and production of adjoining land is accumulating but is site specific. Making generalised comment is inappropriate. However, the spreadsheet does include functions where impacts on both future production and salinity outcomes can be considered. Farmers wishing to include these considerations in their assessment of profitability can do so. Where information is limited or unclear, a range of estimates can be tested for its influence on the result.

For the purposes of this analysis, reference is made to investigations done for the State Salinity Council in the preparation of the State Salinity Action Plan II. ‘Flow tube’ modelling (R George et al – 1999) using a number of management strategies was done for cross sections of high, medium, and low rainfall agricultural landscapes. Selections of the predicted salinity outcomes from the modelling has been used in this analysis as a simulation of the impact of oil mallees.

(a) Toolibin landscape medium impact strategy

The flow tube modelling for this “Toolibin-medium” situation was based on: Sandplain soils (10%) planted to pines plus a phase farming (lucerne) system over the remainder except for two blocks of oil mallees at the break of slope and near the saline area (each 10% of the area).

Hence, around 30% of the land is planted to trees with the other 70% under phased rotation of perennials in order to produce the estimated salinity outcomes. Current saltland was nominated at 10%, expanding to 14% after 20 years in a ‘nil strategy’ scenario. With the strategy, it was estimated that saltland would be reduced from 14% to 6%.

For the purposes of the analysis presented below, it was assumed that all the trees were oil mallees and that they alone produced the saltland reductions. This is an optimistic scenario given that the 70% balance of land under phase farming would be making a significant contribution to recharge reduction.

Graph 2: Break even production values with Toolibin-medium strategy (30% oil mallees)
Notice that the lines on the graphs have been shifted upwards when compared to the 'without salinity' situation. This means that oil mallees are now more profitable than they were previously - due to their impact on salinity. Making the comparison:

- **Standard (4/2) sites**: If production value is $50/ha, the biomass price would only need to be around $12.50/tonne (previously $13/t). Or, if biomass price was $15/tonne, the oil mallees would be profitable on land which had production values of $87/ha or less (previously $79/ha).

- **Low1 (5/3) and Low2 (6/3) sites**: Trees will be more profitable than staying with $50/ha existing enterprises if biomass prices are $19.50/t and $23/t respectively. If biomass price is $15/tonne, Low1 trees would be more profitable if introduced into land with production values of $10/ha or less. Low2 trees are not more profitable in any situation – unless current land use is making a loss.

If the standard break even numbers in Graph 2 are compared to those in the no salinity impact Graph 1 previously, it can be seen that inclusion of a saltland impact has increased the break even production value by $2 to $7/ha at low biomass prices, $8 to $14/ha at medium prices, and up to $16-$21/ha at biomass prices above $20/t.

**(b) North Baandee landscape medium impact strategy**

The flow tube modelling for this “North Baandee-medium” situation was based on — “Sandplain soils (10% of catchment) planted to tagasaste; two rows of oil mallee alleys (2 x 1.5 m) over the rest of the landscape at a nominal belt spacing of 50 m.”

Hence, around 17% of the land is planted to trees to produce the estimated salinity outcomes. Current saltland was nominated at 3%, expanding to 16% after 20 years in a ‘nil strategy’ scenario. With the strategy, saltland would only grow to 10%.

For the purposes of the analysis presented below, it was assumed that all the trees were oil mallees and that they alone produced the saltland reductions. Oil mallees might in fact be a better proposition than tagasaste in this situation given their strong performance on sandplain soils – including acid wodgil. The salinity scenario might be optimistic given that optimum water use on the non tree area would also be required to produce the recharge reduction.

*Graph 3: Break even production values with North Baandee-medium strategy (17% oil mallees)*
Again the lines on the graphs have been shifted upwards when compared to the ‘without salinity’ situation because oil mallees are now more profitable than they were previously.

- **Standard (4/2) sites:** If production value is $50/ha, the biomass price would only need to be around $12.50/tonne. Or, if biomass price was $15/tonne, the oil mallees would be profitable on land which had production values of $90/ha or less.

- **Low1 (5/3) and Low 2 (6/3) sites:** Trees will be more profitable than staying with $50/ha existing enterprises if biomass prices are $19/t and $23/t respectively. If biomass price is $15/tonne, Low 1 trees would be more profitable if introduced into land with production values of $10/ha or less. Low 2 trees are not more profitable in any situation – unless current land use is making a loss.

(c) **North Baandee landscape low impact strategy**

The flow tube modelling for this situation was based on – “Two rows of oil mallee alleys (2 x 1.5 m) over 100% of the landscape at a nominal belt spacing of 100 m. The alleys comprise high water use annual crops and pastures.”

Hence, around 5% of the land is planted to trees to produce the estimated salinity outcomes. Current saltland was nominated at 3%, expanding to 16% after 20 years in a ‘nil strategy’ scenario. With the strategy, saltland would only grow to 14%.

For the purposes of the analysis presented below, it was assumed that the oil mallees alone produced the saltland reductions. This is obviously a very optimistic scenario given that optimum water use on the non tree area would also be required to produce the recharge reduction.

**Graph 4: Break even production values with North Baandee-low strategy (4% oil mallees)**

This time with the relatively minor impact on salinity, the lines on the graphs have only been shifted upwards slightly when compared to the ‘without salinity’ situation.

- **Standard (4/2) sites:** If production value is $50/ha, the biomass price would only need to be around $12.20/tonne. Or, if biomass price was $15/tonne, the oil mallees would be profitable on land which had production values of $91/ha or less.
• Low 1 (5/3) and Low 2 (6/3) sites: Trees will be more profitable than staying with $50/ha existing enterprises if biomass prices are $19/t and $22.50/t respectively. If biomass price is $15/tonne, Low 1 trees would be more profitable if introduced into land with production values of $10/ha or less. Low 2 trees are not more profitable in any situation – unless current land use is making a loss.

The message in summary

Under ‘best bet’ current information, oil mallees in a 4/2 harvest regime returning $15/tonne biomass on-farm will be financially attractive to farmers if the trees are being planted into paddocks with production values of around $79/ha or less. At these levels of performance oil mallee is competitive with conventional crops in many circumstances. If salinity impacts are also considered, oil mallees can compete with current enterprise production values that are $10-$12/ha higher.

In lower tree yield situations where there is likely to be a 5/3 harvest regime, the tree option is only likely to be profitable if current production values are around $10/ha or less.

Harvest regimes of 6/3 will not be profitable unless current enterprises are loss making. Plantings will need to be justified from a landcare perspective or by the promise of improved future returns.

Investors are advised to keep abreast of industry developments and prepare up-to-date budgets when assessing their proposals.
Reference:

Acknowledgements
Thank you to John Bartle, Don Cooper, Rick Giles (all CALM) and Ric Collins, Chris Richardson (Oil Mallee Association) who provided many of the biological and price assumptions and supplied excellent editorial comment to drafts of this document.

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Facsimile: (08) 9478 0333

Do you want a copy of the spreadsheet?

Be aware that spreadsheets are constructed at a particular time with only the information available at that time. Further versions may be developed as new information comes to hand but it is impractical to update all previous copies.

The version prepared April 2000 can be obtained from:

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Revegetation on Farms Project
Agriculture Western Australia
10 Doney Street
NARROGIN. W.A. 6312
Telephone: (08) 9881 0222
Facsimile: (08) 9881 3417
E-Mail: cholt@agric.wa.gov.au
Glossary of terms

**Production value:** The ability of a piece of land to produce net income. Should be expressed as a ‘net’ margin rather than a ‘gross’ margin to be equitable with the oil mallee option - because the capital costs of setting up the oil mallee enterprise are included in the “with trees” cash flow. Therefore, capital costs should also be deducted from the gross margin attached to the non-tree area.

A proxy for capital costs is depreciation on plant and equipment used in the existing enterprises – often approximated as 10% of current value. An analysis of consultancy clients (R. Watt – Agribusiness Decision. December, 1999) indicated machinery depreciation averaging $34.50 per crop hectare but a large variation between clients. A rough estimate for the purposes of this analysis is to calculate the rotation gross margin/ha then deduct $30-35/ha to obtain a production value.

Bankwest benchmarks over the last 3 years have listed a ‘farm operating profit’ which approximates with the above production value. It is defined as the cash operating surplus minus 10% depreciation. Average farm operating profit for selected regions appear below:

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</thead>
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<tr>
<td></td>
<td>Top 25%</td>
<td>Other 75%</td>
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<tr>
<td>South Coast</td>
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<td>$22/ha</td>
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<td>Central Midlands</td>
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<td>North Eastern Wheatbelt</td>
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<td>Northern Wheatbelt &lt;350 mm rain</td>
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<td>Northern Wheatbelt &gt;350 mm rain</td>
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<td>$54/ha</td>
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</tr>
</tbody>
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For the purposes of this analysis, it was assumed that production value does not change after the oil mallees are planted. In reality, as more land is planted to trees, the fixed costs of plant and machinery will be spread over a smaller crop/pasture area so the per ha cost would increase – and the production value would be reduced.

**Oil mallees:** A generic term for a range of eucalyptus species to be used in the industry. While the initial emphasis was on eucalyptus oil production, interest now is also on biomass production for the activated carbon and bioenergy products.

**Biomass:** The total material harvested from the trees. Mallee is harvested to ground level on a 2 or 3 year cycle. It will include woody components such as stems, branches, sticks and twigs as well as leaves and bark.
Opportunity costs: The land area planted to trees can no longer be used for other enterprises. If those other existing enterprises (such as crops and sheep grazing) were earning net income, there is an opportunity lost to continue to earn that income.

Discount rate: Discounting of future costs and returns is done to bring all numbers back to a present day figure. This allows comparison of different cash flow streams on the same present day basis. It is a technique used in investment analysis to calculate Net Present Values of projects, Benefit Cost Ratios, and Internal Rates of Return.

Choice of discount rate is critical to results and should reflect the interest earnings able to be obtained in the next best investment. The convention is to use a real interest rate – roughly equivalent to current commercial rates less the inflation rate (hence 7% used in this analysis). It is also often expressed as roughly equivalent to the last 10 years average bond rate. State Treasury guidelines for investment analysis currently recommend 7-8% and commercial company investments use similar rates. Discount rates can be considerably lower (and even 0%) when assessing proposals which have major social factors and intergenerational equity implications.