Economics and Farm Forestry 9

Understanding the economic tools used to assess the viability of a long-term project such as farm forestry is very important if a farmer is to make an informed investment decision.

Understanding these tools also allows:

- A farm forestry project to be evaluated against other investments, such as investing in the stock market or building a new dam;
- The cash flow of a project to be assessed;
- The financial aspects of the project to be analysed; and
- The economic risks to be highlighted right from the start of the project.

While it may be argued that an economic analysis only considers the monetary aspects of a project, it does allow farmers to weigh up the financial costs and returns against non-economic benefits such as aesthetics, wildlife, erosion or salinity control. For example, a farmer might choose to accept a lower return from a less profitable option (such as using native species rather than exotics) because of the value they place on the non-commercial benefits (such as biodiversity and aesthetics). In effect, an economic analysis can be used to assess the costs associated with providing the non-commercial benefits that are desired.

Although the true 'worth' of the farm forestry project may be greatly underestimated in a financial analysis, it must be remembered that it is simply a tool to help decision making. Therefore, before making any commitment, farmers should also consider the social and environmental benefits, risks and uncertainties associated with the project.

This chapter provides an outline on how to undertake a simple discounted cash flow (DCF) analysis. DCF is the standard method of assessing the financial viability of any long term project like forestry. The steps include the identification and estimation of the costs and returns over the life of the project, determination of an appropriate discount rate and calculation of the Net Present Value and/or Internal Rate of Return for the project.

WHAT YOU'LL NEED

To do a DCF by hand requires a calculator, pencil, rubber and plenty of patience. If your patience is lacking, a computer is extremely helpful. An excel based spreadsheet to help with the economic analysis of any farm forestry project is available from the MTG web site at: www.mtg.unimelb.edu.au/tools.htm

A FEW HINTS

Any analysis is only as good as the data that goes into it.

Keep all units the same. If working in $/ha, make sure all figures are in $/ha. If working in $/5ha, make sure all figures are in $/5ha.

Inflation is ignored, as it is assumed that all costs and returns will inflate at the same rate over time. Therefore all figures used are real figures, ie figures that do not include inflation (Nominal figures do include inflation).

Current (present day) figures should be used over the length of the project, as the DCF tool is there to help with the question, 'based on current knowledge and prices, what is the best course of action'.

The DCF is particularly useful in comparing alternative courses of action over a period of time, rather than providing an absolute measure of the financial outcome of a single project.

The good, the bad and the ugly

Farm forestry financial analysis can be thought of as a case of "*The Good, The Bad and The Ugly*":

The Good are the returns from timber and agricultural products and services generated by the project. Some of these are easy to estimate and value, while others present real challenges and may be best left out of the analysis all together. How do you put a realistic dollar value on the satisfaction a farmer gets from seeing their property improved or being able to pass on a better farm to their children? Individuals will have a feel for the importance of these benefits and should consider them when making the final judgement.

The Bad are the costs incurred as a result of the project. Because of the financial costs, including labour, are incurred at the beginning of the project, they are generally the easiest values to incorporate into the analysis. A farmer can quickly estimate the costs of buying seedlings or preparing the site for planting.

The Ugly are the problems associated with time and the impact this has on future costs and returns over the course of a long-term investment like forestry. Any investor knows that a dollar today is worth more than a dollar in the future because of the potential income that can be generated by investing this money. But this is further complicated by the fact that the rewards and risks become more uncertain the longer the investment. The DCF tool is designed to help with many of these issues and provide a framework for which to work through them.

There is little point in knowing that a farm forestry project is a good investment, unless it can be compared to other investment options such as putting money into the bank, the share market, buying a new tractor or continuing to farm as present. Most farm forestry analyses consider the current land use as the benchmark against which a farm forestry project is to be compared. "Is farm forestry more profitable than the agriculture I am currently doing?" If this is the question, then it is important to know what is presently being earned from the land so that this can be compared against the farm forestry project. This may seem simple, but because agricultural incomes rise and fall, the farmer should be cautious about settling on a

In some cases it is not so much a matter of the cost of growing trees as the cost of not.

figure. It is important to think about how costs and returns have fluctuated over the years, how they might change over time and settle on an 'average' figure to be used when comparing with the farm forestry project.

Agricultural income minus agricultural expenses (variable costs) will provide an Agricultural Gross Margin. This provides an indication of the profitability of the agricultural enterprise. Using an average gross margin is a good start, but it should also be remembered that the use of a gross margin is also limited in comparing agriculture to farm forestry as labour is generally not included in a gross margin, whereas it is generally included in the long term economic analysis of a farm forestry project.

Determining Costs - The "Bad"

Costing an operation is relatively simply. All that is required is a good "guesstimate" of likely present day costs of doing the job. Remember to include all costs from the start (such as ripping, mounding, planting and seedlings) through to the middle (pruning, thinning, pest control) and to the end (harvesting, roading). The cost of land is commonly not included in a farm forestry analysis, especially when trees are being integrated into the farming landscape, as it is presumed that the landowner already owned the land. If, on the other hand, land needs to be bought, this cost should be included as a cost at the start of the project and offset at the end by allocating a sale price for it.

Labour inputs and costs are often forgotten, but are very important in a farm forestry analysis as many of the jobs require labour, but little capital, such as pruning. It is important to try and fully cost out labour or at least record the amount of labour required. While a farmer may not cost their labour, at say $15 per hour, this figure will at least cover any unforeseen contract labour that may be required during the life of the farm forestry project. Likewise there will be a real cost associated with buying and maintaining equipment and machinery. Although any savings associated with utilising on farm labour or existing machinery is an advantage that may make forestry more profitable for farmers than investors the costs, however small, should not be ignored.

Another cost that is often ignored is the time and resources taken to access information and gain new farm forestry skills. These costs, known as 'transaction costs', while sometimes difficult to value, can have a large impact on the economics of the project. The most obvious 'transaction cost' is the cost involved in sourcing accurate, reliable and up-to-date market information for farm forestry products and services. Transaction costs can be accounted for by including the cost of joining a growers group or by calculating the time involved in attending courses, seminars or field days.

Determining Returns - "The Good"

It is the prospect of rewards that drives farmer investment into revegetation and forest management. The rewards come in many forms and although some are difficult to measure or have ill-defined market values, it is worth considering what value you would place on them.

ESTIMATING THE EFFECT ON AGRICULTURAL RETURNS

When planting out a block or belt of forest an estimate of grazing returns from within a stand of trees can be included in the analysis. Grazing under a forest might provide valuable off-shears shelter or act as a nursery paddock for calving cows. These are direct returns to the grazing enterprise as a result of the trees. A grazing gross margin can be used if the grazing under the trees is still considered part of the overall property's enterprise.

In southern Australia, grazing returns under trees can be estimated from the crown cover of the trees, and therefore light, reaching the pasture.(see Figure 1). Other agricultural returns may include cropping or hay production in the early years. The value of a good shelter block might be accounted for as an increase in lambing percentages or a reduction in stock losses. Most farmers could put a reasonable value on these returns whereas trying to predict the affect of shelter on wool, milk or meat production is going to be more difficult.

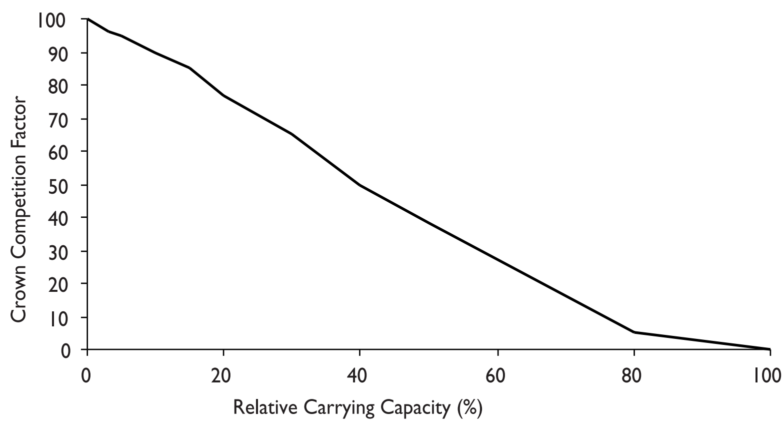

FIG 1.

Estimated relationship between crown cover and relative carrying capacity under Pinus radiata

The need for trees for stock shade and shelter is evident to most farmers, but putting a price on it is more difficult

Research suggests pasture production is less than open pasture under pine and eucalypts but could be better under BlackWalnut

ESTIMATING THE VALUE OF OTHER BENEFITS FROM TREES

There has been many attempts at estimating the economic value of the environmental benefits of trees. One report from the Murray Darling Basin titled, "Cost-sharing for on-ground works" (1996), estimated that for one hectare of farm forestry planted on the Liverpool Plains, where dryland salinity is an important issue, the farmer can expect the following returns from trees:

- $10/ha/yr from increased production;
- $5/ha/yr from lowered water table benefits;
- $2/ha/yr from less soil erosion;
- $5/ha/yr from increased land values; and
- $4/ha/yr from increased amenity values.

What value could be placed on these trees?

In practice the environmental benefits of trees (salinity and erosion control, wildlife, aesthetics, land values etc) may be difficult for a farmer to value, unless there are "buyers" who are prepared to fund revegetation for these reasons. A project that is eligible for up-front funding because of its environmental values will be cheaper to establish. By using this lower cost in the analysis the farmer is effectively accounting for the "sale" of environmental values. Any products sold from the site in later years would be more profitable because of the grant received at the start.

ESTIMATING TIMBER RETURNS

Although uncertainty in production and future markets makes estimating timber returns a difficult task, any information gained from measuring trees, and talking to the possible purchasers is extremely helpful in making a good "guesstimate".

Timber is sold by volume and is expressed in cubic metres (m^3) (1 metre by 1 metre by 1 metre = 1 m^3). In any market there will be quality grades that have different values and possibly different risks. A high quality sawlog might be valued at $80/$m^3$ as it stands in the forest, whereas a pulp log may be worth only $5/$m^3$. Whereas the sawlog can be always sold for pulp if the sawlog market evaporates, the reverse is most unlikely.

Prices for timber are either quoted as mill door prices or as stumpages. The mill door price accounts for the costs of harvesting and transporting the log to the mill, a stumpage price does not, but represents the return to the grower.

To calculate the stumpage prices from a mill door price:

1. Deduct haulage costs from the mill door to the stump for each "product" (it may be that different products go to different mills, i.e. pulp logs to the pulp mill and sawlogs to a sawmill).

Average haulage costs are:

- $0.10/km/m^3 on good sealed roads
- $0.20/km/m^3 on good gravel roads
- $0.40/km/m^3 on farm tracks.

2. Deduct harvesting and other related costs. Some average figures for harvesting are:

   Pine: $14-$18/m^3

   Eucalypts: $17-$20/m^3 ($5/m^3 to snig, $12/m^3 to harvest).

   The cost of the harvesting operation will increase as volumes decrease, access becomes more difficult and the slope increases.
3. The stumpage value must be calculated for each product type.

The stumpage value of pruned eucalypts is largely unknown as few millers have had experience with the timber. Richard Moore with a panel made from 13 year-old Blue Gum (*E. globulus*) in front of a 16 year old tree of the same species.

Example

Mill door price for pruned butt logs =	$100/m^3
- Haulage costs	
50km on good sealed road @ 0.10/km/m^3 =	- $5.00
15km on good gravel road @ 0.20/km/m^3 =	- $3.00
4km on good gravel road @ 0.40/km/m^3 =	- $1.60
- Harvesting Costs =	- $25/m^3
- Marketing and other associated costs =	- $5/m^3
Stumpage Price for the butt log =	$60.40/m^3

To determine the value of an individual tree or forest it is necessary to know, or estimate, the volume of product that can be sold into each product category. *See case study chapters for examples.*

FARM FORESTRY CASH FLOW

Once the costs and returns have been estimated, the project's cash flow can be calculated. Using a spreadsheet this is relatively simple as all anticipated costs and returns for each year can be incorporated then summed to provide a total cost and a total return each year. The net cash flow is simply yearly returns minus yearly costs.

Once the cash flow of the project has been calculated, future financial commitments over the life of the trees can be ascertained by considering when payments are due and returns are expected. This simple information is often ignored by those more interested in the final figure, but the net cash flow of a project can be an extremely important guide for investment decisions and help in building a sound understanding of the financial viability of the farm forestry project.

Accounting for long term investment periods - "The Ugly"

Discounted Cash Flow analysis is a process that involves financial discounting as a means of comparing costs and returns that occur over a long investment period. It is really an economic tool to deal with time. It is interesting to note that it was a German forester, Martin Faustmann, who in 1849 developed the DCF analysis technique for the very purpose of economically evaluating forestry projects.

In order to judge the viability of the project, the costs and returns incurred in different years need to be discounted to a present day value so they can be compared. This involves undertaking a Discounted Cash Flow (DCF) or Cost Benefit Analysis (CBA):

Grazing amongst the trees provides cash flow while the trees are growing.

STEP 1. SETTING A DISCOUNT RATE

The discount rate is like an interest rate. If $1,000 is invested today at 4%, in 28 years time we know it will be worth about $3,000.

$$\text{Future amount} = \$1{,}000 \times (1 + 0.04)^{28}$$
$$= \$2{,}999$$

Alternatively if we can estimate that in 28 years time, our timber will be worth $23,000, then by discounting or reversing the interest process, we should be able to calculate how much it is worth in today's dollars.

$$\text{Current value} = \frac{\$23{,}000}{(1 + 0.04)^{28}}$$
$$= \$7{,}670$$

If a discount rate of 8% is used, the present day value of the same timber would only be $2,665. The choice of rate is therefore critical in any long-term investment. There are two common approaches to setting the discount rate:

1. The cost of borrowing money.
   If money for the project can be borrowed at x% per annum (excluding inflation), then this value can be used as the discount rate. If the calculated return from the farm forestry project is greater than what the money can be borrowed at, then the project is financially viable (it has covered its costs and returned a profit to the investor). If however, the project cannot return an amount greater than what the money is borrowed at, the project is financially unviable for that given discount rate.
2. The return from alternative investments *(The opportunity cost of money)*.
   The idea here is similar to the previous one, except that the discount rate is set to reflect what return can be achieved from an alternative project. At the simplest level, this is generally regarded at what an investor can get on money put into an appropriate interest bearing bank account (disregarding the effect of inflation). Or it could be the return a landowner expects from an improved pasture program, a new dairy shed or the stock market.

Generally a discount rate of between 4 percent and 8 percent is used to evaluate farm forestry projects.

This English Oak (*Quercus robur*) forest may take 50 years to produce valuable sawlogs making it a questionable investment unless the farmer is able to enjoy watching them grow.

STEP 2. PRESENT VALUE OF COSTS AND RETURNS

Once a discount rate has been set, a discount factor can be calculated to discount future sums of money back to today's dollars, or Present Value. The same discount rate should be used for all years of the project.

The discount factor can be read off the Discount Factor Table supplied at the end of this chapter or calculated from the equation below:

$$\text{Discount Factor} = 1/(1+r)^n$$

Where r = % Discount Rate, and n = year

Once a discount factor has been calculated it is multiplied by the net return or loss for a particular year to provide a Present Value for the year in question.

Example

In year 7, total costs are $477/ha with no returns from grazing

Discount Factor at a 4% discount rate = $1/(1 + 0.04)^7$ or a discount factor of 0.7599

Present Value of costs at year 7 = $477/ha x 0.7599 = $362

STEP 3. NET PRESENT VALUE (NPV $/HA)

NPV is a very common economic figure used to present the profitability of a project using discounted cash flow analysis. The NPV is simply calculated by adding all the discounted returns or losses over the rotation of the trees.

Net Present Value ($/ha)

$$= \mathrm{Sum}\left(\frac{(b_1-c_1)}{(1+r)^1} + \frac{(b_2-c_2)}{(1+r)^2} + \frac{(b_3-c_3)}{(1+r)^3} + \ldots\ldots\ldots\ldots + \frac{(b_n-c_n)}{(1+r)^n}\right)$$

Where b = total real benefits (income) accruing that year
c = total real costs accruing in that year
r = real interest or discount rate per annum
n = number of years in investment time-frame

If the NPV is positive, the project is considered financially worthwhile at the discount rate used. If the NPV is negative, the project is said to be making a loss at the discount rate used.

Example

Year	0	1	2	3	4	5	6	7	8	… 27
Net Cash Flow	-$920	-$185	-$60	-$377	-$60	-$327	-$60	-$477	-$60	…$22,607
Discount Factor @ 4%	1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	… 0.3468
Discounted Cash Flow	-$920	-$178	-$55	-$335	-$51	-$269	-$47	-$362	-$44	… $7823

NPV ($/ha) @ 4% = $5006/ha

STEP 4. ANNUITY ($/HA/YEAR)

An annuity is simply the average amount paid by the project each year, over the life of the project, again at a given discount rate. It is a good way of comparing yearly agricultural returns with yearly forestry returns.
An annuity is calculated from the NPV by the formula:

$$\text{Annuity (\$/ha/yr)} = \frac{\text{NPV (\$/ha)}}{\text{Annuity Factor}}$$

The annuity factor can be either read from the Annuity Discount Factor table (provided at the end of the chapter) or calculated from the following equation:

$$\text{Annuity Factor} = \frac{(1+r)^{n-1}}{r \times (1+r)^n}$$

Where r = discount rate (e.g. 4% = 0.04)
n = length of rotation

Example

Using the above example where the NPV ($/ha) equalled $5,006/ha for a 28 rotation and using a 4 percent discount rate, the annuity factor is 16.6631 and the calculated annuity is $300/ha/yr

STEP 5. INTERNAL RATE OF RETURN (IRR % PA)

The IRR is simply the discount rate at which the NPV equals zero. It is a measure of the earning capacity of the project and simply put, is the rate at which money can be borrowed from a bank and the project still break even.

Example

> If a project has a NPV ($/ha) of $5,006 at a 4% discount rate, the IRR is 8.8%. This indicates that if a landholder borrowed money from a bank at 8.8% and after harvesting the trees in 28 years time, the farmer would not make or lose any money.

The IRR is easily calculated using a computer spreadsheet package (such as Excel) but is quite difficult to calculate by hand. A simple method to calculate the IRR for a project is to graph the NPV against the discount rate (which means carrying out the DCF analysis several times at different discount rates) and then estimating at which point the NPV equals 0. From Figure 2 below, the IRR is estimated at 6.5%.

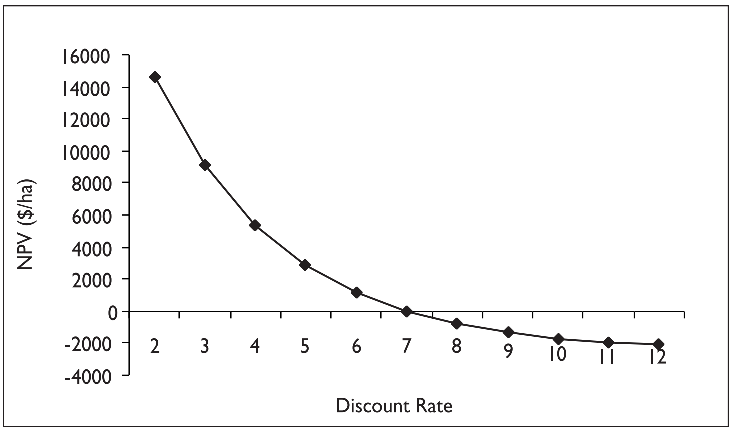

FIG 2.
Graphing the discount rate against the NPV to estimate the IRR for a project.

Once mature, a fine tree like this Hoop Pine (*Araucaria cunninghamii*) can be as good as money in the bank.

6. COMPARING TREES WITH AGRICULTURE

Once a CBA has been completed for the farm forestry project, the exact same process must occur for the same area without trees. Generally the returns from agriculture will be similar from year to year, unless there are fertilising operations or other operations that occur every second, third or fourth year. If this occurs, allowances should be made for these operations.

Remember to include a cost for labour and all costs that may vary over the length of the project. You must compare apples with apples, use the same discounting process, the same discount rates, the same unit (such as $/ha or $/4 ha) and the same length of time as the forestry project.

If the agricultural NPV ($/ha) is greater than the farm forestry project at the same discount rate over the same period of time, agriculture is the more profitable venture. If farm forestry has a higher NPV, farm forestry is more profitable. A full discounted cash flow example for a real farm forestry project has been included at the end of this chapter.

The Effect of the Discount Rate

The discount rate used has a large effect on whether agriculture or farm forestry will be more profitable. Because agriculture generally has smaller annual returns, agriculture is comparatively more profitable when higher discount rates are used. Because forestry has large returns at the end of the project, using a lower discount rate will allow the farm forestry project to be comparatively more profitable as the large return at the end of the project is not discounted as heavily (See Figure 3).

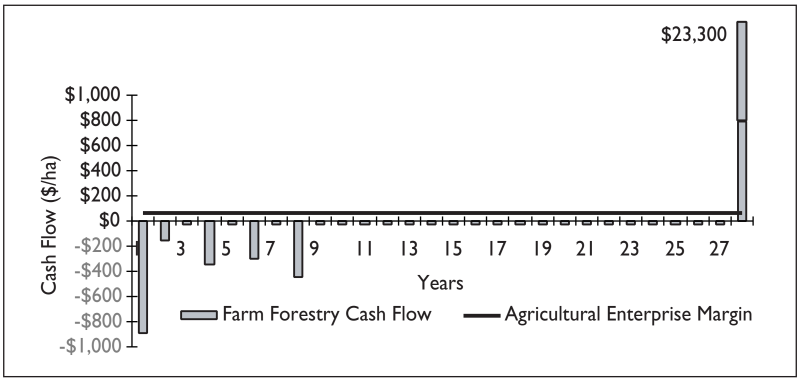

FIG 3.
The effect of the discount rate on the relative profitability of three long-term enterprises.

The Cash Flow

When comparing alternative enterprises such as farm forestry and agriculture, the cash flow for both projects also provides a very useful way of comparing projects. While a farm forestry project may return a higher NPV ($/ha), can the large outlay of cash at establishment or when pruning and thinning be supported? And what of the loss of revenue from grazing? A simple cash flow graph can illustrate the size and timing of these cash outlays as is illustrated in Figure 4.

Comparing the cash flow of agricultural enterprises and farm forestry projects is a useful way of considering the financial worth of each project. Figure 4 represents the cash flow taken from the completed spread sheet presented at the end of this chapter.

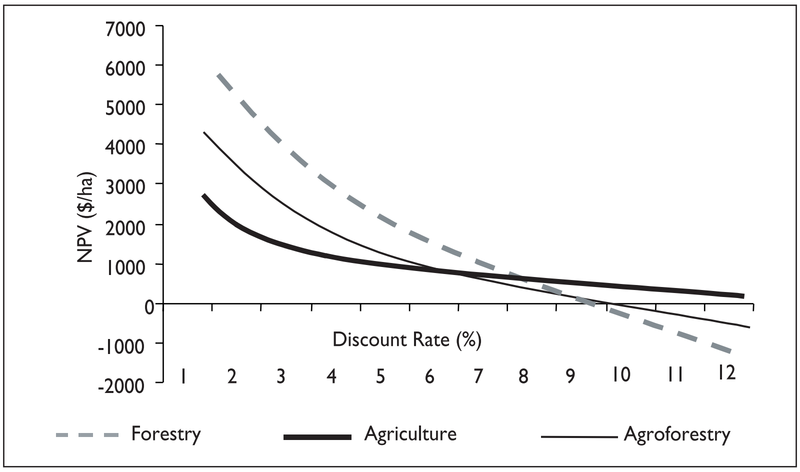

FIG 4.
Cash flow of an agricultural enterprise showing small, (hopefully) consistent annual returns and the cash flow of a forestry enterprise showing large cash 'spikes'

Other Considerations

As already stressed, the discounted cash flow process is only one of many tools on which to base a decision and when judging the financial viability of two enterprises as different as farm forestry and agriculture solely on the NPV figure, many issues may be ignored:

- Agriculture may not be as profitable, but the returns are annual. Farm forestry has large cash "spikes", both positive and negative.

- Likewise, the labour requirements for the farm forestry project will have “spikes” during the planting, pruning and harvesting periods. Therefore it is a good idea to calculate returns per hour invested, for both agriculture and farm forestry.
- Agricultural markets are relatively well known in the short term. Farm forestry markets are unclear and uncertain.
- Landholders have the skills and confidence in agricultural production. New skills and technologies may have to be learnt and understood to successfully produce a commercially viable farm forestry product.

Risk and Uncertainty

As the figures used are the best available "guesstimates" today, some, if not all will be incorrect or change over the life of the project. Therefore it is important to change some of the key variables to test what effect they have on the final result. This is called a "Sensitivity Analysis". In the process a worst case scenario should be considered and a judgement made as to whether the risks involved are worth carrying.

Risk it is largely a personal perception. While one person may see a particular project as very risky another may believe the markets, climate and production will all be in their favour making it a very profitable venture.

In addition to testing different scenarios, risk can be accounted for in the DCF analysis by:

1. Increasing the value of labour;
2. Using higher costs if the exact cost of an operation is not adequately known;
3. Being conservative about tree growth rates and timber yields;
4. Being conservative with stumpage rates; and
5. Using a higher discount rate to reflect a greater conservatism in the use of money.

Taxation

The impact of tax will depend on the individual's tax situation and taxable income. It is an important aspect of commercial tree growing, especially around harvest time. The taxation ruling TR 95/6 and updates are essential reading if farm forestry is going to be a serious consideration.

DISCOUNTED CASH FLOW EXAMPLE

Property Name Holbrook　**Species** P. radiata　**Initial Stocking** 500　**Harvest Age** 28

Stand Size (ha) 6 ha　**Regime** Prune to 6.2m. 1 non-com thin in yr 4　**Final Stocking** 250

Project Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Calender Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Costs																												
Road Construction																												$333
Fencing	$150																											
Vermin Control	$50																											
Cultivation (Rip & Mound)	$150																											
Weed Control	$50																											
Seedlings	$250																											
Planting	$60	$75																										
Fertilising	$150	$50																										
Pruning				$200		$250		$400																				
Prune Stand Cert.				$17		$17		$17																				
Non-com Thin.				$100																								
Project Maintenance	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60	$60
TOTAL COSTS (a)	-$920	-$185	-$60	-$377	-$60	-$327	-$60	-$477	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$443
Revenue																												
Grazing																												
Timber																												$23,000
TOTAL REVENUE (b)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23000
NET CASH FLOW	-$920	-$185	-$60	-$377	-$60	-$327	-$60	-$477	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	\-$60	-$60	-$60	-$60	-$60	-$60	-$60	-$60	$22,557
Discount Factor @4%	1.0000	0.9615	0.9246	0.8890	0.8548	0.8219	0.7903	0.7599	0.7307	0.7026	0.6756	0.6496	0.6246	0.6006	0.5775	0.5553	0.5339	0.5134	0.4936	0.4746	0.4564	0.4388	0.4220	0.4057	0.3901	0.3751	0.3607	0.3468
NET DISC'T C.F. (e)x(b)	-$920	-$178	-$55	-$335	-$51	-$269	-$47	-$362	-$44	-$42	-$41	-$39	-$37	-$36	-$35	-$33	-$32	-$31	-$30	-$28	-$27	-$26	-$25	-$24	-$23	-$23	-$22	$7,823

	Timber	Agriculture
Net Present Value ($/ha)	$5,006	$520
Annuity ($/ha/yr)	$300	$31
IRR (% p.a.)	8.8%	

Agricultural Net Margin	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30	$30
Agric Disc't CF	$30	$29	$28	$27	$26	$25	$24	$23	$22	$21	$20	$19	$19	$18	$17	$17	$16	$15	$15	$14	$14	$13	$13	$12	$12	$11	$11	$10

DISCOUNT FACTOR (p.a.) FOR A RANGE OF DISCOUNT RATES

Present Value of $1 in the Future at Discount Rate r%

Year	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
0	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696
2	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561
3	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575
4	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718
5	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972
6	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323
7	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759
8	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269
9	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843
10	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472
11	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149
12	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869
13	0.6810	0.6006	0.5303	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625
14	0.6611	0.5775	0.5051	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413
15	0.6419	0.5553	0.4810	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229
16	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069
17	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929
18	0.5874	0.4936	0.4155	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808
19	0.5703	0.4746	0.3957	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703
20	0.5537	0.4564	0.3769	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611
21	0.5375	0.4388	0.3589	0.2942	0.2415	0.1987	0.1637	0.1351	0.1117	0.0926	0.0768	0.0638	0.0531
22	0.5219	0.4220	0.3418	0.2775	0.2257	0.1839	0.1502	0.1228	0.1007	0.0826	0.0680	0.0560	0.0462
23	0.5067	0.4057	0.3256	0.2618	0.2109	0.1703	0.1378	0.1117	0.0907	0.0738	0.0601	0.0491	0.0402
24	0.4919	0.3901	0.3101	0.2470	0.1971	0.1577	0.1264	0.1015	0.0817	0.0659	0.0532	0.0431	0.0349
25	0.4776	0.3751	0.2953	0.2330	0.1842	0.1460	0.1160	0.0923	0.0736	0.0588	0.0471	0.0378	0.0304
26	0.4637	0.3607	0.2812	0.2198	0.1722	0.1352	0.1064	0.0839	0.0663	0.0525	0.0417	0.0331	0.0264
27	0.4502	0.3468	0.2678	0.2074	0.1609	0.1252	0.0976	0.0763	0.0597	0.0469	0.0369	0.0291	0.0230
28	0.4371	0.3335	0.2551	0.1956	0.1504	0.1159	0.0895	0.0693	0.0538	0.0419	0.0326	0.0255	0.0200
29	0.4243	0.3207	0.2429	0.1846	0.1406	0.1073	0.0822	0.0630	0.0485	0.0374	0.0289	0.0224	0.0174
30	0.4120	0.3083	0.2314	0.1741	0.1314	0.0994	0.0754	0.0573	0.0437	0.0334	0.0256	0.0196	0.0151
31	0.4000	0.2965	0.2204	0.1643	0.1228	0.0920	0.0691	0.0521	0.0394	0.0298	0.0226	0.0172	0.0131
32	0.3883	0.2851	0.2099	0.1550	0.1147	0.0852	0.0634	0.0474	0.0355	0.0266	0.0200	0.0151	0.0114
33	0.3770	0.2741	0.1999	0.1462	0.1072	0.0789	0.0582	0.0431	0.0319	0.0238	0.0177	0.0132	0.0099
34	0.3660	0.2636	0.1904	0.1379	0.1002	0.0730	0.0534	0.0391	0.0288	0.0212	0.0157	0.0116	0.0086
35	0.3554	0.2534	0.1813	0.1301	0.0937	0.0676	0.0490	0.0356	0.0259	0.0189	0.0139	0.0102	0.0075
36	0.3450	0.2437	0.1727	0.1227	0.0875	0.0626	0.0449	0.0323	0.0234	0.0169	0.0123	0.0089	0.0065
37	0.3350	0.2343	0.1644	0.1158	0.0818	0.0580	0.0412	0.0294	0.0210	0.0151	0.0109	0.0078	0.0057
38	0.3252	0.2253	0.1566	0.1092	0.0765	0.0537	0.0378	0.0267	0.0190	0.0135	0.0096	0.0069	0.0049
39	0.3158	0.2166	0.1491	0.1031	0.0715	0.0497	0.0347	0.0243	0.0171	0.0120	0.0085	0.0060	0.0043
40	0.3066	0.2083	0.1420	0.0972	0.0668	0.0460	0.0318	0.0221	0.0154	0.0107	0.0075	0.0053	0.0037

Discount Factor = $1 / (1 + r)^n$ Where r = Discount rate and n = length of time

ANNUITY FACTOR (p.a.) FOR A RANGE OF DISCOUNT RATES

Present Value of an Annuity of $1 per annum for a term of n years at Discount Rate r%

Year	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
0	1	1	1	1	1	1	1	1	1	1	1	1	1
1	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696
2	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257
3	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832
4	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550
5	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522
6	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845
7	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604
8	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873
9	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716
10	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188
11	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337
12	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206
13	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831
14	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245
15	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474
16	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542
17	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472
18	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280
19	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982
20	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593
21	15.4150	14.0292	12.8212	11.7641	10.8355	10.0168	9.2922	8.6487	8.0751	7.5620	7.1016	6.6870	6.3125
22	15.9369	14.4511	13.1630	12.0416	11.0612	10.2007	9.4424	8.7715	8.1757	7.6446	7.1695	6.7429	6.3587
23	16.4436	14.8568	13.4886	12.3034	11.2722	10.3711	9.5802	8.8832	8.2664	7.7184	7.2297	6.7921	6.3988
24	16.9355	15.2470	13.7986	12.5504	11.4693	10.5288	9.7066	8.9847	8.3481	7.7843	7.2829	6.8351	6.4338
25	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	8.4217	7.8431	7.3300	6.8729	6.4641
26	17.8768	15.9828	14.3752	13.0032	11.8258	10.8100	9.9290	9.1609	8.4881	7.8957	7.3717	6.9061	6.4906
27	18.3270	16.3296	14.6430	13.2105	11.9867	10.9352	10.0266	9.2372	8.5478	7.9426	7.4086	6.9352	6.5135
28	18.7641	16.6631	14.8981	13.4062	12.1371	11.0511	10.1161	9.3066	8.6016	7.9844	7.4412	6.9607	6.5335
29	19.1885	16.9837	15.1411	13.5907	12.2777	11.1584	10.1983	9.3696	8.6501	8.0218	7.4701	6.9830	6.5509
30	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.6938	8.0552	7.4957	7.0027	6.5660
31	20.0004	17.5885	15.5928	13.9291	12.5318	11.3498	10.3428	9.4790	8.7331	8.0850	7.5183	7.0199	6.5791
32	20.3888	17.8736	15.8027	14.0840	12.6466	11.4350	10.4062	9.5264	8.7686	8.1116	7.5383	7.0350	6.5905
33	20.7658	18.1476	16.0025	14.2302	12.7538	11.5139	10.4644	9.5694	8.8005	8.1354	7.5560	7.0482	6.6005
34	21.1318	18.4112	16.1929	14.3681	12.8540	11.5869	10.5178	9.6086	8.8293	8.1566	7.5717	7.0599	6.6091
35	21.4872	18.6646	16.3742	14.4982	12.9477	11.6546	10.5668	9.6442	8.8552	8.1755	7.5856	7.0700	6.6166
36	21.8323	18.9083	16.5469	14.6210	13.0352	11.7172	10.6118	9.6765	8.8786	8.1924	7.5979	7.0790	6.6231
37	22.1672	19.1426	16.7113	14.7368	13.1170	11.7752	10.6530	9.7059	8.8996	8.2075	7.6087	7.0868	6.6288
38	22.4925	19.3679	16.8679	14.8460	13.1935	11.8289	10.6908	9.7327	8.9186	8.2210	7.6183	7.0937	6.6338
39	22.8082	19.5845	17.0170	14.9491	13.2649	11.8786	10.7255	9.7570	8.9357	8.2330	7.6268	7.0997	6.6380
40	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.9511	8.2438	7.6344	7.1050	6.6418

Annuity Factor = [(1 + r)^n - 1] / [(r (1 + r)^n] Where r = Discount rate and n = length of time