11. POTENTIAL FINANCIAL RETURNS FROM HOOP PINE AND AN ASSESSMENT OF THE LIKELY IMPACTS OF VARIOUS SUPPORT MEASURES ON LANDHOLDER WILLINGNESS TO PLANT

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The question of whether hoop pine can be profitably grown is central to the expansion of the hoop pine estate on the Atherton Tablelands. This paper presents the results of a discounted cash flow analysis of establishing additional hoop pine plantations as part of continuing agricultural activities. The base case NPV at a discount rate of 5% is $732, which indicates that the project would be accepted. The LEV is $823 which represents the maximum amount that could be paid per hectare of land for the project still to be viable. The discount rate applied has a strong impact on the NPV and LEV, which is typical for long timeframe of log production projects. For discount rates around 5.5% and less, an investment in hoop pine plantations would be accepted. Stumpage price also has a major impact on NPV but marginal tax rate does not. In addition, the use of lower values for landholder labour costs yields substantially higher NPVs.

INTRODUCTION

The question of whether hoop pine can be profitably grown is central to the expansion of the hoop pine estate on the Atherton Tablelands. For companies, the goal of the firm is generally considered to be wealth maximisation and is measured by net present value (NPV) of future cash flows associated with a project. The same principles also can be applied to government and private investors; however, often these two groups take into account many other factors in making their investment decisions. Discounted cash flow analysis is used to calculate NPV. Land Expectation Value (LEV) – in effect the NPV of an infinite chain of tree rotations – provides another useful financial performance criterion, particularly when the objective is to compare species with different rotation lengths. Importantly, LEV represents the maximum amount that an investor could pay for land for plantation establishment and still obtain a positive financial return for the plantation investment.

The techniques for undertaking financial analysis of timber plantations are well established (e.g. Herbohn 2002, Herbohn and Harrison 2002, Herbohn *et al*. 2002, Dayandra *et al*. 2002). This is not to say that predicting financial returns from plantations is not a challenging task, because there are many uncertainties associated with the key cash flow variables. Sensitivity and risk analysis techniques are typically used to explore the likely impacts of these uncertainties.

The steps in undertaking a financial analysis of hoop pine plantations can be divided into:

- Specifying the basic hoop pine silvicultural system to be analysed;
- Estimating the cash outflows associated with the system;
- Estimating the cash inflows associated with the system;
- Developing a financial model; and
- Undertaking sensitivity analysis.

In financial appraisal, there is often a distinction drawn between capital cash flows and operating cash flows. In the case of a hoop pine plantation, capital flows would be cash inflows associated with the establishment of the plantation (e.g. purchase of land, costs of establishing the plantation, sale of the land at the end of the project). Operating cash flows are associated with the management of the plantation and the sale of timber.

A standard hoop pine silvicultural system is adopted for the financial analysis, from which performance estimates are derived. Also, gaps in information and limitations of the analysis are highlighted. A sensitivity analysis is provided. No comparison of the financial performance in relation to plantation ownership type) (e.g. corporate, self-financing landholder, joint venture) is attempted, and no allowance is made for subsidies. It is envisaged that revisions to the financial analysis may be needed during preparation of the business case.

The Proposed Hoop Pine Silvicultural System and Estimated Cash Outflows

A silvicultural system has been specified, as the framework for the development of a financial model for hoop pine production. This system involves the establishment of a hoop pine plantation with moderate site preparation and an initial planting density of 500 seedlings per ha. This system was developed based on discussions with DPI Forestry staff and relevant literature. The key activities associated with the establishment of hoop pine plantations are presented in Table 1. These activities are those which have typically been undertaken by DPI Forestry when establishing hoop pine plantations. Estimates of the cost of each activity are provided.

After establishment hoop pine plantations typically require aggressive weed control until the seedlings reach 1.3 m in height. Pruning is undertaken to produce a high quality butt log. Plantations are typically thinned to 400 or fewer stems per ha through a non-commercial thin. No commercial thins are generally undertaken. The continuing maintenance activities, their timing and estimated costs are presented in Table 2.

Table 1: Establishment activities and estimated costs.

Activity	Estimated cost ($)
Final survey with global positioning system	250
Slash and spray	600
Site cultivation	600
Seedlings (500 sph, $1.50 each)	750
Planting labour costs	400
Total establishment expenses	2600

Table 2: Continuing maintenance activities, timing and estimated costs for a stand hoop pine plantation.

Activity	Estimated cost ($/ha)	Timing (year)
Post plant spray (supply and apply)	450	1
Prune - contract (3 m lift)	650	4
Post plant spray (supply & apply)	300	1
Post plant spray (supply & apply)	150	2
Pre-commercial thin (400 stems/ha)	500	3
Prune - contract (5.4 m lift)	850	6
Resource assessment (timber inventory plots) – 1	80	5
Resource assessment (timber inventory plots) – 2	80	10
Resource assessment (timber inventory plots) – 3	80	25
Annual expenses (yrs 1-20)	40	1-20
Opportunity cost of land	a	1-45
Rates	a	1-45

[a] No cost allocation made.

The cash outflows for maintenance activities are based on the system adopted by DPI Forestry. An integral part of that system is the regular monitoring of plantation growth as part of a continuing research effort. The resource assessment expenses in years 5, 10 and 25 are associated with these research and monitoring activities. In some circumstances, these expenses would not be incurred by private investors.

The relevant cash outflows associated with the opportunity cost of land and rates will vary, with their amounts being determined according to the opportunity cost principle (as described in Dayanandra *et al*. 2002). If land is purchased to establish a plantation, then the opportunity cost of the land is the cost of investing in the next best investment. All of the costs associated with holding the land (including rates) would also be included in the analysis. If on the other hand a farmer decided to plant trees on an existing piece of productive land then the opportunity cost of using the land would be the income forgone from current production. Rates would not be included in the analysis however, because these are a sunk cost which would have been incurred irrespective of whether hoop pine was planted. If the land on which the trees are planted was non-productive, then the opportunity cost would be zero. Thus, costs such as rates and the opportunity cost of land could vary from being zero (i.e. when currently non-productive land on an existing farm is planted) to being significant (i.e. when high-value agricultural land is purchased for forestry). Whether rates and opportunity cost of land should be included in the analysis will be dependant on the scenario being analysed. Clearly, identifying the scenarios to be analysed is therefore an essential step in the financial modelling process.

Estimates of Cash Inflows

Cash inflows from plantations arise from thinning and final harvest. In the case of hoop pine on the Atherton Tablelands, there is currently no market for thinnings, the only cash inflows being from a one-off final harvest. Cash flows from the final harvest are a function of harvest volume and stumpage price.

Estimates of growth rate are made according to 'site index', defined as the height of the dominant trees at a specified age. In the case of hoop pine, site index is the height (expected) in metres at age 25. A site index of 30 thus means that at that particular site, trees would be expected to reach a height of 30 metres at age 25 years. This index is then related to final predicted yield.

There has been substantial research into developing growth models for hoop pine. These growth models are best developed for south-east Queensland due to the large areas of plantation that have been established. Less well developed models exist for north Queensland sites and there is scant data outside the 'heartland' (i.e. where most of the data lies). Keady (2006) has recommended the use of the growth model for Imbil/Amamoor as being more accurate over a broad range of site indices than the model developed from data from the Atherton Tablelands. He further maintained that the growth rates predictions using the Imbil/Amamoor model will be within 5% of accuracy for similar site indices in north Queensland.

The potential hoop pine plantation yields by SI class for the Atherton Tablelands are presented in Figure 1. These estimates are based on the Imbil/Amamoor yield equation (DPI Forestry 2005, p. 12). Keady (2006) has also generated predictions of yield by log class for five site indices (15, 20, 25, 25, 30, 35) relevant to the Atherton Tablelands, three final stocking rates (300, 400 and 500 stems per ha) and six harvest ages (35, 40, 45, 50, 55 and 60 years).

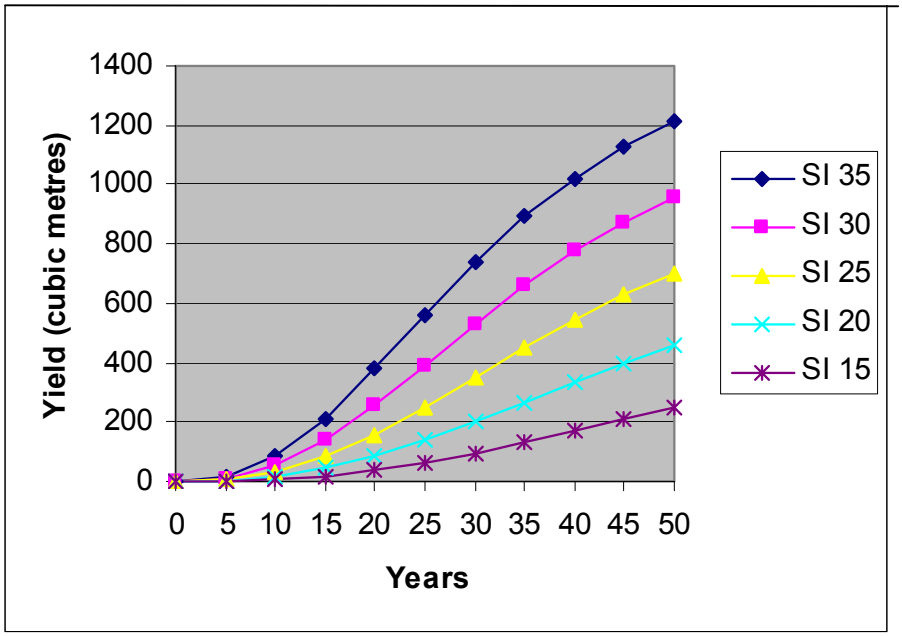

Figure 1: Yield versus age for hoop pine, as a function of site index.

The stumpage price that will be received for hoop pine is difficult to estimate. The current royalties charged by DPI Forestry are considered commercial in confidence and could not be obtained to use in this analysis. Discussions with various industry people suggest that the current royalty in SEQ is about \$70/m^3, while the royalty in north Queensland is about \$50/m^3, in part associated with lower log quality and, perhaps, allowance for the greater distance from markets. For the purpose of this analysis, a stumpage of \$70/m^3 has been used.

The Financial Model

A tentative financial model has been constructed in Excel using the net present value (NPV) model presented in Equation 1. In addition, land expectation value is calculated using Equation 2.

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} - CO \qquad \text{Equation 1}$$

where CO = the capital outlay at the beginning of year 1 (or where t = 0);
k = the risk adjusted real discount rate; and
Ct = net cash flow at the end of year t.

$$LEV = NPV_r + \frac{NPV_n}{[(1+k)^n - 1]} \qquad \text{Equation 2}$$

where LEV = land expectation value;
NPV_r = NPV of initial replication; and
NPV_n = NPV of each replication at year n

The analysis is done on for a representative 1 ha of plantation, and all results are presented on a per-hectare basis.

The Base-Case Financial Analysis

The base case analysis assumes a stumpage of \$70/m^3, approximating the royalty currently paid by purchasers in south-east Queensland. Mr Simms from Ravenshoe Timbers has indicated that he would be willing to pay this amount if the quality of timber he could obtain was sufficiently high. The base case also assumes a site index of 30. This equates to a MAI of 19.4 m^3/ha/year, with a final harvest volume of 872 m^3. The rotation period is 45 years. A 30% tax rate is applied in the analysis. This is the current company tax rate and the most common marginal tax rate for individuals.

The model adopts a *real* and *risk-adjusted* discount rate. There is much discussion about what discount rate is appropriate to use for forestry investments. The rate used in the base case is 5%. This represents a mid-range value in terms of what is used in reported forestry financial evaluations. Typically rates selected range from 4% to 7%. For instance, Row *et al*. (1981) recommended that the US Forest Service use a rate of 4% based on the analysis of the long-term opportunity cost of capital in the private sector of the US economy. While this rate was developed for a public sector organisation, the fact that it is based on the cost of capital to the private sector makes it relevant for use in the private sector. McKillop and Hutchinson (1990) have used portfolio theory and the Capital Asset Pricing Model (CAPM) to determine the appropriate risk for private sector forestry investment. Importantly, they argued that forestry investment for a private sector investment firm would represent only part of a well-diversified portfolio of investments. As a consequence, the accept or reject decision would not be based on the cost of capital for the specific forestry project (e.g. bank lending

rates or rate of return available in the equity markets). The rate of return must compensate the investor for the forestry project's marginal contribution to the risk of the investor's overall portfolio. Based on these principles, McKillop and Hutchinson (1990) estimated the discount rate for private sector forestry investment to be 4.77%. In contrast, various Australian State Government forest services (including Queensland and Tasmania) use discount rates of around 7%.

The base case NPV at a discount rate of 5% is $732, which indicates that the project would be accepted. The LEV is $823, which represents the maximum amount that could be paid per hectare of land for the project still to be viable.

Sensitivity Analysis with Respect to Key Cash Flow Parameters

Discount Rate

The discount rate applied has a strong impact on the NPV and LEV, which is typical for long timeframe of log production projects. The impact of discount rate on NPV is illustrated in Figure 2.

For discount rates around 5.5% and less, an investment in hoop pine plantations would be accepted. Clearly, however, if the required real rate of return from investors is 7%, as is reportedly the case for Queensland DPI Forestry, then the standard hoop pine plantation system that has been assessed would not be accepted as a viable investment.

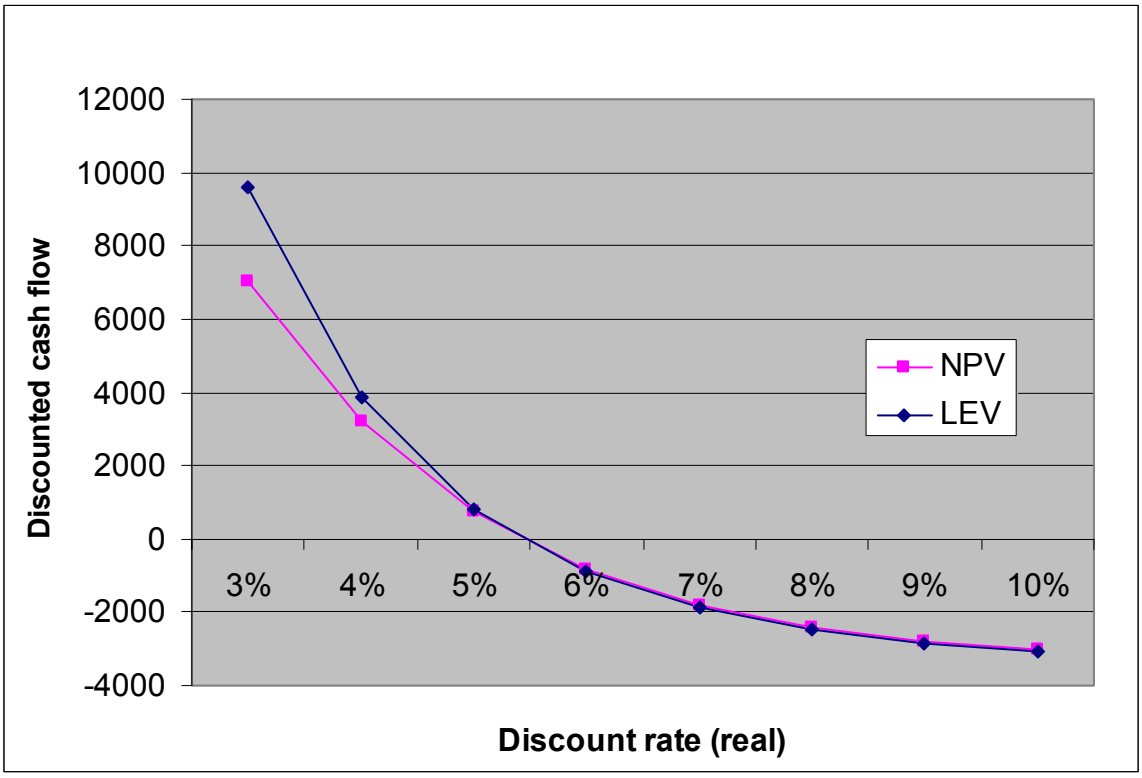

Figure 2: Net present value and land expectation value for hoop pine for a site index of 30 and stumpage of $70 ($/ha).

Stumpage Price of Hoop Pine

The stumpage price has a major impact on the NPV. The base case stumpage price used in the financial analysis is an approximation of the current royalty received by DPI&F in south east Queensland. At various times, higher royalty rates have been achieved, approaching nearly $100/m^3$ several years ago. Given predicted long-term shortages of high quality timber, it is feasible that higher prices could be achieved. The sensitivity of NPV to two levels of higher stumpage ($90/m^3$ and $110/m^3$) is presented in Table 3 and Figure 3. Higher stumpage prices shift the NPV curve to the right, i.e. profitability increases strongly. Importantly, higher stumpage prices mean that hoop pine plantations remain profitable at higher required rates of return.

Table 3: Estimated NPV of hoop pine on the Atherton Tablelands in relation to discount rate and stumpage price ($/ha).

Discount rate	Stumpage price ($/m^3)		
	70	**90**	**110**
0.04	3183	5274	7365
0.05	732	2091	3450
0.06	-821	66	953
0.07	-1801	-1220	-638
0.07	-2415	-2033	-1650

The Impact of Rate of Tax on Outlays and Timber Revenue

While the Australian company tax rate of 30% has been taken as the base case tax rate, it is possible that individual investors could pay a higher marginal rate. The current 2005-06 marginal tax rates for income from $63,001 to 95,000 and for income in excess of $95,000 are 42% and 47% respectively. The marginal tax rates have been found to have little impact on estimated NPV (Figure 4). Plantation expenditure attracts tax deductions, while revenue incurs tax, and to some extent these offset each other. At lower discount rates, the NPV for the base case tax rate of 30% is slightly higher than for the higher marginal rates. This situation reverses for higher discount rates. This is simply due to the increased benefits of tax deductions in early years relative to income tax paid in later years at higher discount rates. The overall impact of tax rates is however negligible and can be largely ignored.

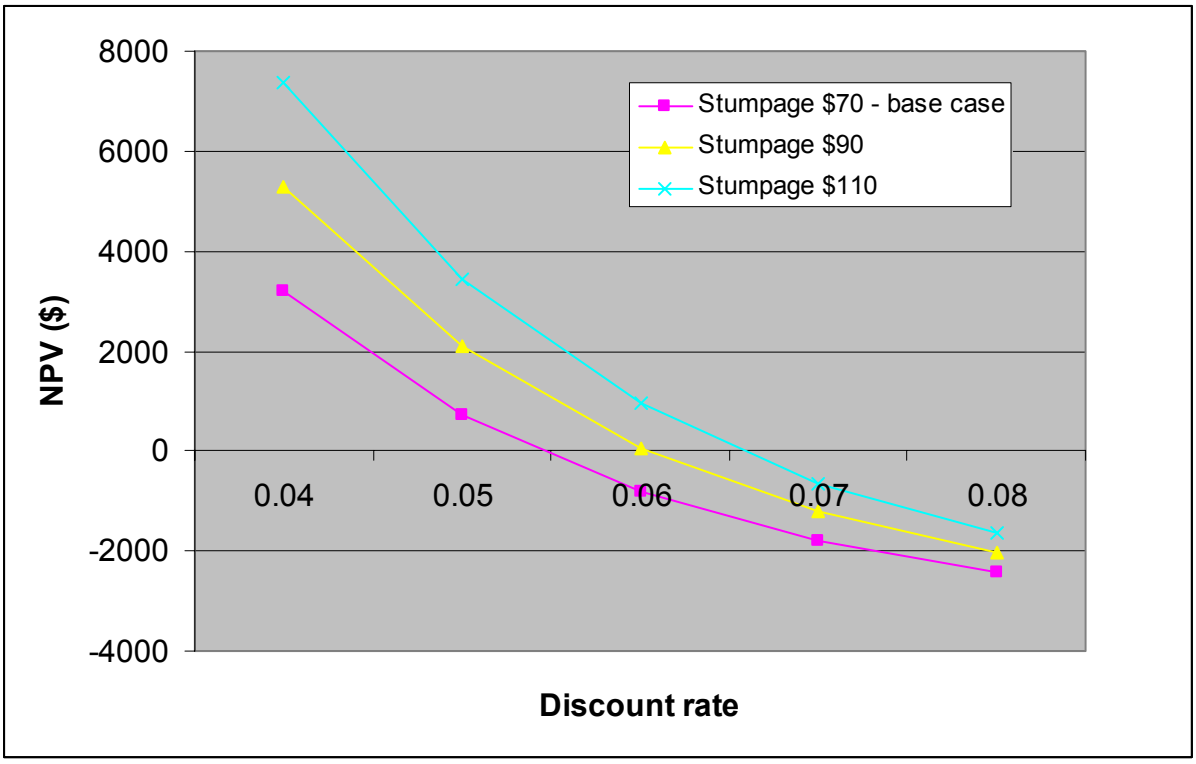

Figure 3: Estimated net present value versus stumpage price.

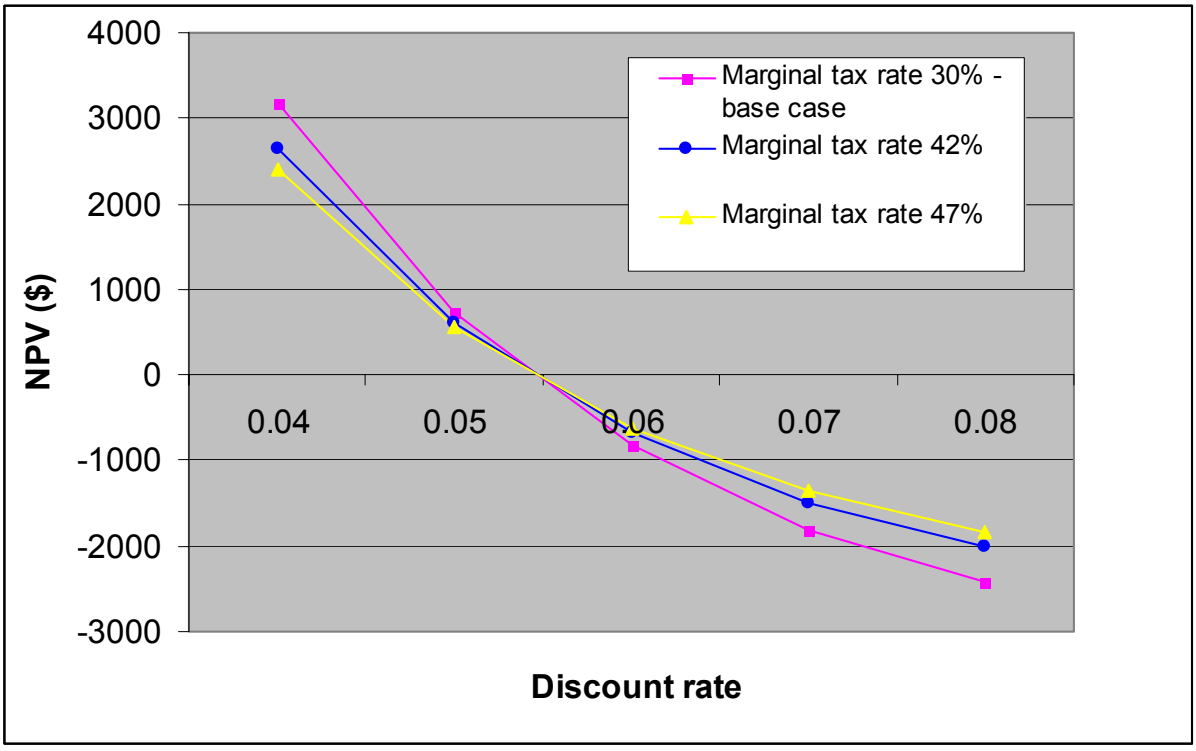

Figure 4: Estimated net present value versus the marginal rate of tax.

Scenario Analysis of Lower Cash Input Costs

The base case has been developed with the assumption that all labour involved in the establishment and management of the plantation (i.e. planting, weed control, thinning and pruning) is provided on a commercial contract basis with a similar cost structure to that of DPI Forestry. Implicit in the use of the DPI Forestry costs for assessing hoop pine plantations on farms is that farmers will contract out the work. However, landholders establishing hoop pine on part of their existing property may decide to undertake part or all of the work themselves. For instance, a landholder may undertake these activities in periods of low activity in other farm operations and the opportunity cost of other income forgone may be very low. Some landholders even view the growing of trees as a recreational activity (Maczkowiack in press). In these cases, attributing a lower value to many of the input items would be appropriate.

Two scenarios have been developed, namely where the labour-intensive inputs are valued at half of the corresponding costs in the base case, and where labour costs are valued at zero (with a small expenditure retained for other inputs including herbicides). The cost levels used in these two scenarios are presented in Table 4. Compared with the base case, reduced expenditure on landholder labour improves the NPV markedly, both for the reduced cost and minimum cost scenarios (Figure 5). This is significant in that hoop pine plantations become highly attractive for landholders who place a low or negligible value on their labour inputs. It is also significant in that these lower labour costs make hoop pine attractive on sites of lower productivity, i.e. site index 20 and 25 (Figure 6).

Table 4: Costs used in reduced cost and minimum cash input cost scenarios.

Activity	Base case costs ($/ha)	Reduced cost ($ ha)	Minimum cost ($ ha)
Establishment			
Slash and spray	600	300	50
Site cultivation	600	300	50
Planting labour costs	400	200	0
Continuing maintenance			
Post Plant Spray (supply and apply)	450	225	50
Prune - contract (3 m lift)	650	325	0
Post Plant Spray (supply and apply)	300	150	50
Post Plant Spray (supply and apply)	150	75	25
Pre-Commercial Thin (400 stems/ha)	500	250	0
Prune - contract (5.4 m lift)	850	425	0

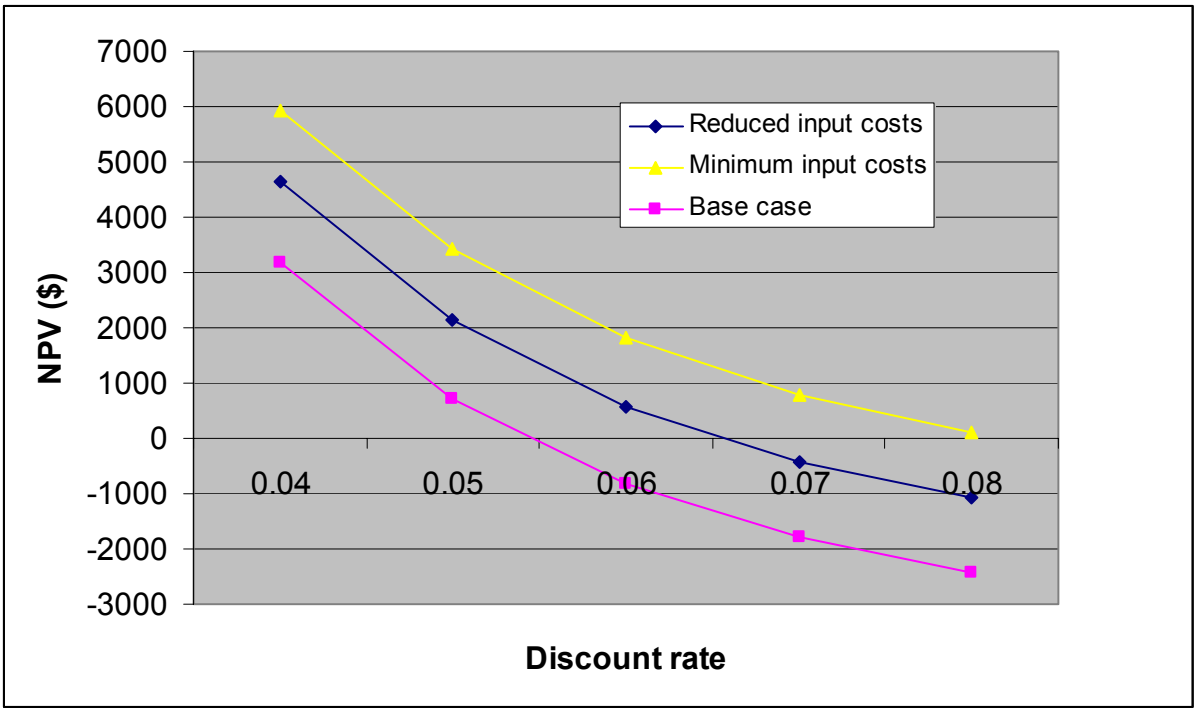

Figure 5: Estimated net present value versus landholder labour input cost.

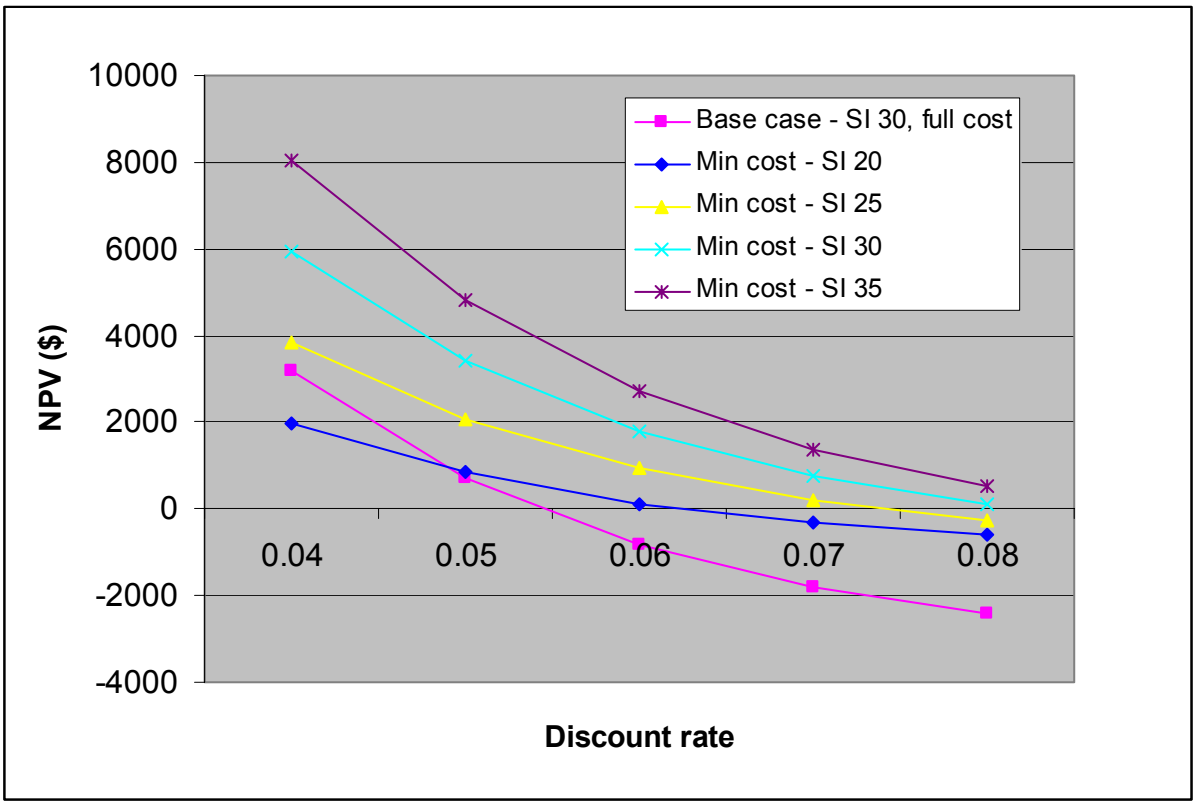

Figure 6: Estimated net present value versus site index.

Summary of Financial Analysis Findings

The financial analysis indicates that a 1 ha plantation would yield a NPV of $732/ha, which indicates that the forestry investment would be financially viable. The sensitivity analysis indicates that discount rate and stumpage price have major impacts on NPV but marginal tax rate does not. In addition, the use of lower values for landholder labour costs yields substantially higher NPVs. It is envisaged that further development of the financial analysis will be undertaken before the business case is finalised. In particular, financial estimates will change when the plantation scenarios to be recommended are identified in more detail.

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