AGROFORESTY AT WORK

Radiata Pine Agroforest for Timber Production and Shelter

TIA Vegetable Research Facility, Forthside

Background

In 1997, the Department of Primary Industries and Private Forest Tasmania jointly set up a trial to show how radiata pine can be established and managed to grow high quality, high value wood and provide shelter for agriculture.

The project was initially funded under the Australia Government's Farm Forestry Program and after 2001 funded by Private Forests Tasmania.

The 1.4 hectare project consists of 15 plots each with 49 trees (1,143 trees per hectare). Trees, either cuttings or seedlings, grown in tubes or as open rooted plants, were selected from the top end of tree breeding programs. (Cuttings have smaller finer branches than seedlings and are more suited to pruning).

The trees were planted on land too steep for cultivation. (It has been estimated that there are up to 27,000 hectares of such land in north-west and northern Tasmania).

1997 – 2000

Best management practices were used to establish the trees – weed control, ripping and mounding, follow-up spot weed control and replanting where necessary. Tree survival and early growth were closely monitored. The first two years after planting were exceptionally dry. In 10 of the first 12 months the total monthly rainfall was 56% less than normal and 80% less in December.

Findings

1. 62% of trees survived the first two years. Losses would have been higher without grass control during the 8 months after planting. (Losses were replanted each year)
2. Trees receiving irrigation runoff from the paddock above had twice the survival rate and grew twice the height than trees without irrigation.
3. Open-rooted plants grew 32% taller in their first and second years than did container grown plants. After 24 months the average height of open-rooted trees was 111cm.
4. About 7% of trees were lost due to browsing by rabbits and cuttings were browsed 12% more than seedlings.

2001 – 2014

The aim of the trial after 2001 was to show how the stand could be managed to grow wood (without compromising shelter) and earn a profitable return on the investment.

Figure 1 Operations

Time (approx)	Operation
Summer 1997	Pre-spray cultivation to control weeds and grass.
March 1997	Ripping and ploughing with a winged ripper and mound plough.
May 1997	Trial layout.
May 1997	Pre-plant spot spraying (Velpar).
July 1997	Planting.
August 1998	Fertilising – 125 gram DAP per tree.
August 1999	Post plant spray (spot application of Velmac G granular herbicide – active constituent 200g/ha Hexazinone).
12 & 24 months	All trees assessed for height, diameter, form, health, weed competition.
July 2001	First lift prune selected trees to height of 2.4 metres.
April 2003	Second lift prune to 4.5 metres.
July 2003	Thinning to waste to retain the best 373 trees per hectare.
Dec 2005	Third lift prune to 6.5 metres.
	Each pruning lift included form pruning to produce a single straight trunk and was immediately followed by a 'Pruned Stand Assessment' as per Australian Forest Growers Pruned Stand Certification to record log quality.
Ongoing Assessment	All trees assessed for height, diameter, pruned height and form.
April 2010	Assessed with Pruned Height measured January 2012.
November 2014	Farm Forestry Toolbox Analysis.

Farm Forestry Toolbox Analysis

The Farm Forestry Toolbox is a computer program developed by Private Forests Tasmania. Among other things, it models current and future tree growth, timber values and carbon sequestration. It also calculates the Net Revenue, Net Present Value (NPV) and Internal Rate of Return (IRR) of an investment (Figure 6). Depending on the owners' objectives, these can help decide when to harvest trees.

The data inputs and tools and Toolbox outputs are shown in Figure 2.

The Toolbox can be downloaded from www.pft.tas.gov.au

Figure 2 Farm Forestry Toolbox – Inputs & Outputs

Data INPUTS/tools	OUTPUTS	Figures
Plantation assessment	**Stand Summary** - Current tree/stand volumes (cubic metres) and growth rates.	Figure 4
+ Current log grades and prices from local timber processors (Log Grade Set – Figure 3)	**Stand Summary** - Product mix (pulpwood, sawlogs, waste) by volume (cubic metres) and dollar value ($/cubic metre).	Figure 4
+ Growth model (Toolbox)	Estimated future product mix by volume and value at nominated harvest times for a specified management regime.	
+ Regime Events and Costs (Figure 5), NPV and IRR tools	**Financial Results** - Net revenue, NPV and IRR enable estimates of preferred harvest time (year) and product mix by volume and value. Presented as tables and graphs.	Figure 6 Figures 7 - 9
+ Biomass functions(Toolbox)	**Carbon** - Biomass sequestration	Figure 10

Figure 3 Log Grade Set

This set of specifications determines the log length and diameter for each category of log.

Name	Code	Length Min (m)	Length Max (m)	SED Dub Min (cm)	LED Dub Max (cm)	Value $/m³	Preferred Length Step (cm)	Overcut Length (cm)	Pruned
Veneer	V+	2.7	5.5	40.0	999.0	90.00	270		☑
Sawlog Pruned	SP	2.7	6.0	35.0	999.0	65.00	30		☑
Cat 1	A	2.7	6.0	30.0	999.0	50.00	30		☐
Knotty Sawlog	KS	2.7	11.0	20.0	999.0	30.00	30		☐
Pulp	P	2.4	11.0	10.0	999.0	3.00	10		☐
Waste	X	0.0	999.0	0.0	9,999.0	0.00			☐

Log Grade Attribute	Description
Length	Individual log lengths (metres)
SED	Small end diameter of the log (centimeters)
LED	Large end diameter of the log (centimeters)
Value	The price paid for the log by the buyer ($ per cubic metre)
Preferred length step	Multiples into which the log length can be divided (centimeters)
Pruned	Log categories which are accepted as pruned logs.

The Toolbox calculates the tree and stand values (Figure 4).

Figure 4 Stand Summary - April 2010.

Output	Attribute	Value
Plantation Assessment	Age	13.8 years
	Mean Diameter (DBHob)	37.5 cm
	Stocking	373 stems/ha
	Basal Area	41.2 m^2/ha
	Mean Dominant Height	18.9 m
	Mean Annual Increment	21.2 m^3/ha
	Total Volume	249.9 m^3/ha
Products and Value	Saleable Volume	236.0 m^3/ha
	Average Tree Volume	0.67 m^3/tree
	Stand Value	7,520 $/ha
	Veneer V+ Value	0 $/ha
	Sawlog Pruned SP	589 $/ha
	Cat 1 A Value	2,939 $/ha
	Knotty Sawlog KS Value	3,875 $/ha
	Pulp Grade Value	117 $/ha

The Toolbox uses scheduled operations (i.e. regime) and costs (Figure 5) to estimate financial returns being; net revenue, Net Present Value and Internal Rate of Return (Figure 6).

Figure 5 Regime Events and Costs (e.g. harvest at 30 years)

Date	Event	Description	Cost ($)
1/1997	Spraying	Pre cultivation spray	120/ha
3/1997	Ripping & Mounding		160/ha
5/1997	Management Planning	Planning, design and layout	500/ha
7/1997	Spraying	Pre plant spray	120/ha
7/1997	Nursery costs	Cutings@$400/1000 and seedlings $325/1000	360/ha
7/1997	Financial Base	Interest rate 5.0%	0
7/1997	Planting	1143/ha	A50/ha
8/1997	Fertilising	DAP	400/ha
8/1998	Spraying	Velpar	200/ha
7/2001	Pruning	Lit 1; 2.5m; 373/ha	600/ha
3/2003	Pruning	Lift 2; 4.5m; 373/ha	600/ha
7/2003	Thinning	T1; Waste; Out 0; 373/ha; Bias 0	500/ha
12/2005	Pruning	Lift 3; 6.5m;373/ha	600/ha
6/2028	Forest Practices Plan		600
7/2028	Clear felling	Commercial	0

Figure 6 Financial Results - Stand Net Revenue, Net Present Value and Internal Rate of Return

Clearfell age (years)	Net Revenue ($/ha)	NPV ($/ha)	IRR (%)
20	29,486	7,062	11.31
25	**41,546**	**8,267**	**10.41**
30	**50,832**	**7,797**	**9.27**
35	57,611	6,511	8.23
40	62,644	4,965	7.33

Figure 7 Stand Harvest Net Revenue

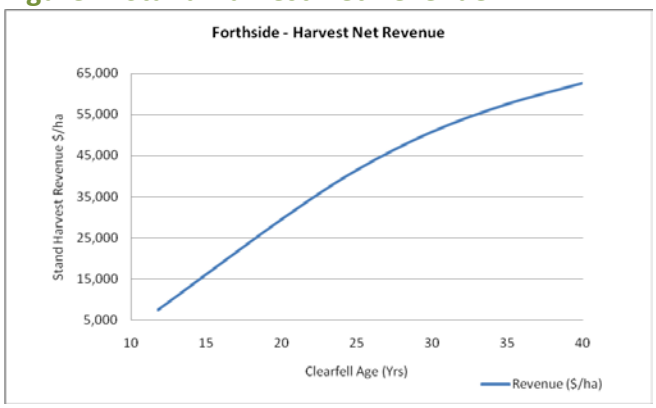


Figure 8 Net Present Value

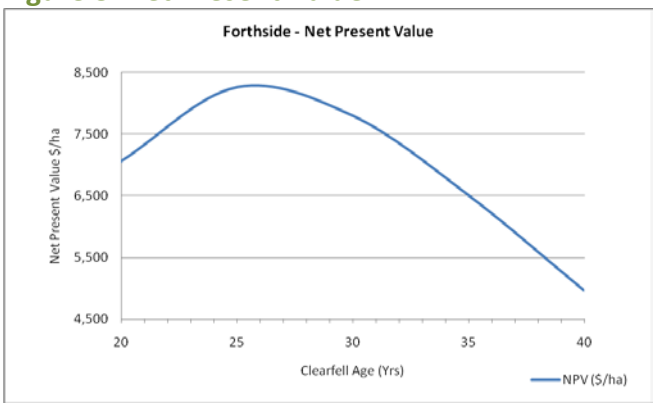
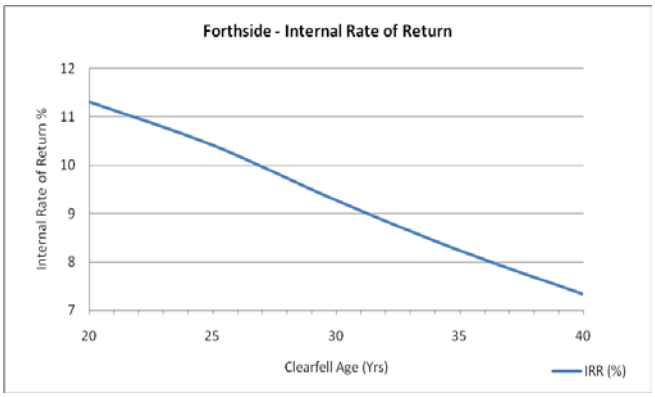


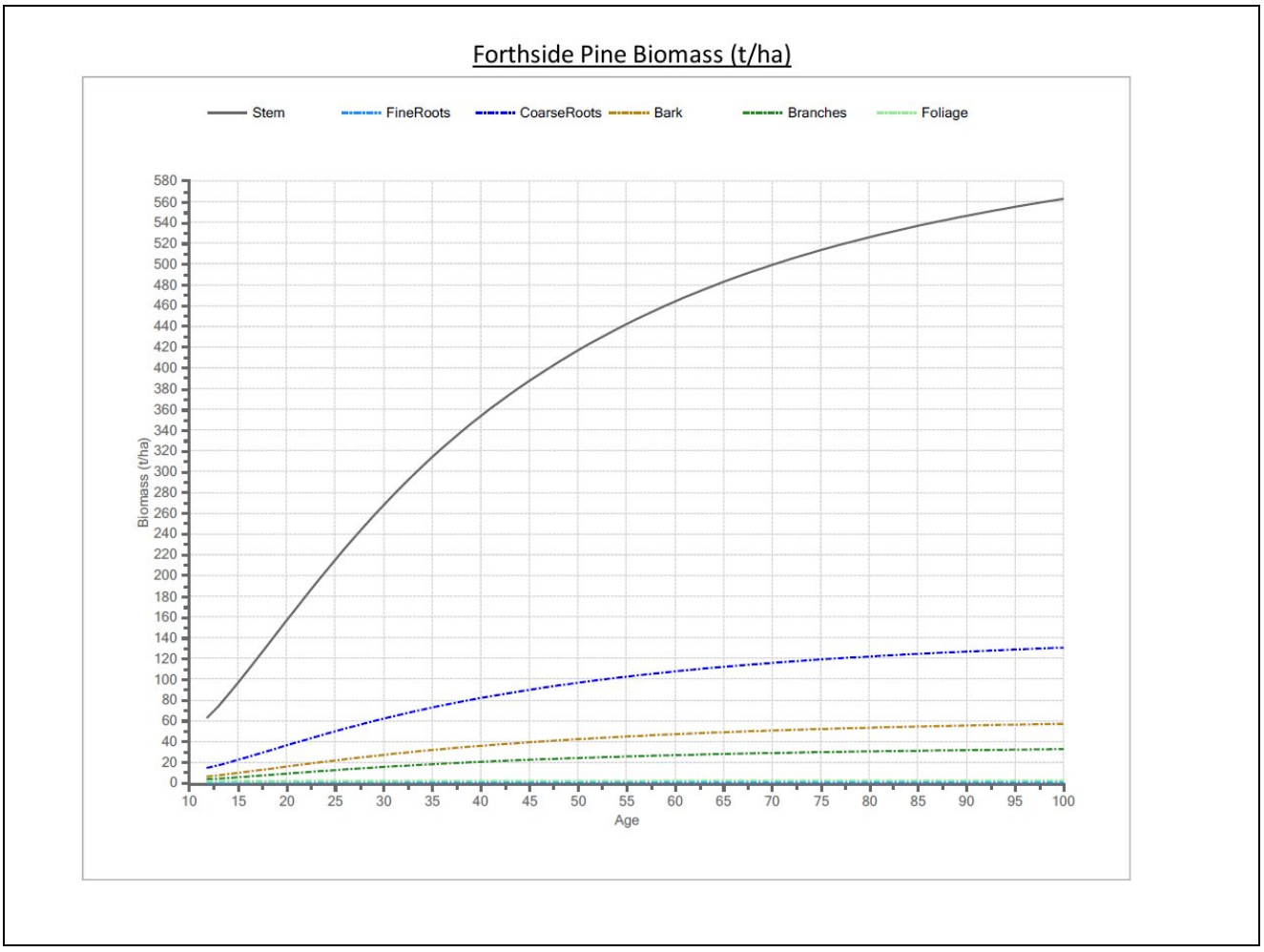
Figure 9 Internal Rate of Return



The Toolbox estimates the carbon (biomass) sequestration (tonnes/ha) over 100 years (Figure 10). Potential revenue from carbon credits at various carbon prices (not included here) is also estimated.

Note: To convert carbon biomass (t/ha) to CO2 equivalent, multiply the total carbon biomass x 3.667.
For example, the carbon CO2 equivalent of this agroforest at 30 years is 1,379 CO2 t/ha. (i.e. 3.667 X total carbon biomass of 376 t/ha (includes; stem 268, fine roots 1, coarse roots 62, bark 27, branches 16 and foliage 2 as shown in Figure 10).

Figure 10 Carbon Biomass



Shelter Effect

Wind speed is reduced behind shelterbelts. Generally, when winds are perpendicular (90 degrees to the belt), the maximum extent of 50% wind speed reduction is 5 X tree height (H). In this case, 5 X 20m or 100m. The area over which some wind speed reduction occurs is about 25 X H or 500m. (Source; National Windbreak Program 2002). Effects of local topography have not been taken into account. When winds are at 45 degrees, wind speed is reduced to at least 15 X H, and at 60 degrees to 6 X H. On the map below, boundaries in green (5 X H) and blue (25 X H) indicate potential reduction in wind speed.

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