THE ECONOMICS OF FORESTRY VERSUS PASTURE

J. B. JACKMAN

Department of Agriculture, Hamilton

Summary

The post-tax returns/acre/annum of farm woodlot scale forestry are compared with sheep stocked at 5 stock units/acre. The results are presented as a break-even timber value. This is the point at which returns from forestry and farming are equal, thereby implying that farm forestry would be more profitable than sheep grazing at timber values above the breakeven.

A FARMER who has 20 acres which could be planted in trees has a complex choice to make in deciding whether to put in a plantation or to continue grazing the area with stock. It would be sensible to begin by tracing through the expected pattern of costs and retums. It is not possible to foresee exactly what will happen in the future, but, by making reasonable assumptions, a firmer base for making a judgement can be built.

There must be no prejudice against forestry, so examples should be taken which assume a favourable site. If trees do not compare well in the favourable case, there would be little point in investigating a site where establishment costs would be much higher. Farmers are usually in'terested in planting either into pockets of pasture which are awkward to manage or into areas of gorse, bracken fern and other weeds. Two examples will be worked through, the first representing grassland and the second the land with weed cover.

Costs in forestry are variable in the extreme and, what is more, they are inter-related. Experience has shown that it is cheap-r in the long run to do a thorough job of the initial land clearing operation. If this is followed by a high standard of planting, then seedling survival should be above the critical 70 to 80%. This in turn means that blanking to fill in the gaps can be avoided entirely and only one or two releases from smothering weeds should be necessary.

"Thorough land clearing" generally means cultivation where the contour allows it. The existing cover of gorse, bracken fern or light scrub would be burnt then double-disced and heavily harrowed. On today's costs one would expect to spend $20 per

TABLE 1: CALENDAR OF OPERATIONS

	Operation	Grassland ($/acre)	Weed Cover ($/acre)
COSTS			
0	Land clearing	—	20
	Planting	42	40
1	Blanking	—	—
	Releasing	15	20
			20
6	Pruning (O-8 ft), 300 stems	20	
8	Pruning (8-14 ft), 150 stems	18	
10	Pruning (14-20 ft), 80 stems	12	
	Thinning to waste	15	
1 to 25	Incidentals	2	
RETURNS			
25	Clearfell 8-10,000 cu. ft/acre		
	Net stumpage 5 c/cu. ft	500	
	10 c/cu. ft	1,000	
	15 c/cu. ft	1,500	
	25 c/cu. ft	2,500	

acre on this type of land clearing. If heavy scrub has to be cut by hand, then the clearing cost would be more like $40; however, there is less regrowth after dense scrub which is some compensation.

For planting into pasture, the practice in the central plateau is to lift an 18 in. square of turf with a spade and fold this back. Consequently, grassland clearing costs are nil but planting costs would be slightly more expensive. On clear country, the contract cost of hand planting would be $22 an acre at 8 ft x 6 ft spacings. The balance of the $40 set aside for planting is made tip from seedling trees at $15/thousand plus freight from the nursery.

Releasing is frequently overlooked by an inexperienced farm forester. Grass would probably be sprayed with atrazine at a contract cost of $15 per acre while picloram would be used to spray gorse. The latter material can be applied from the air before planting, or while the trees are still dormant in late winter. Spring sprayings of gorse would have to be done by hand at a cost of between $15 and $20 per acre. Bracken fern releasing is also costly and hand fronding could be expected to cost $22 per acre.

Three stages of pruning are recommended. The first 8 ft can be reached with secateurs while standing on the ground but for higher pruning the practice is to use a ladder and jack-saw or long-handled saw.

Again, contract pruning costs have been adopted on grounds of skill required to select the best trees to prune. Furthermore, it is unlikely the farmer could spare the two man-days/acre of time which would be needed at each stage. To expect the farmer to do his own pruning would be like expecting him to do his own shearing.

There are two schools of thought on thinning. It has been a practice to extract thinnings for fence posts and to delay the main thinning until year 20. By the twentieth year, a proportion of the thinnings would be salable logs. About 2,200 cu. ft of salable timber worth about two-thirds of value per cube of the clcarfelled logs could be expected.

Production thinning does have the advantage of bringing in returns earlier in the rotation but at the expense of retarded growth rate in the final crop trees. The extra competition between years 10 and 20 would lengthen the rotation. It should be noted tnat if production thinning extends the rotation by more than 4 years it is unprofitable. The financial result will be much the same for a 25-year rotation which is thinned to waste and for a 29-year rotation from which production thinnings are taken, assuming the latter is feasible.

The incidentals cost of $2/acre/annum should cover the main risks in forestry. *Dothistroma* fungus could be a problem between years 10 and 15. To spray with copper would cost $5 per acre and it may be necessary to do this twice.

Annual insurance against the fire risk would cost about 0.9% of the value of the trees. This is too expensive, therefore the common attitude is to take sensible precautions. If the plantation borders an area of scrub, it would be reasonable to maintain a break betwen the two.

The end of the production cycle would be reached in year 25 with a yield of between 8,000 and 10,000 cu. ft/acre. The following calculations show the effect of yield on profitability.

Timber value depends on two factors. The most important is transport distance with logging costs influencing value as well. Road transport costs have been quoted at about 3 c/15 miles for short hauls or up to 8 c when the haul is about 60 miles. This underlines the significance of proximity to a sawmill or export port. Commercial logging and loading costs vary from 7

to 11 c/cube depending on the contour of the land and access. The combined effect on value/cu. ft of location and contour could be over 10 c/cube. A range of values from 5 c to 25 c/cube will be considered.

Optimistically output could be valued by taking the current price of export logs on the wharf at Mt Maunganui then subtracting logging and transport costs. On these assumptions timber trees in the area between Rotorua and Taupo would be worth between 20 and 25 c/cube. In practice, current returns are half this. Fifteen down to 6 c per cube would be offered. It should be pointed out that the trees being felled today have not been tended, therefore their quality would be poorer than the quoted plantation.

As an incentive for forestry Government will pay half the establishment and tending costs listed. This payment is made under the Forestry Encouragement Grants Scheme. However, the 50% of costs borne by the grower cannot be deducted from income for tax purposes either in the year they are incurred or at the time of utilization. In effect, the grant is a tax deduction in advance and it halves all the forestry expenses listed in Table 1.

The tax liability is greater under forestry because expenses cannot be claimed as a deduction. In contrast, farm income is taxed after expenses are deducted, therefore the amount of tax due on the same gross farming returns would be less. To take this difference into account the comparison will be made after tax. The forestry returns in year 25 will be substantial; therefore, even allowing for the five-year income spreading concessions, it would be reasonable to assume that clearfelling returns would be taxed at the maximum rate of 50 cents in the dollar.

There is thus a pattern of costs and returns for forestry spread over 25 years. The problem is to compare this with a farming return which comes immediately and is relatively constant from year to year.

The technique used is known as discounting. Each cash amount is multiplied by a discount percentage which reduces the value of money received or spent in the future to its equivalent value today. Discounting can be thought of as compound interest in reverse — both are based on interest rates. If borrowing were necessary to finance the project, a discounting interest rate would be chosen which is the same as the interest on the loan. If the returns discounted at the loan interest rate still out-

weighed the discounted costs, this project would pay debt charges and the discounted surplus is the profit.

If cash were available to finance the project, interest would not have to be paid on a loan. However, it can be reasoned that this money could be invested to bring in interest. Either way, long-term projects should cover interest before profits are counted.

Discounting at 7% gives the equivalent profits per acre per annum for forestry. Figure 1 relates post-tax returns/acre/annum to the value of timber. The four sloping lines represent the grassland and weed cover examples each at two levels of clear-felling yield. If trees planted in pasture were to yield 10,000 cu. ft/acre, then the post-tax return/acre/annum would be — $1.10 at a timber value of 5 c/cube. All cases give negative returns at 5 cents timber value. The price needed for returns to outweigh costs is the point where each sloping line crosses the horizontal axis.

At the other end of the scale returns are more attractive. For example, the return is $14.07/acre/annum at 25 c in the grassland — 10,000 cu. ft/acre case. But at higher timber values the effect of yield variation becomes marked. A 2,000 cu.ft reduction in yield causes the return to fall by $4/acre/annum (at 25 c) .

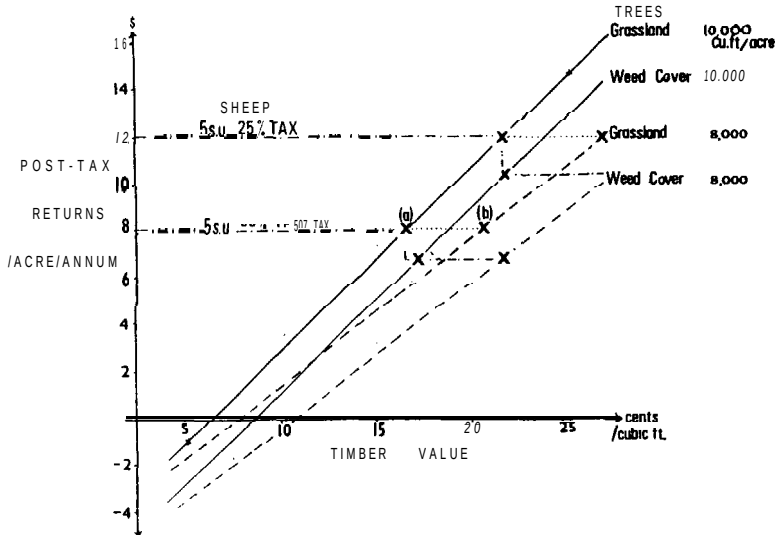

FIG. *1: Break-even analysis,*

Undiscounted costs are $43/acre higher in the weed cover example (refer to Table 1). The extra cost compared with planting in grassland reduces the return by $1.70/acre/annum at each level of timber value and for both levels of yield. In other words, at any given yield the graphs of grassland and weed cover returns would be parallel and $1.70 apart.

The farming situation can now be considered. Table 2 derives a gross margin for fat lamb ewes where flock replacements are bred on the property. The gross margin of $4.74 per breeding ewe converts to $4.10 per stock unit. The two assumptions which have most influence on this figure are lambing percentage and the lamb price.

TABLE 2: FAT LAMB — BREEDING REPLACEMENTS

	$	$
Gross revenue (per ewe):		
Lambs — 95% survival (@ $4.50)	3.15	
Wool — 12 lb/ewe (@ 20 c net)	2.40	
Cull ewes — 18% (@ $3)	0.54	
		6.09
Direct costs:		
Animal health	0.30	
Shearing and crutching	0.35	
Ram replacement	0.25	
Hay	0.10	
Interest capital stock	0.35	
		1.35
Gross margin/breeding ewe or $4.10 per stock unit		$4.74

If the land is capable of carrying an average Taupo stocking rate of just over 5 stock units per acre, then a gross margin/acre of $20.50 can be expected.

With a change-over to forestry, some overhead costs can also be avoided. The major one of these would be fertilizer at $4 per acre and a further 50 c/acre can be added to cover extra repairs on fences and water supply. No allowance is made for labour savings because cash savings would normally be non-existent on a one-man unit.

By deducting $4.50 in overheads from the $20.50 gross margin/acre, a profit from sheep of $16 per acre is obtained. To arrive at the figure for comparison with forestry, taxation need only be deducted from the $16. If the farmer is on the maximum tax bracket then the pre-tax figure must be halved.

Most farmers have marginal tax rates in the range 25 c in the dollar up to 50 c, therefore these two extremes will be used.

When the sheep results are superimposed on the graph of forestry returns (Fig. 1) the break-even points are highlighted. The sheep results are horizontal lines because sheep returns are independent of timber value. In the maximum tax rate case, the lines intersect at 17 c timber value (a). At this point the returns from sheep and trees would be equal. Below 17 c it would pay to carry sheep, above 17 c forestry should be favoured. If forestry yields were 8,000 cu. ft/acre the grassland break-even would be at 21 c per cube — (b), 50% tax.

A further adjustment must be made to obtain the break-even for the gorse and bracken fern and light scrub cases. The analysis so far ignores the cost of developing the country to carry the stock. To be realistic, the capital cost of development should be assessed, then the interest charge at S.A.C. rates on this capital cost should be deducted from the $16 per acre pre-tax gross margin. If the development costs $50 per acre, then $2.75 ($50 X 5½%) would be deducted from the $16 gross margin/acre. By carrying through this calculation, break-evens would be found which are approximately the same as in the grassland case.

Overall it can be seen that break-even points range from a low of 17 c in the case most Eavourable for forestry up to 27 c in the least favourable case.

The conclusions that can be drawn from this analysis are that a minimum timber value of at least 17 c/cube will be needed if farm forestry is to be more profitable than sheep farming at 5 stock units/acre. The likelihood of achieving this return per cube depends on the proximity to a sawmill or export port. Variations in the costs of establishment do not have a major effect on break-even point because weed-covered land would also have to be developed for agriculture at high cost.

APPENDIX

The derivation of the results presented in Fig. 1 is in two stages.

1. Present Value (PV)

Cost and returns occurring in the future are reduced to their equivalent in the base year.

$$PV = \sum_{i=1}^{n} \frac{Ri}{(1+r)^i} - \sum_{i=1}^{n} \frac{Ci}{(1+r)^i}$$

where (a) Ri and Ci are the returns and costs, respectively, in the ith year of the project

(b) r is the rate of interest expressed as a decimal.

2. *Annuity* (A)

This formula gives the annual amount to be paid at the end of each year for n years which will be equal -to a given present value.

$$A = \frac{PV.r\ (1 + r)^n}{(1 + r)^n - 1}$$

where (a) PV is the present value derived in stage one.
(b) r is the rate of interest expressed as a decimal,
(c) n is the length in years of the forestry rotation.

JOINT DISCUSSION

Willis (Greatford) commented that forestry provided more employment per unit area than did agriculture. He asked whether the problem of *Dothistroma pini* would result in an annual increase in cost per acre or would they continue to be able to deal with it at the recent low costs. Ure stated that this was the first significant pathogen in New Zealand exotic forests and that its effects had been immediate and dramatic. Two species, ponderosa and Corsican pines, had been eliminated completely from the spectrum of species used. This was because they would need to be sprayed every 3 or 4 years throughout a long rotation. With radiata pine they were more fortunate, since it required only a light application twice or three times in the life of the crop. In drier areas -- e.g., Weirarapa — no spraying was required. The cost of aerial spraying was only $5 per acre. Asked by O'Connor (Lincoln College) whether more consideration could be given to the aesthetic use of land in the Taupo region, Ure agreed that it was a pity that there were large blocks of forest and large blocks of grassland. In future there might be a better blend of the two, but even starting with a clean sheet it would be difficult to achieve that. On the east side of Taupo. he hoped that some land could be kept for agriculture, purely from the scenic point of view. To enhance the scenery he wanted to avoid a monoculture of radiata and have other species interspersed with it. He would also try to preserve viewpoints from which the lake and the mountains could be seen and to maintain the present ecology of streams feeding into the lake. Cumberland (Auckland) asked for comment on the economics of cropping of grass and trees on the one area of land. Ure said that extensive trials on multiple use had been commenced. Something from both must be sacrificed — for instance, widely spaced trees would affect the quality of timber. Jackman considered that multiple use might be more profitable than any of the existing systems, particularly with the long wait for trees to mature. There would be a cost of 25c for tree protection. Risk factors, such as inflation and fire, would be associated with such use, but Jackman commented that inflation would be covered by the discount system. Insurance of trees would be out of the question on cost. Ure thought that propaganda and publicity provided the best insurance against fire losses which were relatively small in the area. Lancashire (Palmerston North) asked if the copper sprays used in the control of *Dothistroma* could affect stock and lake life. Ure replied that tests had been carried out which showed that there was no problem, mainly because applications were not sufficiently frequent or concentrated to be of any significance.