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NO. 35

THE RELATIVE ECONOMICS OF WOODLAND MANAGEMENT SYSTEMS

by

K.J. Crockford, M.J. Spilsbury
and P.S. Savill

1987

OXFORD FORESTRY INSTITUTE
Department of Plant Sciences
UNIVERSITY OF OXFORD



Note: The computer program 'Woodland Management Decisions' described in this paper is available separately from OFI, on diskette, for IBM PC and compatible computers. Please enquire for details.

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PART 1

CHAPTER 1

ECONOMICS OF WOODLANDS MANAGED FOR FUELWOOD AND TIMBER PRODUCTION

1.1 INTRODUCTION

The objectives and priorities for managing woodlands vary widely. They can range from maximizing timber production or returns on investment, to management for sporting purposes or conservation and amenity. The financial viability of a woodland management regime is usually assessed by considering the return on the investment at an appropriate real discount rate. This is conventionaly done because forestry, unlike many other forms of investment, has very long cycles between investing the money in a new plantation and obtaining a return. Discounting provides a method of bringing all expenditures and returns to a single point in time and expresses the disadvantage of having to wait. The discount rate selected depends on such factors as the financial risks involved, or conversely the value put on woodlands as a secure investment and values other than maximised return. The factors which influence profitability are numerous. They include site quality, in terms of soil and climate, the species and silvicultural system used, the size of a woodland block, ease of access for removal of timber, proximity to markets, and the availability of grants and fiscal incentives. In general, low discount rates, short rotations and early returns from thinning increase the attractiveness of an investment, while high discount rates, high early expenditure and very long rotations do the reverse.

Systems considered favourable to conservation and amenity, such as coppicing and growing native broadleaved trees, have been little practised in recent decades due to the decline in markets for their traditional products and generally low returns. Fuelwood offers an alternative market for some of the products of such systems, and also for early thinnings and the lop and top which, until recently, would have been at best harvested for no profit or more likely left un-used in the forest. The purpose of the study described in this paper is to consider the economic viability of a range of management systems and options, in which fuelwood can be sold as well as the timber. The net revenues are considered under a range of discount rates, productivity and price levels, and information on the effects of taxation, grants and other factors is also provided.

1.2 DISCOUNTING THEORY

Discounting is the inverse process of compounding, which is familiar to anyone who has a deposit account in a bank. It involves subtracting from a sum of money promised in the future a certain percentage of that sum for every year from the present until that sum is received. A discounted cost or revenue is the value multiplied by a discounting factor (which is always less than one), determined by the discount rate and number of years from the present. As with other financial analyses the measure of overall profit is the difference between total revenues and total costs, in this case however both sets are discounted values and the measure is usually known as 'Net Discount Revenue' (NDR) or 'Net Present Value' (NPV). NDR's are expressed in terms of pounds present value and indicate the magnitude of the profit or loss at the discount rate selected.

Individual woodland and estate owners, when considering the profitability of management options, do not usually apply discounting techniques as such, often being more concerned with maintaining a positive net periodic revenue from the woodland overall. Discounting, however, is often used on an

intuitive level in that immediate costs are given far greater weight than revenues in the future. Future revenues need to be great enough to compensate for the time spent waiting for them. Discounting techniques are used when assessing the profitability of a long-term investment and they are used in this study for comparing the profitabilities of a range of management options.

In order to compare the profitability of management options which involve different rotation lenghts, NDR's alone are not satisfactory. One must instead compare NDR's for an infinite series of rotations. This concept was first considered by Faustman in 1849 and is called the 'Soil' or 'Land Expectation Value' (LEV), it could also be called net discounted revenue in perpetuity. Land expectation values are calculated by treating the NDR as a periodic payment occurring now and at the beginning of each subsequent rotation. The LEV is the sum of all these NDR's, each being discounted from the start of the rotation to which it refers, back to the present. It is easily calculated using multipliers which are based on rotation length and the same discount rate as was used for the NDR calculation, (see Pryor, 1982 for description of the equations). The LEV multipliers can also be used for calculating the present value of an infinite series of costs or revenues occuring at regular periods.

The appropriate discount rate to use has always been a subject of considerable controversy. The Government's test discount rate is 5 per cent, although Forestry Commission 'productive' plantations have, in the past, only been required to make 3 per cent. In contrast a figure of only 1 per cent is used in the more testing environment of Sweden, by the Swedish Forest Service (Helliwell, 1984). Higher discount rates tend to favour shorter rotations and thus conifers relative to broadleaved species. The discount rate to use should depend on the users circumstances and objectives in terms of maximised profit, investment liquidity, conservation and amenity considerations.

Inflation is normally excluded from the calculations, so that discount rates are expressed in real terms at today's values, net of inflation. This does not, however, necessitate the assumption that all costs and prices will move in harmony in the future. It has been forecast that there will be a long-term rise in the real price of timber (CAS, 1980). If the chosen discount rate is 5 per cent and prices are assumed to increase in real terms at 2 per cent per annum, the costs would be discounted at 5 per cent but the prices at 3 per cent (5%-2%).

1.3 PROCEDURE

The methodology used in this study is based on that developed by Pryor (1982). For each management option a basic LEV table is constructed as follows:

1) Three productivity levels are considered, predicted volumes through a rotation being discounted to the year of establishment to produce tables of discounted volume. The procedure of discounting volumes rather than prices ends with the same result, but saves several steps of calculation.

2) Prices are applied to the discounted volumes to produce discounted revenues. Three to five price structures are used for each productivity level corresponding to low, medium and high price level combinations for fuel and timber products.

3) Establishment costs are determined and discounted.

4) NDR's are calculated as the differences between total discounted revenues and total discounted costs.

5) These NDR's are then put on an infinite time scale by applying the LEV multiplier. The LEV's are calculated for five discount rates of 0, 2, 3, 4 and 5 per cent.

These basic LEV tables do not take into account tax, grants and other revenues or costs. The LEV tables presented in Chapter 2 are adjusted to take account of annual management costs, planting grants (at two levels) and income tax schedule and rate (at three levels). In order to indicate the times of occurrence of costs and revenues during a rotation, a discounted cash flow is also produced and presented for medium productivity and price levels. The computer program which has been developed, and described in Part 2, allows a user to make adjustments to basic LEV values for the range of management options and the major variables described below. The assumptions concerning these variables are also detailed in Part 2.

1.4 MAJOR VARIABLES

The major variables which determine the profitability of woodland management are:

1. Productivity

The yields from woodlands depend on many factors including soil quality, climate and the species used. The potential number of silvicultural choices or systems that could be considered are great. In this study 18 systems are investigated, ranging from very productive, monospecific, capital intensive, clear fell options to low input systems such as coppice where levels of productivity are also low. Although 18 systems are considered many are very similar to other possible systems. It should not therefore be difficult to fit any likely management system found in the UK to one of these 18. The potential number that could be applied on any one site is usually limited to four or five.

The productivity levels are based on national averages and ranges of yield classes (from Nicholls, 1981) to represent low, average and high productivity classes for the particular species. Volumes are determined from the Forestry Commission Forest Managment Tables (Edwards and Christie, 1981) and other tables relating to coppice (Crockford, Corbyn and Savill, 1987), free growth of oak (Jobling and Pearce, 1977) and cherry (Pryor, 1985). Volumes from mixtures and irregular systems were estimated from yield tables, adjusted for the conditions likely to be existing under those options.

2. Prices

The price that the woodland owner receives for timber depends on the stage at which it is sold. It is the residual value left when the costs of felling, extraction, hauling, handling, and primary sawing and processing are deducted from the selling price. The more of these processes the owner carries out, the greater value added is retained, but, of course, the greater the costs. The price size curves used in this study are the range (low, medium and high) of values that might be obtained if the timber were sold standing. The price/size curves for coniferous timber are displayed in Fig. 1.1. This shows how prices are determined by the size of produce; it is usually impossible to state a single price for coniferous timber. Price/size curves for broadleaved timber characteristically take on a stepped form, this is illustrated for oak in Fig. 1.2. Price/size values for coniferous and broadleaved timber and those for fuelwood (roundwood and chips) are presented

Fig. 1.1 Conifers

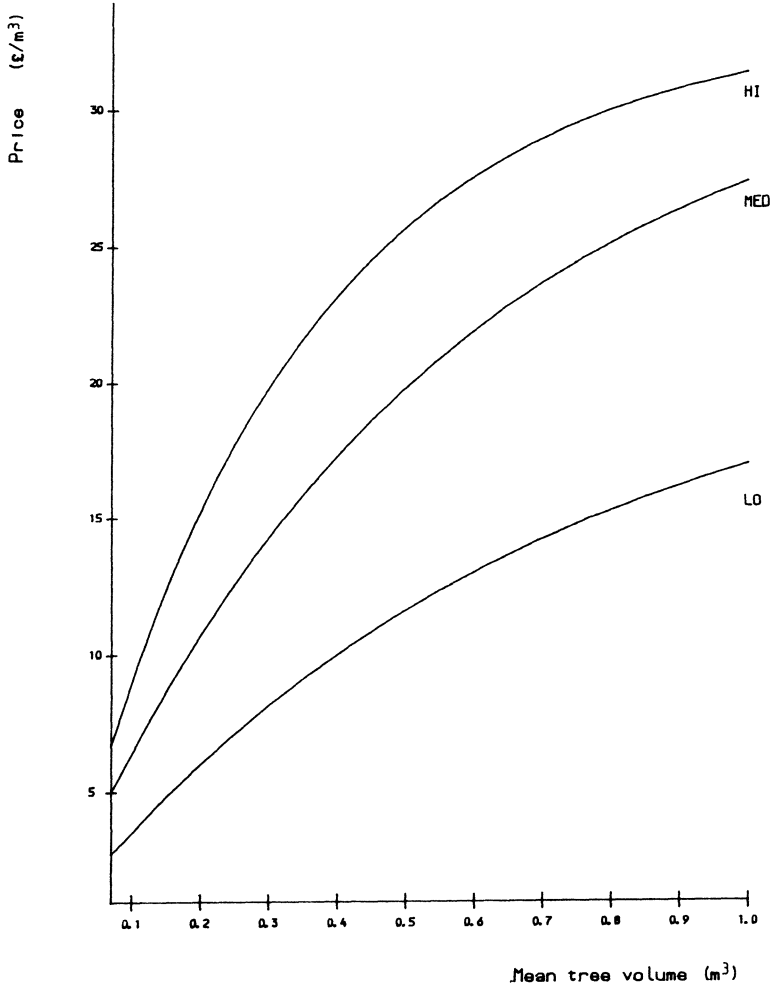
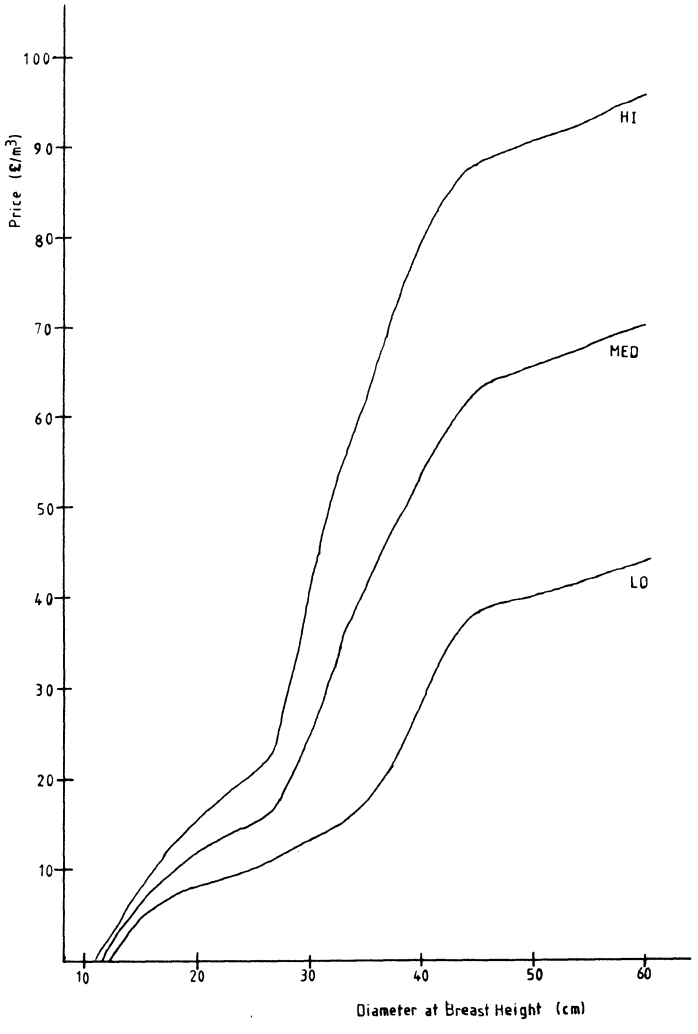


Fig. 1.2 Oak



Figs. 1.1 and 1.2 Price/size curves for conifers combined and oak timber. Prices are at three levels of low, medium and high and are expressed in £/m³ standing value.

in Appendix 1 together with notes on their sources. Low, medium and high prices for fuelwood at 1986 values are £2, £9 and £16/m^3 standing for roundwood and £0, £5 and £10/m^3 standing for chipped branchwood. The low and medium prices for fuelwood are the normal range if it were sold standing, whereas if it is sold at the roadside all three levels (net of felling and extraction costs) are possible. Fuelwood delivered to customers should be able to command the medium and high prices depending on distance and strength of demand.

3. Establishment and Maintenance Costs

These relate to expenditure, and many occur at the beginning of the rotation. They include such costs as ground preparation, planting, weeding, beating up and fencing. The costs used in this study are based on those published for establishment in private forestry (Dolan and Russell, 1985) and prices in nursery catalogues inflated to December 1985 values. Only one level of costs is used for each option although the computer program allows adjustments to be made if necessary. Fencing, to control rabbits and deer, can be very expensive, especially for small areas. The level of fencing costs alone can markedly change the profitability of an option. In the economic analyses, fencing has been included at a standard amount for a 10 hectare block for all options. This will make no difference to the relative profitabilities of options but will serve to make the estimates of profitability more accurate. The establishment costs used include labour 'on-costs' at 30 per cent of the estimated direct labour costs. This covers wet-time, holidays, pensions, national insurance, transport and basic tools and equipment. Management overheads and surcharges are not included in the basic LEV tables but are entered as an annual cost adjustment to them, the level of which can be selected if the computer program is used.

4. Sporting, Conservation and Amenity Values

Many woodlands owe their past and continued existence to their values for sporting. Sporting rentals can sometimes make a significant contributions to the profitability of a management option. They commonly range from £2/ha/yr for a little vermin shooting to almost £20/ha/yr for a woodland well designed for pheasant shooting, which can also result in a considerable improvement to the capital value of the woodland.

Whereas the sporting value of a woodland can easily be included in financial calculations, the conservation and amenity values are usually non-monetary in nature and thus difficult to assess, though attempts to do so have been made (e.g. Helliwell, 1986). The value of a woodland for conservation depends on its size, species composition and structure in terms of age class distribution, width of rides, presence of underwood and openings in the canopy. Woodlands of high conservation and amenity values are normally assessed more subjectively, using methods other than those involving the financial return on investment, or by applying a lower discount rate.

5. Grants

Grants are available for tree planting from the Forestry Commission, Countryside Commissions, Ministry of Agriculture Fisheries and Food and its Scottish equivalent, and Nature Conservancy Council. Grants are paid by the various bodies depending on the objectives of the owner i.e., timber production, landscape, agricultural or nature conservation value. Forestry Commission grants usually require that timber production is one of the objectives and their current (1987) two schemes are the only ones considered in the LEV calculations. The 'Forestry Grant Scheme' (FGS) is intended to encourage the expansion of private forestry and to increase timber production

in Britain. In recognition of the higher costs involved in managing small woodlands, grants are higher for smaller blocks and also broadleaf plantings command higher grants. The 'Broadleaved Woodlands Grant Scheme' (BWGS) is designed to encourage the rehabilitation of existing broadleaved woodlands by natural regeneration and planting, and the establishment of new woods. Only planting or natural regeneration of pure broadleaf crop are grant aided. The scheme is intended to encourage a wide range of management objectives as well as timber production. As with the FGS the level of grants is higher for smaller areas of planting.

6. Taxation

Amenity woodlands and small woods associated with farms, but not commercially managed, do not generate income and are not assessed for income tax. They are, however, liable to capital taxation. Commercially managed woodlands are liable to income and capital tax.

Commercially managed woodlands can be assessed either under income tax Schedule B or D. Under Schedule B the occupier is taxed on one third of the 'prairie-value' of the land, this being the nominal rent from letting the land in its unimproved state. The 'prairie-value' is normally in the range £2-£5/ha/yr and thus most annual tax payments are well under £1/ha/yr. Schedule B assessments are suitable for management options with low costs or where costs are less than income. It is very advantageous to have income-generating woodlands assessed under Schedule B.

The occupier can, alternatively, elect for assessment under Schedule D which is calculated on the basis of costs and revenues actually occurring in any one year. A net loss in any year can be off-set against other taxable income. Under Schedule D, however, all grants and felling revenues are taxable at the tax rate percentage of the owner. For those who earn high levels of taxable income, it is desirable to establish woodlands under Schedule D but to remain on this Schedule beyond the time when they make a net annual loss is highly disadvantageous. Election for woodlands to be assessed under Schedule D must be made within two years of occupying the woodlands or of their replanting. Once election of Schedule D has been made it cannot be changed during the life of the crop while the same owner is in occupation. By changing ownership (e.g. by giving the wood to ones spouse or children or selling it) just before the first profitable thinning, a woodland can be assessed under Schedule D for the costly establishment period and 'switched' to Schedule B during the latter part of the rotation when revenue is being generated. This system of 'legal tax avoidance' is the basis of most of the investment forestry in the UK, and has done much to provide extensive planting in the uplands.

Capital gains tax is payable only on increases in the value of the land, and it makes no reference to the standing timber. Capital allowances can be obtained for expenditure on roads, buildings and permanent fencing. The amount of capital transfer tax charged on death is calculated on the value of the estate at the time of death, adding in gifts made during the previous ten years. With a lifetime transfer of woodlands, gifts made in the previous ten years are cumulated with the value of the woods to arrive at a total taxable transfer. Payments of tax on death can be deferred until the time the timber is disposed of. 50 per cent business assets relief is also usually available. Ancient semi-natural woodlands are now exempted from capital taxation on scenic as well as scientific or historic grounds.

Capital taxation is an aspect which cannot easily be taken into account in the comparison of management options presented here. However, it should be noted that with good advice, capital taxation is normally very small indeed.

1.5 PRICE MAXIMISATION FOR FUEL AND TIMBER MARKETS

Because of their long life cycles trees, unlike most of mans' crops, provide different types of produce at different stages. Young stands normally supply a limited range of relatively low-value produce which can be difficult to dispose of profitably. Older stands supply a much wider range of markets because they contain both large and small dimensions of wood.

The problem many owners have to face is how to sell their produce profitably. Wood is sold on what is essentially a world market; there is no protection for it in the UK as there is for many agricultural commodities. Prices vary according to the supply and demand for both wood and alternative materials such as coal, gas, oil and electricity in the case of fuelwood. Prices for wood also tend to be much more sensitive to local demand than many other commodities because it is such a bulky material. Transport can therefore add considerably to its delivered cost.

Chapter 2 considers the management and profitability of 18 management systems. In this section information from three different but representative types of crops is discussed in an attempt to highlight the number of thinnings that can obtain higher prices from the fuelwood rather than the timber market, under various price level combinations of fuel and timber. It also illustrates the improvements in profitability that can be achieved by selling the branchwood for fuel rather than leaving it un-used. The three systems considered are a pure conifer crop (Corsican pine), a mixture of conifer and broadleaved trees (Corsican pine/beech), and a pure broadleaved crop (beech). Five different price combinations of fuel and timber components are used; these are combination of low, medium and high prices for fuel (F) and timber (NF) products. Timber price size curves are shown in Appendix 1. The discussion is based on land expectation values (LEV's) under the following assumptions:

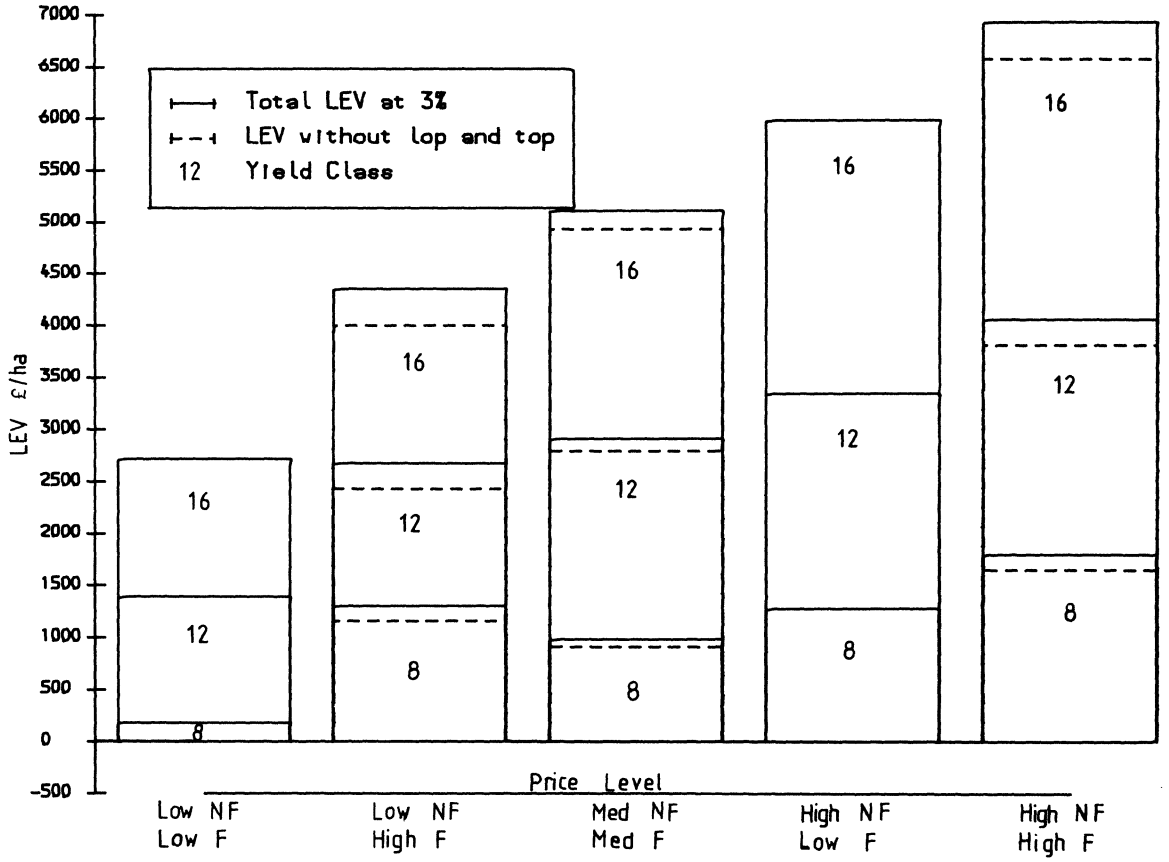
a) The discount rate is 3 per cent
b) Planting grants are paid at the lowest level
c) The owner is in the hightest tax bracket (60 per cent)
d) The plantations are established on tax schedule D and switched to B just before the first thinnings.

The LEV's are shown in Fig. 1.3 for the five price combinations and three productivity levels.

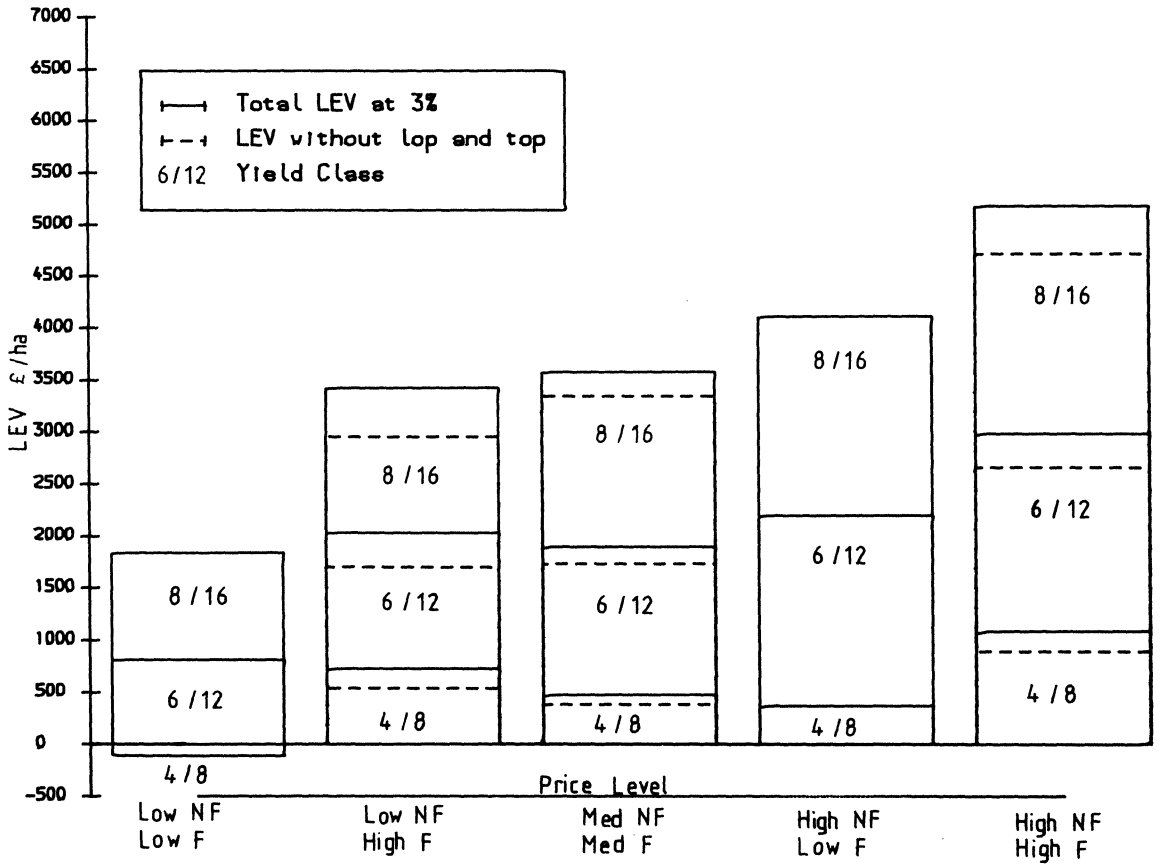
In all three examples, the prices paid for fuel as roundwood for the domestic market are higher than those for chips in industrial markets. It is therefore always more profitable to attempt to sell small diameter roundwood to domestic consumers rather than to chip it together with the branchwood for industrial uses. Economies of scale, local markets and the type of harvesting system used must obviously affect the decision as to whether to chip or not, and this may dictate how the small roundwood is used. Other general observations are given below, and further details for these and the other 15 options in Chapter 2.

In general the pure conifer crop is the most profitable and the pure broadleaf the least, with fuelwood contributing much greater proportions to the overall revenues for the broadleaved crops.

a. Corsican Pine



b. Beech/Corsican Pine Mixture



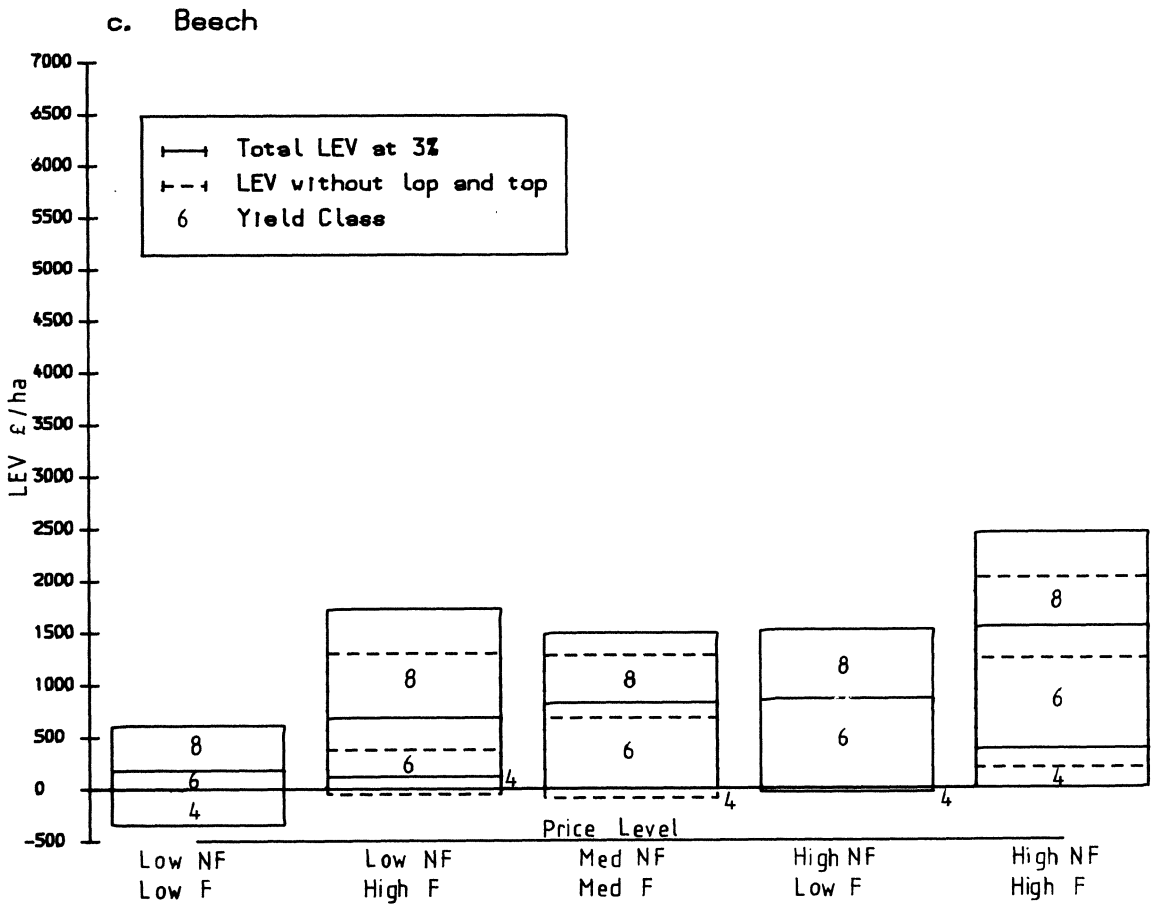


Fig. 1.3 Land expectation values, at 3 per cent discount rate, for three management systems. The five price level combinations refer to low, medium and high prices for timber (NF) and fuelwood (F) markets. LEV levels represented by broken lines show the profitabilities where lop and top is excluded from revenues.

The number of thinnings which can advantageously be sold as fuelwood depends largely on the relative prices of fuelwood and timber. If fuel prices are low all conifer thinnings would be better sold into the timber market, whilst the first one or two thinnings from broadleaf crops will, except when timber prices are high, still attain better prices through fuelwood. When fuelwood prices are higher, especially relative to timber prices, more of the thinnings should be sold as fuelwood. This may be as many as the first four or five for broadleaf thinnings and all conifer thinnings. Under present and likely price levels for conifers this is unlikely and the maximum will probably be more in the order of the first two or three thinnings.

As with the number of thinnings, the improvement to LEV's obtainable through chipping branchwood for fuel depends on the price level combinations for fuel and timber. With broadleaf crops, the branchwood percentage tends to be much higher than for coniferous crops and, due to low initial LEV's, increases may be as great as 100 per cent, making the difference between a loss and a profit at 3 per cent discount rate. This is for low yielding crops and high fuel prices. In general, with lower fuel prices and higher yielding crops improvements in revenues will be lower. The chipping of lop and top from pure broadleaves will increase LEV's in the order of 17 to 23 per cent for high and medium yielding crops at medium price levels for both fuel and timber. Improvements to LEV's will be much lower for pure conifer crops and, under average yield conditions, will be around 5 per cent. Only in the unlikely situation where high prices exist for fuel and low ones for coniferous timber would improvements be as high as 15 per cent. With mixtures of conifers and broadleaves improvements in LEV's will be between the two extremes outlined above. Increases would seldom exceed 25 per cent and this is for low yield classes. Increases of 7 to 9 per cent are more likely for higher yield classes.

CHAPTER 2

WOODLAND MANAGEMENT AND PROFITABILITY FOR FUEL AND TIMBER PRODUCTION

2.1 INTRODUCTION

The yield of fuelwood from woodlands depends on many factors including species, management system and prices. The yields from branchwood are mainly influenced by the first two factors, whereas the proportion of roundwood from thinnings which might be used as fuel is particularly sensitive to the relative prices of fuel and timber.

This Chapter considers in detail the results of profitability studies on 18 management systems which are described together with general details on their fuelwood yields and management.

2.2 FUELWOOD YIELDS

The potential fuelwood yields from forestry systems can be considered as the sum of the branchwood or crownwood yields and the volume of thinnings which command highest prices as fuelwood. The branchwood proportions assumed in this paper are based on studies by Crockford, Corbyn and Savill, 1987. The yields of branchwood as a proportion of total volume declines with age in coniferous woodlands whereas in broadleaves it increases. The volume of branchwood from coniferous crops can consequently make up a significant proportion of the total yield in the first thinning; this declines subsequently, but there is also a large yield in the final felling. In contrast, branchwood yields from the first thinning of broadleaved crops are small, but they increase with age and are particularly substantial at clear felling. Whereas the branchwood yields can quite readily be determined, (the quantities being largely influenced by species and stand density), the potential roundwood fuel yields from thinnings can be very variable, ranging from little or none to practically all thinning yields. The most important determining factor is the comparative prices of fuel and timber; where fuelwood prices are low, little or none of the thinnings would be sold for fuel whilst where fuelwood prices are high and timber prices low many more of the thinnings would be sold as fuel and under the most extreme conditions the entire yield of the rotation could be sold as fuel. The other factors which influence roundwood fuel yields are species, productivity level and stand density. Stand density influences the diameter of stems at a particular age and consequently the time at which produce may be sold in the generally more rewarding timber markets.

The fuelwood yields from branchwood and thinnings are discussed below for four types of management options. Thinning yields are those that may occur at medium price levels for both timber and fuelwood. The branchwood yields were estimated by applying branchwood percentage values, (Crockford et al, 1987) to the volumes of thinnings and clear fellings. The yields presented in the following discussion are consequently estimated and subject to considerable variation. They should therefore only be used as guides to the levels of yields that may be obtained.

1. Pure Coniferous Crops

Estimated branchwood and thinning yields for Corsican pine are shown in Table 2.1. Of the total branchwood yield about 15 per cent is normally obtained during the first thinning and this declines in subsequent thinnings. About 45 per cent originates from the final felling, though this maybe slightly higher for low yielding crops. Branchwood yields appear to be similar for Sitka spruce and slightly less for Douglas fir. Japanese larch yields less

than 65 per cent of the total branchwood volume of Corsican pine. In contrast, western red cedar tends to produce much greater quantites, up to about 55 per cent more than Corsican pine.

Under the price and management situations assumed in this discussion, the first two thinnings would most profitably be sold as fuelwood.

Table 2.1 Branchwood and thinning yields of fuelwood from pure Corsican pine crops

YC	Total branchwood m^3/ha	Thinnings Yielding Fuel		Total fuel m^3/ha
		Number	m^3/ha	
8	83	2	75	158
12	95	2	83	178
16	106	2	90	196

Shade tolerant species and crops with higher stocking will have greater fuelwood yields due to the smaller diameters of thinnings. Light demanding trees such as Japanese larch tend to have few fuelwood thinnings, as do high yielding crops.

2. Conifer/Broadleaved mixtures

The branchwood yields of mixtures such as Corsican pine and beech can be considerable (Table 2.2), with significant early branchwood yields from the conifer and substantial quantities from the final felling of beech; 50 to 60 per cent of the total branchwood yield originates from the final felling.

Douglas fir/oak mixtures would give lower branchwood yields at low productivity levels but similar yields at the higher productivity levels.

Much of the beech from the first two or three thinnings can only be used for fuelwood, however only small quantities are removed at this stage in the rotation. The Corsican pine component of the first one or possible two thinnings may also be sold as fuelwood. Similar quantities are likely for Douglas fir/oak mixtures.

Table 2.2 Branchwood and thinning yields for fuel from Corsican pine/beech mixture

YC	Total branchwood		Thinnings Yielding Fuel				Total
CP/Be	C. pine m^3/ha	Beech m^3/ha	C. pine No.	m^3/ha	Beech No.	m^3/ha	fuel m^3/ha
8/4	46	99	2	64	2	28	237
12/6	52	138	1	41	2	30	261
16/8	58	166	1	46	3	42	312

3. Pure Broadleaved Crops

The fuelwood yields from branches and thinnings of beech are detailed in Table 2.3. The branchwood yields from first thinnings are usually very low at between 4 and 7 m^3/ha whereas the final yields of branchwood can be considerable, at about 73 per cent of the total branchwood yields.

Table 2.3 Branchwood and thinning yields of fuel from beech plantations

YC	Total branchwood m^3/ha	Thinnings Yielding Fuel		Total fuel m^3/ha
		Number	m^3/ha	
4	114	2	62	176
6	195	2	70	265
8	338	2	87	425

The first two thinnings of beech are likely to find good prices in the fuelwood market.

Comparisons with other pure broadleaf options suggests that oak tends to have lower branchwood yields in total but a larger number of thinnings suitable for fuel, and therefore a greater yield of roundwood fuel. Mixtures of oak and ash or oak, ash and cherry have high branchwood yields. Fuelwood from thinnings, however, tends to be much lower as there is frequently a good demand for the timber of ash and cherry even at small diameters.

4. Coppice

In the coppice systems considered, all the produce is sold as fuelwood. Consequently yields can be very high considering the short rotations of these systems.

Table 2.4 Branchwood and thinning yields of fuel from simple coppice

YC	Rotation length yrs	Branchwood m^3/ha	Roundwood m^3/ha	Total fuel m^3/ha
3	25	23	75	98
5.5	20	33	110	143
8	20	48	160	208

The actual amount of branchwood is largely influenced by the coppice species. The coppice with standards system yielded slightly less roundwood fuel, per coppice rotation, but greater quantities of branchwood.

2.3 ECONOMIC ANALYSIS OF MANAGEMENT OPTIONS

Chapter 1 described the approaches that were taken to determine the profitability of 18 woodland management systems and how profitability can be affected by such factors as fuelwood price and productivity level. The potential number of combinations of productivity, prices, costs, grant levels, tax situations and sporting rentals is almost infinite but in this section tables are presented which display the LEV's for a restricted number of combinations. Those taken into account are:

1. Three productivity (yield) levels;

2. Five price combinations, namely: a) low timber and fuel prices (LO/LO); b) low timber and high fuel prices (LO/HI); c) medium timber and fuel prices (MED/MED); d) high timber and low fuel prices (HI/LO) and e) high timber and fuel prices (HI/HI).

3. Three discount rates; 0, 3 and 5 per cent.

4. With and without planting grants, at the lowest grant level.

5. Three income tax situations a) Schedule B for the entire rotation; Schedule B switching to D before first thinning at b) 30 per cent and c) 60 per cent tax rate. Differences between them indicate the advantage of being assessed at higher tax rates.

Management overheads and estimated branchwood revenues are also included in the LEV estimates. The tables, together with a table showing the discounted cash flow at 3 per cent for each option for mean yield and price situations, are presented on the pages following each management description. It must be stressed that the values are not definitive and should be regarded more as a guide for ascertaining the order of magnitude of LEV's and how they are affected by various tax levels, grants and other variables. The tables can be used by selecting the row of interest in terms of productivity and price e.g. '6-MED/MED' refers to a yield class of 6 m^3/ha/yr with medium prices for both timber and fuel. The selected row should be followed along to the appropriate discount rate, then to the 'with' or 'without' grants columns, and finally to the three income tax situations (B, D/B 30%, or D/B 60%). Notes on the management and profitability of each option are presented with reference to these tables. A full account of the assumptions taken with each option is presented, with reference to the computer program, in Chapter 2 of Part 2. Though the tables are relatively easy for a technically informed reader to use, they may prove more difficult for woodland owners who do not have a background in forest economics. A 'user-friendly' computer program has also being prepared, as detailed in Part 2 which helps guide an owner to the appropriate option with a minimum of effort. The program will also enable a far greater number of management combinations to be considered, for example excluding branchwood revenues, selecting the appropriate planting grant level and will also allow entry of such incomes as sporting rental.

The 18 woodland management systems are considered below.

1. Replace with Douglas Fir (Table 2.5)

Existing woodlands may be replaced by, or open land planted with, Douglas fir. This species does better in the wetter, western parts of the country, although it will grow satisfactorily in the lower rainfall areas of south and south-east England. It is an exacting species often planted on middle valley slopes as it requires deep, well drained soils. Yields are high with a mean yield class of just under 14 m^3/ha/yr (Nicholls, 1981).

Table 2.5

DISCOUNTED CASH FLOW : Douglas Fir YC14 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground prep.	0		-205	-205	-205
Planting	0		-585	-585	-585
Grant (1st. Inst.)	0		184	184	184
Fencing	0		-280	-280	-280
Beating up yr.1&3	2		-115	-115	-108
Weeding yrs.0-4	2		-420	-420	-396
Grant (2nd. Inst.)	5		46	46	40
Cleaning	7		-130	-130	-106
Thin 13cm	21	49	9	441	237
Thin 13cm	27	54	9	486	219
Thin 16cm	32	49	9	441	171
Thin 20cm	37	49	12.7	622	208
Thin 24cm	42	49	15.6	764	221
Thin 27cm	47	49	21.2	1039	259
Clear fell 31cm	52	418	24.2	10116	2175

Annual management cost = -8
Net benefit = 11990 Net disc. revenue = 1820
Land Expectation Value = 2320
L.E.V. with 60% tax relief until D/B switch at year 20 = 3490
Additional discounted revenue from branchwood = 150

Net Revenue and Land Expectation Values for : Douglas Fir

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
10-LO/LO	3040	3560	4060	2810	3400	3970	-780	-200	380	-1060	-390	270	-1280	-780	-290	-1510	-940	-380
10-LO/HI	7600	8130	8630	7370	7960	8540	760	1350	1920	490	1160	1810	-660	-160	330	-890	-320	240
10-MED/MED	6800	7320	7830	6570	7160	7730	310	900	1470	30	700	1360	-870	-370	120	-1110	-540	20
10-HI/LO	8510	9040	9540	8280	8880	9450	640	1230	1800	360	1030	1690	-810	-310	180	-1040	-470	90
10-HI/HI	10280	10800	11300	10050	10640	11210	1380	1970	2540	1100	1770	2430	-480	20	510	-710	-140	420
14-LO/LO	6880	7400	7900	6650	7240	7810	560	1170	1760	280	970	1650	-780	-270	220	-1020	-440	130
14-LO/HI	10430	10960	11460	10200	10800	11370	2290	2900	3490	2010	2700	3380	40	550	1040	-200	380	950
14-MED/MED	12360	12880	13380	12130	12720	13290	2430	3040	3640	2150	2840	3520	-60	450	940	-300	280	850
14-HI/LO	14150	14680	15180	13920	14520	15090	2910	3510	4110	2620	3310	3990	70	580	1070	-170	410	980
14-HI/HI	16170	16700	17200	15940	16530	17110	3910	4520	5110	3630	4320	5000	560	1070	1560	320	900	1470
18-LO/LO	9670	10190	10690	9440	10030	10600	1840	2460	3070	1550	2260	2950	-270	250	750	-510	80	650
18-LO/HI	13500	14020	14520	13270	13860	14430	3960	4580	5190	3670	4380	5070	790	1300	1810	550	1140	1710
18-MED/MED	17010	17530	18030	16780	17370	17940	4630	5250	5860	4340	5050	5740	850	1360	1860	600	1190	1770
18-HI/LO	19910	20430	20940	19680	20270	20840	5500	6120	6730	5210	5920	6620	1110	1620	2130	870	1450	2030
18-HI/HI	22220	22740	23240	21990	22580	23150	6780	7410	8010	6490	7200	7900	1760	2270	2780	1520	2100	2680

The fuelwood yield from Douglas fir can be quite high for a pure coniferous crop with an estimated total of about 184 m^3/ha per rotation at yield class 14; 45 per cent of this being branchwood.

As with other conifers, owners can obtain planting grants under the Forestry Grant Scheme for establishing Douglas fir. The species produces large diameter timber of fine quality which commands high prices. It is the most profitable of the 18 options studied. Land expectation values are almost always postitive and high at 3 per cent discount rate. Apart from low yielding sites and poor prices, LEV's are normally positive at 5 per cent. The most profitable option is for one to switch from income tax Schedule D to B before first thinning, especially for those in the higher income tax bracket. In such circumstance planting grants do not improve profitability significantly but they can be of value for low yielding crops taxed under Schedule B.

2. Corsican Pine (Table 2.6)

Corsican pine will not grow in the uplands, except on south and west facing slopes at lower elevations. It grows well on the milder sites of the lowlands where rainfall is low and on a wide range of mineral soils. Regions of east England prone to severe winters may cause problems. Establishment is difficult and increasing use is being made of container-grown plants to improve survival. Productivity can be very high and the mean is just under 12 m^3/ha/yr.

As described in Section 2.2, estimated total fuelwood yield is about 178 m^3/ha per rotation at yield class 12, 53 per cent of this from branchwood.

This can be one of the more profitable pure conifer options as long as establishment is successful. Land expectation values are usually positive at 3 per cent discount rate, although at 5 per cent the poorer yielding sites often make a loss. Planting grants and owners whose income tax is assessed at 60 per cent and who switch to Schedule D for the establishment period can make such crops profitable at 5 per cent. Scots pine would probably command similar returns although mean yields are somewhat less.

3. Japanese Larch (Table 2.7)

Japanese and hybrid larches do best in hilly districts in the milder, wetter, western regions. The species grow well over a wide range of conditions but do best on well drained, moderately fertile soils which are not too heavy. They are suitable for upland planting but the soil must be naturally well drained. Dry sites in the south and east of England should be avoided and also sites subject to early autumn frosts.

Some of their main attractions are the speed of establishment (good on sites prone to heavy weeds), rapid early growth giving a possibility of early returns and amenity value.

The larches are not high yielders, the mean yield class for Japanese and hybrid larch being 10 m^3/ha/yr, European larch has a mean yield class of just under 8 m^3/ha/yr.

Japanese and hybrid larch tend to yield relatively little fuelwood; 86 m^3/ha per rotation at a yield class of 10 m^3/ha , 69 per cent of this is branchwood.

Table 2.6

DISCOUNTED CASH FLOW : Corsican Pine YC12 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Planting	0		-370	-370	-370
Fencing	0		-280	-280	-280
Grant 1st Inst.	0		184	184	184
Beat Up 1-4	2		-175	-175	-165
Weeding 0-4	2		-420	-420	-396
Grant 2nd Inst.	5		46	46	40
Clean	8		-100	-100	-79
Thin	24	41	9	369	182
Thin	29	42	9	378	160
Thin	34	42	11	462	169
Thin	39	42	15.6	655	207
Thin	44	42	15.6	655	178
Thin	49	42	19.7	827	194
Clear Fell	54	370	24.2	8954	1815

Annual management cost = -8
Net benefit = 10550 Net disc. revenue = 1420
Land Expectation Value = 1780
L.E.V. with 60% tax relief until D/B switch at year 20 = 2790
Additional discounted revenue from branchwood = 120

Net Revenue and Land Expectation Values for : Corsican Pine

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
8-LO/LO	2320	2800	3260	2090	2640	3170	-840	-320	190	-1120	-510	80	-1180	-740	-310	-1420	-910	-410
8-LO/HI	5990	6470	6930	5760	6310	6830	280	810	1310	10	610	1200	-760	-320	110	-1000	-490	10
8-MED/MED	5330	5810	6260	5100	5650	6170	-40	480	980	-320	290	880	-900	-460	-30	-1140	-630	-130
8-HI/LO	6800	7280	7740	6570	7120	7650	250	780	1280	-20	580	1170	-840	-400	30	-1070	-560	-60
8-HI/HI	8210	8690	9150	7980	8530	9060	770	1300	1800	500	1100	1690	-620	-180	250	-860	-350	150
12-LO/LO	6040	6500	6950	5810	6340	6860	350	880	1390	70	680	1280	-750	-310	120	-990	-480	20
12-LO/HI	8940	9410	9850	8710	9250	9760	1630	2160	2670	1350	1970	2560	-170	270	700	-410	100	600
12-MED/MED	10860	11330	11770	10630	11170	11680	1870	2400	2910	1590	2200	2800	-190	250	680	-430	90	590
12-HI/LO	12540	13010	13450	12310	12850	13360	2300	2830	3340	2020	2630	3230	-70	370	800	-310	210	710
12-HI/HI	14110	14570	15020	13880	14410	14930	3010	3530	4050	2730	3340	3940	260	700	1130	20	530	1040
16-LO/LO	8680	9140	9590	8450	8980	9500	1640	2190	2720	1350	1990	2610	-230	220	660	-480	50	560
16-LO/HI	11770	12230	12670	11540	12070	12580	3280	3830	4360	2990	3620	4250	550	1000	1440	310	830	1340
16-MED/MED	15130	15590	16030	14900	15430	15940	4030	4580	5110	3740	4380	5000	690	1140	1580	450	970	1480
16-HI/LO	17880	18340	18780	17650	18180	18690	4900	5450	5990	4610	5250	5870	980	1430	1870	730	1260	1770
16-HI/HI	19680	20140	20590	19450	19980	20500	5850	6400	6930	5560	6200	6820	1430	1880	2320	1190	1710	2230

Table 2.7

DISCOUNTED CASH FLOW : Japanese Larch YC10 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Fencing	0		-280	-280	-280
Planting	0		-264	-264	-264
Grant 1st Inst.	0		184	184	184
Beating Up yrs1&3	2		-115	-115	-108
Weeding yrs.1-4	2		-420	-420	-396
Grant 2nd Inst.	5		46	46	40
Cleaning	8		-110	-110	-87
Thin	19	27	9	243	139
Thin	24	35	9	315	155
Thin	29	35	12.7	445	189
Thin	34	35	15.6	546	200
Thin	39	35	19.7	690	218
Clear Fell	44	257	22.8	5860	1596

Annual management cost = -8
Net benefit = 6580 Net disc. revenue = 1190
Land Expectation Value = 1630
L.E.V. with 60% tax relief until D/B switch at year 18 = 2600
Additional discounted revenue from branchwood = 100

Net Revenue and Land Expectation Values for : Japanese Larch

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
6-LO/LO	1270	1690	2090	1040	1530	2000	-880	-420	40	-1160	-610	-80	-1080	-690	-310	-1320	-850	-400
6-LO/HI	3690	4110	4500	3460	3950	4410	-40	430	880	-320	230	770	-740	-350	30	-980	-510	-60
6-MED/MED	3300	3720	4120	3070	3560	4030	-280	190	640	-560	-10	530	-860	-470	-90	-1100	-630	-180
6-HI/LO	4460	4870	5270	4230	4710	5180	10	470	920	-270	280	810	-780	-390	-10	-1010	-550	-100
6-HI/HI	5220	5640	6040	4990	5480	5940	340	800	1250	60	610	1140	-630	-230	150	-860	-400	50
10-LO/LO	3650	4050	4440	3420	3890	4350	320	820	1310	20	610	1190	-580	-180	220	-830	-350	120
10-LO/HI	5690	6090	6480	5460	5930	6390	1490	1990	2480	1190	1780	2360	-20	380	780	-270	210	680
10-MED/MED	6770	7170	7560	6540	7010	7460	1710	2210	2690	1400	1990	2570	-20	380	780	-270	210	680
10-HI/LO	8330	8730	9110	8100	8570	9020	2320	2820	3310	2020	2610	3190	210	620	1010	-40	440	910
10-HI/HI	9230	9630	10010	9000	9460	9920	2860	3360	3850	2550	3140	3720	480	880	1270	230	710	1170
14-LO/LO	6490	6880	7260	6250	6710	7170	1920	2440	2940	1600	2210	2810	110	520	930	-140	350	820
14-LO/HI	8400	8800	9190	8170	8640	9100	3240	3750	4260	2920	3530	4130	800	1210	1610	550	1030	1510
14-MED/MED	11250	11650	12040	11020	11490	11950	4290	4800	5310	3970	4580	5180	1120	1530	1930	860	1350	1830
14-HI/LO	13490	13890	14280	13260	13730	14180	5340	5860	6360	5020	5640	6240	1540	1950	2350	1290	1770	2250
14-HI/HI	14480	14880	15260	14250	14720	15170	5980	6490	7000	5660	6270	6870	1860	2280	2680	1610	2100	2580

Overall profitability can be very high because of the relatively short rotations and, as with Corsican pine, LEV's are usually positive and high at discount rates of 3 per cent and less. Low yielding crops may make a loss at this discount rate, although if advantage is taken of planting grants and tax Schedule D even these sites can make a 3 per cent rate of return. Lower yield classes, however, are usually unable to make a return of 5 per cent.

4. Sitka Spruce (Table 2.8)

Sitka spruce is the most widely planted species in the UK. It is at its best in the high rainfall uplands regions of the west and north and should be avoided in the dry parts of east, south and central England. It also tolerates high exposure although windthrow is a great problem on wet soils where rooting is shallow. It grows best on deep freely drained soils although it will also tolerate gleys and peats. If the site is not naturally very fertile adequate fertilizers have to be applied and this is especially true if the harvesting of residues were to become a more widespread practise. Productivity can be high with a mean yield class of $12m^3$/ha/yr.

The fuel yields of Sitka spruce at yield class 12 are 171 m^3/ha, 56 per cent of this being branchwood.

As with the other pure conifer crops LEV's are usually positive and often high at a 3 per cent discount rate. Only on low yielding sites without grants or the benefits of Schedule D income tax during establishment, may a positive return not be achieved at this discount rate. Poor and medium yielding sites may not be able to achieve a return of 5 per cent.

5. Douglas Fir/Oak Mixture (Table 2.9)

This mixture is used in many western and other regions suitable for both Douglas fir and oak. Advantages of mixtures include the conifer's status as a 'nurse' to the broadleaved component, but more often its greatest value is in earning early revenue from the conifer with the objective of retaining the oak as the final crop. It is imperative that the mixture is thinned regularly and early otherwise serious suppression or even total loss can result to the oak. This is especially so if the Douglas fir has a yield class of more than twice that of the oak. Norway spruce is also commonly used in mixture with oak in many regions of central and eastern England.

The fuelwood yields of this option can be very high with an estimated total of 283 m^3/ha under the mean productivity level of yield classes 14 and 5 m^3/ha for Douglas fir and oak respectively. Oak contributes 56 per cent to this total and of this about 85 per cent is branchwood yield.

Planting grants are obtained through the FGS with the rate determined by the relative areas occupied by the softwood and hardwood component respectively. In this analysis equal numbers of oak and Douglas fir are planted. This tends to be a profitable mixture, achieving a 3 per cent return except where prices are lowest. At a discount rate of 5 per cent, however, even good sites can have negative LEV's unless woodlands are elected under Schedule D for the establishment phase. At a high tax rate and including planting grants even the low yielding sites can usually make a 5 per cent return.

Table 2.8

DISCOUNTED CASH FLOW : Sitka Spruce YC12 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-213	-213	-213
Fert. PK	0		-92	-92	-92
Planting	0		-442	-442	-442
Fencing	0		-280	-280	-280
Grant 1st Inst.	0		184	184	184
Weeding	2		-110	-110	-104
Grant 2nd Inst.	5		46	46	40
Fert. yrs8-16	12		-454	-454	-318
Thin	25	33	9	297	142
Thin	30	42	9	378	156
Thin	35	42	11	462	164
Thin	40	42	15.6	655	201
Thin	45	42	15.6	655	173
Thin	50	40	19.7	788	180
Clear Fell	55	401	22.8	9143	1799

Annual management cost = -8
Net benefit = 10580 Net disc. revenue = 1380
Land Expectation Value = 1710
L.E.V. with 60% tax relief until D/B switch at year 20 = 2680
Additional discounted revenue from branchwood = 150

Net Revenue and Land Expectation Values for : Sitka Spruce

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
8-LO/LO	1720	2220	2690	1490	2060	2590	-940	-440	40	-1210	-630	-70	-1150	-730	-330	-1380	-900	-420
8-LO/HI	6150	6640	7110	5920	6480	7020	260	760	1250	-10	570	1140	-720	-300	100	-950	-460	10
8-MED/MED	4810	5310	5770	4580	5140	5680	-170	330	810	-440	140	700	-890	-480	-70	-1120	-640	-170
8-HI/LO	6080	6570	7040	5850	6410	6950	50	550	1040	-220	360	930	-840	-430	-20	-1070	-590	-120
8-HI/HI	7560	8050	8520	7330	7890	8430	550	1050	1530	280	860	1430	-630	-220	180	-870	-380	90
12-LO/LO	6080	6550	7010	5850	6390	6920	350	860	1350	70	660	1240	-700	-290	120	-940	-450	20
12-LO/HI	9390	9860	10320	9160	9700	10230	1660	2170	2660	1380	1970	2550	-140	280	680	-370	110	580
12-MED/MED	11000	11480	11940	10770	11320	11840	1830	2330	2830	1550	2140	2720	-170	240	640	-410	80	550
12-HI/LO	13140	13620	14070	12910	13460	13980	2350	2860	3350	2070	2660	3240	-20	400	800	-250	230	710
12-HI/HI	14860	15340	15790	14630	15180	15700	3060	3560	4060	2780	3370	3940	300	710	1110	60	550	1020
18-LO/LO	9720	10200	10660	9490	10040	10560	1730	2250	2750	1450	2050	2640	-170	250	650	-410	80	560
18-LO/HI	12920	13400	13850	12690	13240	13760	3250	3760	4270	2960	3560	4150	530	950	1360	300	790	1270
18-MED/MED	16760	17230	17690	16530	17070	17600	4040	4560	5060	3760	4360	4950	680	1100	1510	440	930	1410
18-HI/LO	19840	20320	20770	19610	20150	20680	4970	5490	5990	4690	5290	5880	990	1410	1820	750	1250	1730
18-HI/HI	21700	22180	22640	21470	22020	22540	5810	6320	6830	5520	6120	6710	1380	1800	2210	1140	1630	2110

Table 2.9

DISCOUNTED CASH FLOW : Douglas Fir/Oak YC14/5 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground prep.	0		-205	-205	-205
Planting	0		-390	-390	-390
Fencing	0		-280	-280	-280
Grant 1st Inst.	0		272	272	272
Beat up yrs.1&3	2		-115	-115	-108
Weeding yrs.0-4	2		-420	-420	-396
Grant 2nd Inst.	5		68	68	59
Cleaning yrs.6&10	8		-166	-166	-131
Thin DF	20	34	9	306	169
Thin DF	27	46	9	414	186
Thin DF/OK	34	46	10.5	483	177
Thin DF	41	46	15.6	718	214
Thin DF/OK	48	46	18	828	200
Clear fell DF	55	185	26	4810	946
Thin	65	35	12.4	434	64
Thin	75	35	12.4	434	47
Thin	85	35	16.3	571	46
Thin	95	35	34.3	1201	72
Thin	105	35	34.3	1201	54
Clear fell	120	233	63.1	14702	424

Annual management cost = -10
Net benefit = 23670 Net disc. revenue = 1100
Land Expectation Value = 1130
L.E.V. with 60% tax relief until D/B switch at year 20 = 1920
Additional discounted revenue from branchwood = 180

Net Revenue and Land Expectation Values for : Douglas Fir/Oak Mixture

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
10/4-LO/LO	3980	4450	4900	3640	4220	4760	-680	-240	200	-1040	-480	50	-1090	-680	-290	-1420	-910	-430
10/4-LO/HI	7820	8290	8740	7480	8050	8600	290	740	1170	-60	490	1030	-670	-260	130	-1000	-490	0
10/4-MED/MED	10350	10820	11270	10010	10580	11130	260	710	1140	-100	460	1000	-780	-370	20	-1110	-600	-110
10/4-HI/LO	14120	14590	15040	13780	14350	14900	530	980	1410	180	730	1270	-760	-350	40	-1090	-580	-90
10/4-HI/HI	16400	16870	17320	16060	16630	17180	1160	1610	2040	810	1360	1900	-470	-60	330	-800	-290	190
14/5-LO/LO	12930	13380	13820	12590	13150	13680	-40	390	790	-380	150	660	-860	-470	-90	-1190	-700	-220
14/5-LO/HI	17830	18280	18710	17490	18040	18580	1270	1690	2100	930	1460	1970	-210	180	570	-540	-40	440
14/5-MED/MED	24570	25020	25450	24230	24780	25310	1270	1690	2100	930	1460	1970	-370	30	410	-690	-200	280
14/5-HI/LO	30970	31420	31850	30630	31180	31720	1570	1990	2400	1230	1750	2260	-360	40	420	-680	-190	290
14/5-HI/HI	35490	35940	36370	35150	35700	36230	2460	2890	3290	2120	2650	3160	90	490	870	-230	260	740
18/6-LO/LO	17410	17840	18250	17070	17600	18120	620	1030	1430	280	790	1290	-610	-220	150	-930	-450	20
18/6-LO/HI	22590	23020	23430	22250	22780	23300	2030	2440	2830	1690	2200	2700	100	490	860	-220	260	730
18/6-MED/MED	32040	32470	32890	31700	32240	32750	2330	2740	3140	1990	2500	3000	50	430	810	-280	200	680
18/6-HI/LO	42340	42770	43190	42000	42530	43050	2930	3340	3740	2590	3100	3600	430	810	1190	100	580	1060
18/6-HI/HI	45720	46150	46560	45380	45910	46430	3830	4240	4640	3490	4000	4500	620	1000	1380	290	770	1250

6. Oak (Table 2.10)

Oak, both sessile and pedunculate, grow best on deep, well drained but moist soils. Very exposed sites should be avoided as yields are low and form extremely poor. Frost hollows should also be avoided due to susceptibility to late spring frosts. Shake can be a serious problem to the timber value of oak but this mainly occurs on light, very freely drained sites where the species should not be planted if quality timber is desired. Due to the tendency for epicormics to develop, pruning selected stems may be worthwhile at some stage during the rotation. The mean yield class is 5 m^3/ha/yr. Pure broadleaved plantings of oak can obtain higher planting grants than conifers or mixed crops through the Broadleaved Woodland Grant Scheme.

At the mean productivity level of yield class 5 the total fuelwood yield is 265 m^3/ha, 74 per cent being branchwood.

Growing plantation oak is not usually profitable at a discount rate of 5 per cent even under the most advantageous conditions of income tax schedules and planting grants, hence the popularity of mixtures. At 3 per cent, however, LEV's are frequently positive, especially if Schedule D income tax is elected for during establishment and/or planting grants are obtained. Fuelwood can often provide a market for small diameter thinnings and low grade oak which might otherwise be a non-revenue earner.

7. Corsican Pine/Beech Mixture (Table 2.11)

Corsican pine in mixture with beech is used, as with conifer mixtures with oak, to secure some early financial return and also to act as a nurse to the beech. In the Chilterns and other regions European larch is also frequently used as a nurse to plant with beech. As with all mixtures it is imperative to thin regularly and early to ensure protection of the final crop species which is usually the slower growing.

This management system can produce substantial fuelwood, especially at high productivity levels, with an estimated total of 261 m^3/ha at the mean yield classes of 12 and 6 m^3/ha for Corsican pine and beech respectively. Beech contributes 64 per cent to this total and of this 82 per cent is branchwood.

This option can usually make a profit at 3 per cent discount rate, except on low yielding sites under Schedule B income tax during the establishment phase. Land expectation values are seldom positive at a 5 per cent discount rate except for high yielding sites and favourable income tax situations. This option is comparable in profitability to the Douglas fir/oak mixture although Corsican pine tends to be slightly lower yielding, and European larch lower still, but the beech is potentially higher yielding than oak on suitable sites.

8. Beech (Table 2.12)

Beech will grow well on a wide range of sites but prefers base-rich soils and does well on such sites even if they are shallow. It is unsuited to heavy water-logged soils and infertile, dry sandy ones as it is a species which can suffer severely from drought in dry years. Beech holds its form better than oak or ash on very exposed sites. In valley bottoms and frost hollows it suffers from both early autumn and late spring frosts. Because of this susceptibility to frost and the benefits it gains from side shelter it establishes well with a nurse crop as described in the previous option. The mean yield class is 6 m^3/ha/yr.

Table 2.10

DISCOUNTED CASH FLOW : Oak YC5 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Planting	0		-350	-350	-350
Fencing	0		-280	-280	-280
Grant 1st Inst.	0		420	420	420
Beat Up Yrs.1&3	2		-115	-115	-108
Weeding Yrs.0-4	2		-420	-420	-396
Grant 2nd Inst.	5		90	90	78
Cleaning Yrs.6&10	8		-170	-170	-134
Grant 3rd Inst.	10		90	90	67
Thin	35	28	9	252	90
Prune	40		-60	-60	-18
Thin	45	35	9	315	83
Thin	55	35	9	315	62
Thin	65	35	12.4	434	64
Thin	75	35	12.4	434	47
Thin	85	35	16.3	571	46
Thin	95	35	34.3	1201	72
Thin	105	35	34.3	1201	54
Clear Fell	120	296	63.1	18678	538

Annual management cost = -8
Net benefit = 21440 Net disc. revenue = -130
Land Expectation Value = -130
L.E.V. with 60% tax relief until D/B switch at year 30 = 510
Additional discounted revenue from branchwood = 90

Net Revenue and Land Expectation Values for : Oak

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
4-LO/LO	2230	2630	2990	1630	2210	2750	-920	-550	-210	-1530	-980	-450	-1010	-680	-370	-1560	-1070	-600
4-LO/HI	5210	5610	5980	4610	5190	5740	-440	-70	270	-1050	-500	30	-860	-530	-220	-1410	-920	-440
4-MED/MED	7840	8240	8610	7240	7820	8370	-370	-10	330	-980	-430	90	-890	-560	-250	-1440	-950	-470
4-HI/LO	11570	11970	12340	10970	11550	12100	-170	200	540	-780	-230	300	-870	-550	-240	-1430	-940	-460
4-HI/HI	13620	14030	14390	13020	13610	14150	200	560	900	-410	140	660	-750	-430	-120	-1300	-810	-340
5-LO/LO	11560	11940	12300	10960	11520	12060	-650	-310	20	-1230	-710	-210	-970	-650	-350	-1520	-1040	-570
5-LO/HI	15540	15920	16280	14940	15500	16040	-50	290	620	-630	-110	390	-750	-430	-130	-1300	-810	-350
5-MED/MED	22180	22570	22920	21580	22150	22680	-80	270	590	-660	-140	360	-840	-520	-220	-1390	-900	-440
5-HI/LO	30100	30480	30830	29500	30060	30590	100	440	770	-490	40	540	-870	-550	-240	-1410	-930	-460
5-HI/HI	33000	33390	33740	32400	32970	33500	540	890	1220	-40	480	980	-690	-370	-60	-1240	-750	-280
6-LO/LO	14710	15080	15420	14110	14660	15180	-450	-110	210	-1030	-520	-20	-920	-610	-310	-1470	-990	-520
6-LO/HI	19230	19600	19940	18630	19180	19700	330	670	990	-250	260	760	-640	-320	-20	-1190	-710	-240
6-MED/MED	27640	28000	28350	27040	27580	28110	320	660	980	-260	250	740	-730	-410	-110	-1280	-800	-330
6-HI/LO	37330	37690	38030	36730	37270	37790	530	870	1190	-50	470	960	-760	-450	-150	-1310	-830	-370
6-HI/HI	40810	41180	41520	40210	40760	41280	1160	1490	1820	570	1090	1580	-500	-190	110	-1050	-570	-110

Table 2.11

DISCOUNTED CASH FLOW : Beech/Corsican Pine YC6/12 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Planting	0		-518	-518	-518
Fencing	0		-280	-280	-280
Grant	0		272	272	272
Beating Up yrs1-4	2		-146	-146	-138
Weeding yrs0-4	2		-420	-420	-396
Grant	5		68	68	59
Cleaning yrs6&10	8		-150	-150	-118
Thin CP	24	41	9	369	182
Thin CP	31	44	9	396	158
Thin CP&BE	38	44	11.4	502	163
Thin CP&BE	45	44	14.8	651	172
Clear Fell CP	52	153	22.8	3488	750
Thin BE	62	35	9	315	50
Thin BE	72	42	12.1	508	60
Thin BE	82	42	14.6	613	54
Clear Fell BE	92	264	43.9	11590	764

Annual management cost = -10
Net benefit = 16130 Net disc. revenue = 720
Land Expectation Value = 770
L.E.V. with 60% tax relief until D/B switch at year 20 = 1690
Additional discounted revenue from branchwood = 170

Net Revenue and Land Expectation Values for : Corsican Pine/Beech

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
8/4-LO/LO	3830	4340	4830	3490	4100	4690	-1110	-620	-160	-1450	-860	-290	-1340	-890	-460	-1670	-1120	-590
8/4-LO/HI	7820	8330	8820	7480	8100	8690	-260	220	690	-610	-20	550	-1000	-560	-120	-1330	-780	-250
8/4-MED/MED	8200	8710	9200	7860	8480	9070	-510	-30	440	-860	-270	300	-1130	-680	-250	-1460	-910	-380
8/4-HI/LO	9190	9710	10200	8850	9470	10060	-630	-140	330	-970	-380	190	-1210	-760	-330	-1530	-990	-460
8/4-HI/HI	12620	13140	13630	12280	12900	13490	100	580	1050	-250	340	910	-920	-480	-50	-1250	-710	-180
12/6-LO/LO	10220	10710	11190	9880	10480	11050	-190	290	760	-540	40	620	-1050	-610	-180	-1380	-840	-310
12/6-LO/HI	14820	15310	15780	14480	15070	15650	1040	1530	1990	690	1280	1850	-490	-50	380	-820	-280	250
12/6-MED/MED	16930	17430	17900	16590	17190	17760	910	1390	1860	550	1140	1720	-640	-200	230	-970	-430	90
12/6-HI/LO	20570	21060	21530	20230	20820	21400	1200	1680	2150	850	1440	2010	-610	-170	260	-940	-400	130
12/6-HI/HI	23520	24020	24490	23180	23780	24350	2000	2480	2950	1640	2230	2810	-240	200	630	-570	-30	490
16/8-LO/LO	13560	14050	14520	13220	13810	14390	820	1310	1790	450	1060	1640	-690	-240	190	-1020	-470	60
16/8-LO/HI	18470	18960	19440	18130	18730	19300	2430	2930	3410	2070	2670	3260	100	550	980	-230	320	850
16/8-MED/MED	22120	22610	23080	21780	22370	22950	2570	3070	3550	2210	2810	3400	-10	430	860	-350	200	730
16/8-HI/LO	26550	27040	27520	26210	26800	27380	3080	3580	4060	2720	3320	3910	70	520	950	-260	290	820
16/8-HI/HI	29950	30450	30920	29610	30210	30790	4180	4680	5160	3820	4420	5010	610	1060	1490	280	830	1360

Table 2.12

DISCOUNTED CASH FLOW : Beech YC6 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Planting	0		-660	-660	-660
Fencing	0		-280	-280	-280
Grant 1st Inst.	0		420	420	420
Beat Up Yrs.1&3	2		-115	-115	-108
Weeding Yrs.0-4	2		-420	-420	-396
Grant 2nd Inst.	5		90	90	78
Cleaning Yrs.6&10	8		-180	-180	-142
Grant 3rd Inst.	8		90	90	71
Thin	35	28	9	252	90
Thin	45	42	9	378	100
Thin	55	42	9	378	74
Thin	65	42	9	378	55
Thin	75	42	12.1	508	55
Thin	85	42	14.6	613	50
Clear Fell	95	332	43.9	14575	879

Annual management cost = -8
Net benefit = 15060 Net disc. revenue = -170
Land Expectation Value = -180
L.E.V. with 60% tax relief until D/B switch at year 30 = 680
Additional discounted revenue from branchwood = 150

Net Revenue and Land Expectation Values for : Beech

YC-Price NF/F	0% Disc. Rate + Grants			0% Disc. Rate - Grants			3% Disc. Rate + Grants			3% Disc. Rate - Grants			5% Disc. Rate + Grants			5% Disc. Rate - Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
4-LOW/LOW	3170	3670	4130	2570	3250	3890	-1240	-780	-350	-1840	-1200	-580	-1330	-910	-510	-1880	-1300	-730
4-LOW/HIGH	6550	7050	7510	5950	6630	7270	-770	-310	130	-1370	-730	-110	-1200	-780	-370	-1750	-1160	-590
4-MED/MED	7040	7540	8000	6440	7120	7760	-900	-440	0	-1490	-850	-240	-1250	-830	-430	-1800	-1220	-650
4-HIGH/LOW	8270	8760	9230	7670	8340	8990	-940	-480	-40	-1530	-890	-280	-1290	-870	-460	-1840	-1250	-680
4-HIGH/HIGH	11120	11620	12080	10520	11200	11840	-520	-60	380	-1120	-480	140	-1160	-740	-340	-1710	-1130	-560
6-LOW/LOW	9820	10300	10750	9220	9880	10510	-710	-250	180	-1310	-670	-60	-1230	-810	-410	-1780	-1200	-630
6-LOW/HIGH	13100	13580	14030	12500	13160	13790	-200	250	690	-810	-170	450	-1060	-640	-240	-1610	-1030	-460
6-MED/MED	16260	16740	17190	15660	16320	16950	-70	390	830	-670	-30	590	-1050	-640	-230	-1600	-1020	-450
6-HIGH/LOW	19150	19630	20080	18550	19210	19840	-30	420	860	-640	0	620	-1110	-690	-290	-1660	-1080	-510
6-HIGH/HIGH	23090	23570	24020	22490	23150	23780	660	1110	1550	60	690	1310	-860	-440	-40	-1410	-830	-260
8-LOW/LOW	16720	17190	17620	16120	16770	17380	-270	180	610	-860	-240	370	-1140	-730	-330	-1690	-1110	-550
8-LOW/HIGH	22780	23240	23680	22180	22820	23440	850	1300	1730	260	880	1490	-710	-290	100	-1260	-680	-120
8-MED/MED	25500	25960	26400	24900	25540	26160	630	1070	1500	30	660	1260	-880	-470	-70	-1430	-850	-290
8-HIGH/LOW	29470	29940	30370	28870	29520	30130	650	1090	1520	50	670	1280	-970	-560	-160	-1520	-940	-380
8-HIGH/HIGH	34500	34960	35400	33900	34540	35160	1570	2020	2450	980	1600	2210	-600	-180	210	-1150	-570	-10

Beech yields large quantities of fuelwood, especially branchwood. At the mean yield class of 6 the estimated total yield is 265 m^3/ha, branchwood contributing 74 per cent to this total.

Due to the higher yielding nature of beech it can often be a more profitable species to grow in plantations than oak. Under favourable grant and income tax situations it should be able to earn a positive LEV at a discount rate of 3 per cent although it is unlikely to make a 5 per cent return. The branchwood component of beechwoods is often greater than that for oak and thus harvesting the lop and top after fellings can significantly increase revenues.

9. Oak/Ash/Cherry Mixture (Table 2.13)

Two options are considered here:

i) The object of this mixture is to plant pure broadleaves, but to include some species that will mature early. Cherry is frost hardy, grows rapidly in the early years following planting and has rotation lengths only five or ten years longer than those for most conifers (Pryor, 1985). It can therefore be grown well in mixtures with oak and especially ash. Regular thinning should be carried out to ensure that the oak is not suppressed by the cherry. The ash component is removed shortly after the cherry leaving a final crop of oak to grow to maturity.

Cherry, like ash, prefers deep and moist soil for good growth (Pryor, 1985). Cherry is often found on rather heavy soils and this produces good growth as long as they are freely draining.

Ash prefers calcarious loams which are moist, deep and well drained, and have a high content of available nitrogen. It is not a species well suited to extensive plantings or on open ground and planting adjacent to arable fields should be avoided due to their tendency to die-back (Pawsey, 1983). Ash is, however, an excellent firewood species and also produces sought-after timber and consequently can be a very desirable component of a crop. Mean yield classes are 5,6 and 8 m^3/ha/yr for oak, ash and cherry respectively.

This option yields considerable quantities of fuelwood and, as small diameter ash and cherry can frequently be sold into markets other than fuelwood, much of the yield comes from branchwood. The total fuel yield is estimated at 285 m^3/ha for a medium site, branchwood contributing 86 per cent of this.

Because of the early returns achievable from the cherry and ash, this is the second most profitable pure broadleaf option, the shelterwood system for ash and sycamore being potentially the most profitable. It can usually make a 3 per cent return on investment, especially if the BWGS is obtained and/or schedule D assessment is elected for during the establishment. At 5 per cent, however, crops require to grow faster than average and must obtain full benefits from planting grants and tax rebates to make a profit.

ii) The profitability tables presented for this option are for a replanting or new planting. It may be desirable, however, to carry out conversion to this management system over a period of years by felling small (1-3 ha) coupes and then planting with the mixture described above. If this were carried out over thirty to sixty years, it would result in reduced LEV's. An analysis has also been carried out for such a conversion with grants applied at the level appropriate to a 1-2.9 ha planting coupe size over a 30 year period felling coupes at ten yearly intervals. The longer the time period over which conversion is carried out and the shorter the intervals between coupe felling, the lower the LEV.

Table 2.13

DISCOUNTED CASH FLOW : Oak/Ash/Cherry YC5/6/8 Medium Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0	1	-205	-205	-205
Fencing	0	1	-280	-280	-280
Planting	0	1	-422	-422	-422
Grant 1st Inst.	0	1	420	420	420
Beating Up yrs1&3	2	1	-115	-115	-108
Weeding yrs0-4	2	1	-420	-420	-396
Grant 2nd Inst.	5	1	90	90	78
Cleaning yrs6&10	8	1	-200	-200	-158
Grant 3rd Inst.	10	1	90	90	67
Thin	30	35	10	350	144
Thin	40	43	11.3	486	149
Thin	50	43	14.9	641	146
C. Fell Cherry	60	74	31.6	2338	397
C.Fell Ash	75	71	31.6	2244	244
Thin oak	85	35	16.3	571	46
Thin oak	95	35	34.3	1201	72
Thin oak	105	35	34.3	1201	54
C.Fell Oak	120	224	63.1	14134	407

Annual management cost = -8
Net benefit = 21160 Net disc. revenue = 400
Land Expectation Value = 410
L.E.V. with 60% tax relief until D/B switch at year 25 = 1090
Additional discounted revenue from branchwood = 150

Net Revenue and Land Expectation Values for : Oak/Ash/Cherry Mixture

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
L-LO/LO	3450	3860	4250	2850	3440	4010	-720	-340	30	-1320	-760	-210	-1000	-650	-310	-1550	-1030	-530
L-LO/HI	6870	7280	7670	6270	6860	7430	-90	300	660	-690	-120	420	-760	-410	-80	-1310	-800	-300
L-MED/MED	9590	10000	10390	8990	9580	10150	-10	370	740	-610	-50	500	-790	-450	-110	-1350	-830	-330
L-HI/LO	14110	14530	14910	13510	14110	14670	390	770	1140	-220	350	900	-720	-370	-40	-1270	-760	-260
L-HI/HI	16410	16820	17210	15810	16400	16970	820	1210	1580	220	790	1340	-550	-200	130	-1100	-590	-90
M-LO/LO	11640	12040	12420	11040	11620	12180	-300	60	420	-890	-340	180	-890	-550	-220	-1440	-930	-440
M-LO/HI	15400	15790	16170	14800	15370	15930	360	730	1080	-220	320	850	-620	-270	50	-1170	-660	-170
M-MED/MED	22230	22630	23010	21630	22210	22770	520	890	1240	-60	480	1010	-660	-320	10	-1210	-700	-210
M-HI/LO	30470	30870	31240	29870	30450	31000	980	1350	1700	400	940	1460	-590	-250	80	-1140	-630	-140
M-HI/HI	33490	33890	34260	32890	33470	34020	1480	1850	2200	900	1450	1970	-380	-40	290	-930	-420	70
H-LO/LO	17340	17720	18080	16740	17300	17840	300	660	1010	-280	260	770	-720	-380	-60	-1260	-760	-270
H-LO/HI	21970	22350	22710	21370	21930	22470	1260	1620	1960	680	1210	1730	-280	50	380	-830	-330	160
H-MED/MED	30960	31340	31700	30360	30920	31460	1480	1840	2190	900	1440	1960	-350	-10	310	-900	-400	90
H-HI/LO	41670	42050	42410	41070	41630	42170	2120	2480	2830	1540	2080	2590	-250	90	410	-800	-290	190
H-HI/HI	45360	45740	46100	44760	45320	45860	2830	3190	3540	2250	2790	3310	70	410	730	-480	20	510

Net Revenue and Land Expectation Values for : Oak/Ash/Cherry Mixture 30 Year Conversion Grants at 2.5ha

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
L-LO/LO	3850	4140	4410	2850	3440	4010	-310	-110	70	-990	-590	-200	-430	-270	-130	-940	-630	-340
L-LO/HI	7270	7560	7830	6270	6860	7430	110	310	490	-570	-160	220	-290	-140	0	-800	-490	-200
L-MED/MED	9990	10280	10550	8990	9580	10150	160	370	550	-510	-110	280	-320	-160	-20	-830	-520	-230
L-HI/LO	14510	14810	15070	13510	14110	14670	440	640	820	-240	160	550	-280	-120	20	-790	-480	-190
L-HI/HI	16810	17100	17370	15810	16400	16970	730	930	1110	50	460	840	-180	-20	120	-690	-380	-90
M-LO/LO	12040	12320	12580	11040	11620	12180	-40	150	320	-700	-310	60	-370	-220	-80	-880	-580	-290
M-LO/HI	15800	16070	16330	14800	15370	15930	400	590	770	-250	130	500	-230	-70	60	-730	-430	-140
M-MED/MED	22630	22910	23170	21630	22210	22770	520	710	880	-130	250	620	-250	-100	40	-760	-460	-170
M-HI/LO	30870	31150	31400	29870	30450	31000	830	1020	1190	170	560	930	-200	-50	80	-710	-410	-120
M-HI/HI	33890	34170	34420	32890	33470	34020	1160	1350	1530	510	900	1270	-90	60	190	-600	-300	-10
H-LO/LO	17740	18000	18240	16740	17300	17840	370	550	720	-290	90	460	-270	-130	0	-780	-480	-200
H-LO/HI	22370	22630	22870	21370	21930	22470	1020	1200	1370	360	740	1110	-30	110	240	-540	-240	40
H-MED/MED	31360	31620	31860	30360	30920	31460	1170	1350	1520	520	890	1260	-70	70	210	-580	-280	0
H-HI/LO	42070	42330	42570	41070	41630	42170	1600	1780	1950	950	1330	1690	-10	130	260	-520	-220	60
H-HI/HI	45760	46020	46260	44760	45320	45860	2090	2270	2440	1430	1810	2170	160	310	440	-340	-50	240

10. Replace neglected coppice with standards with oak standards and coppice (Table 2.14)

Many of the broadleaved woodlands in the south of England are neglected coppice with standards, commonly either oak standards over hazel coppice or a mixed coppice of field maple, ash and other species. In many of these woodlands there are too many mature standards and the coppice beneath is suppressed. In this option it is assumed that all the existing standards and coppice are felled. Oak transplants are planted at a density of 100/ha within individual tree shelters for protection. It is assumed coppice regrowth from the past coppicing would only provide 500 stools/ha, a further 500 stems per hectare of oak, ash and maple should be planted to attain full stocking. The standards are reduced to about 60/ha by the end of rotation. Under the free growth conditions of the standards, increase in girth is faster than under plantation conditions and thus rotations can be shorter. Pruning should be carried out to ensure clean straight boles although the surrounding coppice growth may inhibit epicormics. The newly planted coppice should be cut 7 to 10 years after planting and then left on rotations of about 20 years, depending on the type of produce required. Obviously in many situations standards may be planted or recruited at intervals, and the previous standards thinned out heavily and not actually clear felled. This would provide timber as well as coppice produce after each coppice cut rather than having even aged standards. If this is carried out it is important that the remaining canopy is thinned out adequately, otherwise stool mortality will be high. The land expectation values for such a system will be slightly lower than those produced in this evaluation due to the period required for conversion. Yields of the standards are between 1.25 and 1.88 m^3/ha/yr whilst for the coppice low, medium and high productivity levels are assumed at 3, 5 and 7 m^3/ha/yr to 7 cm top diameter. These decline as the standards mature.

The fuelwood from this system originates from branchwood and roundwood of the coppice, and the crownwood from felling the standards. Under average productivity levels a total of 140 m^3/ha are produced in each coppice rotation, 88 per cent of this coming from the coppice component.

The option of obtaining planting grants is included in this financial analysis although they may not be available in many conservancies. Election could be made for schedule D income tax assessment during establishment although this would probably not be required for subsequent rotations. Further plantings would be cheaper due to the reduced need to replant the coppice; the costs would mainly be restricted to the establishment of standards. This system is usually profitable at a 3 per cent discount rate except when fuel prices are low. At 5 per cent, however, LEV's are seldom positive except on high yielding sites where fuel prices are high.

11. Underplant neglected coppice with standards with western red cedar (Table 2.15)

Western red cedar is a very shade tolerant species and underplanting neglected coppice with standards is a system occasionally used for converting such woodlands. Its site preference is for the heavier-textured lowland soils in S. England, especially calcarious clays. Prior to planting, the poorer standards and the coppice should be felled and removed leaving about 90 standards/ha. These should be underplanted with western red cedar. Beating up and weeding costs will be reduced because of the overstorey and the shade tolerant habit of western red cedar. Cleaning to remove any coppice regrowth will be required at some stage and the remaining oaks removed after about 10 years.

Table 2.14

DISCOUNTED CASH FLOW : Replace with Coppice with Standards

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-100	-100	-100
Planting Standards	0		-140	-140	-140
Planting Coppice	0		-115	-115	-115
Fencing	0		-280	-280	-280
Weeding yrs.0-4	2		-350	-350	-330
Cleaning	8		-100	-100	-79
Cut Coppice	25	100	9	900	430
Prune Standards	30		-15	-15	-6
Cut Coppice	45	100	9	900	238
Prune Standards	50		-15	-15	-3
Cut Coppice	65	84	9	756	111
Cut Coppice	85	70	9	630	51
Fell Standards	85	134	66.5	8911	722

Annual management cost = -11
Net benefit = 10050 Net disc. revenue = 160
Land Expectation Value = 210
L.E.V. with 60% tax relief until D/B switch at year 0 = 170
L.E.V. with 60% tax relief until D/B switch at year 20 = 910
Additional discounted revenue from branchwood = 200

Net Revenue and Land Expectation Values for : Replace with Coppice with Standards

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
L-LO/LO	3290	3520	3740	2690	3100	3500	-440	-230	-40	-1010	-630	-270	-600	-410	-230	-1150	-790	-450
L-LO/HI	10050	10280	10490	9450	9860	10250	880	1090	1280	310	690	1050	-70	120	300	-620	-260	80
L-MED/MED	8020	8250	8460	7420	7830	8220	340	550	740	-220	150	510	-320	-120	60	-860	-510	-160
L-HI/LO	8710	8940	9150	8110	8520	8910	40	250	440	-530	-150	210	-520	-320	-140	-1060	-700	-360
L-HI/HI	12760	12990	13200	12160	12570	12960	1120	1320	1520	550	930	1290	-30	160	350	-580	-220	130
M-LO/LO	4690	4930	5140	4090	4510	4900	-260	-50	140	-820	-450	-90	-550	-360	-170	-1100	-740	-390
M-LO/HI	11360	11590	11800	10760	11170	11560	1530	1740	1930	970	1350	1710	260	460	640	-280	80	420
M-MED/MED	11410	11640	11850	10810	11220	11610	940	1150	1340	380	750	1110	-90	100	280	-640	-280	60
M-HI/LO	11470	11710	11920	10870	11290	11680	340	550	740	-220	150	510	-440	-250	-70	-990	-630	-280
M-HI/HI	18140	18370	18580	17540	17950	18340	2140	2340	2530	1570	1950	2310	370	570	750	-170	180	530
H-LO/LO	6060	6290	6500	5460	5870	6260	-80	120	310	-650	-270	90	-500	-300	-120	-1040	-680	-340
H-LO/HI	15370	15600	15810	14770	15180	15570	2440	2650	2840	1880	2250	2610	650	840	1030	100	460	810
H-MED/MED	14770	15000	15210	14170	14580	14970	1530	1740	1930	970	1340	1700	140	330	520	-410	-50	300
H-HI/LO	14150	14380	14600	13550	13960	14360	630	840	1030	70	440	800	-370	-170	10	-910	-550	-210
H-HI/HI	23460	23690	23910	22860	23270	23670	3160	3360	3550	2590	2970	3330	780	970	1150	230	590	940

Table 2.15

DISCOUNTED CASH FLOW : Underplant with Western Red Cedar YC14

Operation	Year	Volume	Price	Value	Disc.val.
Under Planting	0		-375	-375	-375
Fencing	0		-280	-280	-280
Grant 1st	0		184	184	184
Beating Up	2		-90	-90	-85
Grant 2nd	5		46	46	40
Cleaning	8		-70	-70	-55
Thin	28	39	9	351	153
Thin	32	39	9	351	136
Thin	36	39	9	351	121
Thin	40	39	9	351	108
Thin	44	39	11	429	117
Thin	48	39	12.7	495	120
Thin	52	39	15.6	608	131
Thin	56	39	15.6	608	116
Thin	60	35	17.8	623	106
Clear Fell	64	543	21.2	11512	1736

Annual management cost = -8
Net benefit = 14580 Net disc. revenue = 2050
Land Expectation Value = 2410
L.E.V. with 60% tax relief until D/B switch at year 25 = 2880
Additional discounted revenue from branchwood = 190

Net Revenue and Land Expectation Values for : Underplant with Western Red Cedar

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
12-LO/LO	6510	6770	7000	6280	6610	6910	540	800	1040	280	620	940	-330	-100	110	-560	-260	20
12-LO/HI	12650	12910	13140	12420	12750	13050	2230	2490	2730	1970	2310	2630	310	540	750	80	380	660
12-MED/MED	12110	12370	12610	11880	12210	12520	1800	2050	2300	1530	1870	2190	80	310	520	-150	150	430
12-HI/LO	14410	14670	14910	14180	14510	14810	2120	2380	2620	1860	2200	2520	150	370	580	-80	210	490
12-HI/HI	17270	17530	17770	17040	17370	17670	3030	3290	3530	2770	3100	3420	520	740	950	290	580	860
14-LO/LO	8780	9040	9270	8550	8880	9180	1060	1320	1560	790	1130	1450	-160	60	270	-400	-100	180
14-LO/HI	14690	14950	15190	14460	14790	15090	2820	3080	3320	2560	2900	3220	530	750	960	300	590	870
14-MED/MED	15320	15580	15810	15090	15420	15720	2570	2830	3070	2300	2640	2960	340	560	770	100	400	680
14-HI/LO	18210	18470	18710	17980	18310	18620	3050	3310	3550	2780	3120	3440	440	670	880	210	510	780
14-HI/HI	21120	21380	21620	20890	21220	21520	3990	4250	4500	3730	4070	4390	840	1060	1270	610	900	1180
18-LO/LO	12780	13020	13250	12550	12860	13150	2330	2590	2830	2060	2400	2720	290	510	720	60	350	630
18-LO/HI	18130	18370	18590	17900	18210	18500	4370	4630	4870	4100	4440	4760	1200	1420	1630	970	1260	1540
18-MED/MED	21420	21670	21890	21190	21510	21800	4610	4870	5110	4340	4680	5000	1100	1320	1530	870	1160	1430
18-HI/LO	24290	24530	24750	24060	24370	24660	5240	5490	5730	4970	5300	5620	1270	1490	1700	1030	1320	1600
18-HI/HI	27420	27660	27890	27190	27500	27790	6410	6660	6900	6140	6470	6790	1800	2020	2220	1560	1850	2130

Due to the reduced establishment costs and high yields, (a national average of 14 m^3/ha/yr), this is a very profitable option. Fuelwood yields are high for a pure coniferous crop, with a potential total of 261 m^3/ha; this is due to the heavy branching of this shade tolerant species and the small dimensions of individual trees. Branchwood contributes 55 per cent to the estimated total yield. Land expectation values are very high at 3 per cent and usually positive at 5 per cent discount rate. Only when prices and yields are low will LEV's be negative at 5 per cent. This system, however, is not favourable from a conservation viewpoint.

12. Convert western oak to pure oak coppice (Table 2.16)

Large areas of Wales and south west England have oak woods originally of coppice origin. Improvement of such woodlands often entails clear felling and replacing with more productive species. An alternative is to fell and allow coppice growth to develop. Depending on the level of grazing damage and stool mortality after cutting, yields can be reasonable (Crockford et al, 1987). Some costs will be incurred at the beginning of each coppice rotation for gapping up purposes although birch and other species will often colonize gaps and can be recruited into the coppice. In this option it is assumed that no grants are available and woodlands would be taxed under schedule B. There are two variations to this option for which analyses have been carried out. The first is clear felling the entire woodland area in year 0, whilst the second is cutting one thirtieth (30 years being the rotation length considered) each year to produce a normal age structure.

It is assumed in this analysis that all wood is sold for fuel. At a mean productivity level of 4.5 m^3/ha/yr over a rotation length of 30 years there is an estimated total yield of 175 m^3/ha/yr of which 77 per cent is roundwood.

Because costs are very low in these options, land expectation values are usually positive (except where fuelwood prices are also low) at discount rates of 3 and 5 per cent. The LEV's, although positive, are rarely high and are reduced by carrying out the conversion over a period of years. Oak coppice, however, can have high conservation and amenity values.

13. Convert to oak/ash mixture using group felling system (Table 2.17)

This system can be used for converting existing broadleaved woodlands, especially neglected coppice with standards woodland. Small areas are felled, the size being large enough to encourage natural regeneration but small enough to minimize weed growth. The size should also take account of the shade tolerance of the species to be regenerated. In this analysis group fellings are 0.5 ha in size with the clearing being planted with a mixture of oak (1000/ha) and ash (500/ha). Natural regeneration should provide a further 500 ash/ha. Some failure of the crop is expected but no beating up is required and, if the group size is small enough, weeding should be limited. Some cleaning of the natural regeneration will be required in year 10 and also the the oaks should be pruned in year 35. LEV's are calculated on a per hectare basis in which costs are incurred and revenues generated at different times for different groups. The LEV is therefore a mean of profitabilities of groups established at different ages and consequently the cash flow, which refers to an individual group on a per hectare basis, does not have an LEV calculated. Fencing is at the 10 ha level to represent the entire compartment but planting grants, through the broadleaved woodland grant scheme, are at the highest level due to the small size of coupes. Because of the complexity of the system, management overheads can be high and also it is usually impractical to elect for income tax assessment under schedule D because revenues and income occur at the same time.

Table 2.16

DISCOUNTED CASH FLOW : Convert to Pure Oak Coppice

Operation	Year	Volume	Price	Value	Disc.val.
Misc. Costs	0		-50	-50	-50
Cut Coppice	30	135	9	1215	501

Annual management cost = -5
Net benefit = 1020 Net disc. revenue = 350
Land Expectation Value = 600
L.E.V. with 60% tax relief until D/B switch at year 0 = 570
Additional discounted revenue from branchwood = 140

Net Revenue and Land Expectation Values for : Convert to Pure Oak Coppice

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
2.5-LO	-80	-80	-80	-80	-80	-80	-180	-180	-180	-180	-180	-180	-140	-140	-140	-140	-140	-140
2.5-MED	560	560	560	560	560	560	270	270	270	270	270	270	60	60	60	60	60	60
2.5-HI	1200	1200	1200	1200	1200	1200	710	710	710	710	710	710	250	250	250	250	250	250
4.5-LO	40	40	40	40	40	40	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
4.5-MED	1190	1190	1190	1190	1190	1190	700	700	700	700	700	700	240	240	240	240	240	240
4.5-HI	2340	2340	2340	2340	2340	2340	1520	1520	1520	1520	1520	1520	580	580	580	580	580	580
6.0-LO	130	130	130	130	130	130	-30	-30	-30	-30	-30	-30	-80	-80	-80	-80	-80	-80
6.0-MED	1660	1660	1660	1660	1660	1660	1040	1040	1040	1040	1040	1040	380	380	380	380	380	380
6.0-HI	3190	3190	3190	3190	3190	3190	2110	2110	2110	2110	2110	2110	850	850	850	850	850	850

Net Revenue and Land Expectation Values for : 30 Year Conversion to Pure Oak Coppice

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
2.5-LO	-80	-80	-80	-80	-80	-80	-190	-190	-190	-190	-190	-190	-130	-130	-130	-130	-130	-130
2.5-MED	560	560	560	560	560	560	100	100	100	100	100	100	-30	-30	-30	-30	-30	-30
2.5-HI	1200	1200	1200	1200	1200	1200	400	400	400	400	400	400	70	70	70	70	70	70
4.5-LO	40	40	40	40	40	40	-130	-130	-130	-130	-130	-130	-110	-110	-110	-110	-110	-110
4.5-MED	1190	1190	1190	1190	1190	1190	390	390	390	390	390	390	60	60	60	60	60	60
4.5-HI	2340	2340	2340	2340	2340	2340	910	910	910	910	910	910	240	240	240	240	240	240
6.0-LO	130	130	130	130	130	130	-90	-90	-90	-90	-90	-90	-100	-100	-100	-100	-100	-100
6.0-MED	1660	1660	1660	1660	1660	1660	610	610	610	610	610	610	130	130	130	130	130	130
6.0-HI	3190	3190	3190	3190	3190	3190	1310	1310	1310	1310	1310	1310	370	370	370	370	370	370

Table 2.17

DISCOUNTED CASH FLOW : Group Felling Oak/Ash YC5/6 Med. Price

Operation	Year	Volume	Price	Value	Disc.val.
Planting	0		-280	-280	-280
Fencing	0		-283	-283	-283
Weeding Yr.2	2		-109	-109	-103
Cleaning	10		-70	-70	-52
Thin Ash	25	20	9	180	86
Prune	35		-60	-60	-21
Thin Ash & Oak	37	46	11.2	515	173
Thin Ash & Oak	49	42	14.6	613	144
Clear Fell Ash	60	103	31.6	3255	552
Thin Oak	70	35	12.4	434	55
Thin Oak	80	35	16.3	571	54
Thin Oak	90	35	16.3	571	40
Thin Oak	100	35	34.3	1201	62
Thin Oak	110	33	50.1	1653	64
Clear Fell Oak	120	199	63.1	12557	362

Net Revenue and Land Expectation Values for : Group Felling System (0.5ha) for Oak/Ash Mixture

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B	D/B	B	D/B	D/B	B	D/B	D/B	B	D/B	D/B	B	D/B	D/B	B	D/B	D/B
		30%	60%		30%	60%		30%	60%		30%	60%		30%	60%		30%	60%
4/4-L/L	3110	3110	3110	1910	1910	1910	60	60	60	-740	-740	-740	-50	-50	-50	-640	-640	-640
4/4-L/H	6580	6580	6580	5380	5380	5380	510	510	510	-290	-290	-290	110	110	110	-490	-490	-490
4/4-M/M	8470	8470	8470	7270	7270	7270	470	470	470	-330	-330	-330	60	60	60	-530	-530	-530
4/4-H/L	11760	11760	11760	10560	10560	10560	600	600	600	-200	-200	-200	60	60	60	-530	-530	-530
4/4-H/H	13870	13870	13870	12670	12670	12670	880	880	880	70	70	70	170	170	170	-430	-430	-430
5/6-L/L	11210	11210	11210	10010	10010	10010	370	370	370	-410	-410	-410	20	20	20	-570	-570	-570
5/6-L/H	15430	15430	15430	14230	14230	14230	870	870	870	90	90	90	200	200	200	-390	-390	-390
5/6-M/M	21260	21260	21260	20060	20060	20060	930	930	930	150	150	150	160	160	160	-430	-430	-430
5/6-H/L	28290	28290	28290	27090	27090	27090	1160	1160	1160	380	380	380	190	190	190	-400	-400	-400
5/6-H/H	31310	31310	31310	30110	30110	30110	1500	1500	1500	720	720	720	310	310	310	-280	-280	-280
6/8-L/L	19060	19060	19060	17860	17860	17860	1080	1080	1080	300	300	300	200	200	200	-390	-390	-390
6/8-L/H	23220	23220	23220	22020	22020	22020	1590	1590	1590	810	810	810	370	370	370	-220	-220	-220
6/8-M/M	32700	32700	32700	31500	31500	31500	1920	1920	1920	1140	1140	1140	400	400	400	-190	-190	-190
6/8-H/L	43160	43160	43160	41960	41960	41960	2410	2410	2410	1630	1630	1630	500	500	500	-90	-90	-90
6/8-H/H	46410	46410	46410	45210	45210	45210	2760	2760	2760	1980	1980	1980	610	610	610	20	20	20

Oak/ash mixtures yield large quantities of fuelwood; for an even aged plantation of this mixture, at yield classes of 5 and 6 m^3/ha/yr for oak and ash respectively, the estimated total fuelwood yield is 326 m^3/ha. Oak contributes 66 per cent to this total and of this 59 per cent is branchwood.

In this analysis it is assumed that conversion is carried out over 30 years with new groups being cut at 5 yearly intervals, a number of groups being felled and converted in any one year. The more frequent the felling and planting of groups or the longer the time period over which conversion is carried out the lower will be the land expectation value.

If planting grants are obtained at the highest level then LEV's are positive at both 3 and 5 per cent; at the former discount rate, LEV's can be surprisingly high for reasonable yielding sites if prices are good. Without grants, however, LEV's are almost always negative at 5 per cent and also at 3 per cent for low yielding sites.

14. Naturally regenerated beech, gaps planted up with native hardwood whips (Table 2.18)

In this option natural regeneration is encouraged by felling about 70 per cent of the overstorey, the remainder being left to inhibit weed growth during germination and early growth. The removal of timber will scarify the site and thus improve establishment. A clear forest floor is essential and thus branchwood must be sold for fuelwood or otherwise removed. The objective is to retain enough overstorey to inhibit weed growth but not so much as to inhibit the growth of the regeneration itself. The canopy should be thinned or removed in response to the condition of the natural regeneration. In this analysis the remaining canopy is removed in year 5 and the natural regeneration re-spaced and gaps planted (assuming 60 per cent stocking from natural regeneration). Weeding should then be carried out in years subsequent to this. A little manual weeding may also be required during the period before the canopy is removed.

It is assumed that naturally regenerated beech yields the same quantities of fuelwood as plantation grown beech, i.e. at a mean yield class of 6 m^3/ha/yr the estimated total yield is 265 m^3/ha, branchwood contributing 74 per cent to this total.

Natural regeneration, if successful, offers the potential for reduced establishment costs and grants would be available under the BWGS. LEV's are usually higher than those for plantation grown beech and are more likely to be positive when income tax is assessed under schedule B. Revenues would obviously be further improved if schedule D income tax is elected for during the establishment phase. However, this has the disadvantage that the revenues from felling the remaining canopy, after regeneration has been achieved, will be taxable at the rate applying. This is not apparent from the LEV tables because the revenues from felling the existing crop are excluded from the calculations. Land expectation values will, however, rarely be positive at a 5 per cent discount rate. It is important to stress that unsuccessful attempts at establishment by natural regeneration, can result in establishment costs which are equal if not greater than the costs for plantation establishment and in such situations LEV's would be much lower.

Table 2.18

DISCOUNTED CASH FLOW : Naturally Regenerated Beech YC6 Med. Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-205	-205	-205
Fencing	0		-280	-280	-280
Grant 1st	0		300	300	300
Weeding yr2	2		-70	-70	-66
Gap Up	5		-107	-107	-92
Clean N.R.	5		-60	-60	-52
Grant 2nd	5		180	180	155
Weeding yrs5-8	6		-380	-380	-318
Grant 3rd	10		120	120	89
Cleaning	12		-70	-70	-49
Thin	35	27	9	243	86
Thin	45	42	9	378	100
Thin	55	42	9	378	74
Thin	65	42	9	378	55
Thin	75	42	12.1	508	55
Thin	85	42	14.6	613	50
Clear Fell	95	333	43.9	14619	882

Annual management cost = -10
Net benefit = 15600 Net disc. revenue = 470
Land Expectation Value = 500
L.E.V. with 60% tax relief until D/B switch at year 30 = 930
Additional discounted revenue from branchwood = 130

Net Revenue and Land Expectation Values for : Beech Natural Regeneration

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
4-LO/LO	3640	3950	4230	3040	3530	3990	-560	-310	-90	-1140	-720	-320	-650	-440	-240	-1170	-800	-450
4-LO/HI	6820	7130	7410	6220	6710	7170	-110	140	360	-690	-260	130	-520	-310	-110	-1040	-670	-320
4-MED/MED	7400	7710	7990	6800	7290	7750	-230	20	250	-800	-380	20	-570	-360	-160	-1090	-720	-370
4-HI/LO	8720	9030	9310	8120	8610	9070	-260	-10	220	-830	-410	-10	-600	-390	-200	-1120	-750	-400
4-HI/HI	11370	11680	11960	10770	11260	11720	140	390	610	-440	-10	380	-490	-280	-80	-1010	-640	-290
6-LO/LO	10350	10640	10900	9750	10220	10660	-20	220	450	-600	-180	220	-540	-330	-140	-1060	-700	-350
6-LO/HI	14960	15250	15510	14360	14830	15270	760	1010	1230	180	600	1000	-270	-60	130	-790	-430	-80
6-MED/MED	16640	16930	17190	16040	16510	16950	610	850	1080	30	450	850	-380	-170	20	-900	-530	-180
6-HI/LO	19710	20000	20260	19110	19580	20020	660	900	1130	80	500	890	-420	-220	-20	-940	-580	-230
6-HI/HI	23340	23630	23900	22740	23210	23660	1310	1550	1770	730	1140	1540	-190	20	210	-710	-340	0
8-LO/LO	17350	17620	17870	16750	17200	17630	420	650	870	-150	250	640	-450	-250	-60	-970	-610	-270
8-LO/HI	23000	23280	23520	22400	22860	23280	1490	1720	1930	910	1310	1700	-50	150	340	-570	-210	130
8-MED/MED	25960	26240	26480	25360	25820	26240	1290	1520	1730	710	1120	1500	-200	0	190	-720	-360	-20
8-HI/LO	30190	30460	30710	29590	30040	30470	1340	1570	1790	760	1170	1560	-280	-80	110	-800	-440	-100
8-HI/HI	34820	35090	35330	34220	34670	35090	2210	2440	2660	1640	2040	2430	60	260	450	-460	-100	240

15. Planting simple coppice (Table 2.19)

This option represents the planting of new coppice. The species mixture on which this analysis is based is oak/ash/maple planted at just over 1,000 stems/ha. It could also be applied to hornbeam, sweet chestnut or other traditional species as long as yields are within the range considered here. It is imperative that the new plantings are well maintained by weeding, beating up and fencing and the new shoots should be cut to the base at about year 8, once they are well established and the cut material is large enough to be used for firewood. In this analysis the first cut is assumed to make no profit. Coppice rotations are 20 years after that with yields increasing after the first full rotation as rootstocks develop. It is possible that planting grants may be obtained for the initial work or election under schedule D for income tax relief. This would only be likely for the initial planting and no grants are assumed for subsequent rotations. Once established, a new coppice of this type is unlikely to need much input, apart from the occasional planting of gaps, for many rotations.

As with oak coppice it is assumed that all produce is sold for fuel. At a mean productivity level of 5.5 m^3/ha/yr and a rotation length of 20 years, the total yield is 143 m^3/ha; 77 per cent of this is roundwood.

LEV's are unlikely to be positive at a 5 per cent discount rate unless prices and yields are very high. At 3 per cent reasonable prices are required to make this system profitable, although planting grants and/or income tax benefits from schedule D can help substantially.

16. Convert to simple coppice (Table 2.20)

This option is similar to that for oak coppice but assumes higher yields. It should be used for considering the economics of the type of coppice described in the last option which is still being managed or from overgrown coppice of these species. It is thus suitable for neglected mixed coppice, hornbeam or sweet chestnut coppice, where the rotation lengths vary from 20 to 30 years depending on yield class.

The fuelwood yields are assumed to be the same as the previous option although in practice planting new coppice will take about two rotations before the full yield potential is achieved.

Grants are not included and it is not worth electing for assessment under schedule D for income tax relief. As with converting oak coppice LEV's are positive at both 3 and 5 per cent discount rates except where fuel prices are low. The LEV's, due to the higher yields, are slightly greater than for oak coppice.

17. Naturally regenerated birch (Table 2.21)

The two native species of birch, Betulus pendula and B. pubescens, overlap in their site requirements and, with their prolific natural regeneration can colonise most sites very easily. The object of this option is to allow birch regeneration to colonise cleared regions with very little site preparation; only ground clearance and fencing, and no maintenance costs. The values of such a system include its low cost, value for fuelwood and use as a shelter for stock and wild animals. It can also be of high conservation and amenity value. It is assumed that adequate stocking is realised by year 7 and that production is delayed by five years. Rotation lengths are about 50 years and the mean yield class 6 m^3/ha/yr.

Table 2.19

DISCOUNTED CASH FLOW : Planting Simple Coppice MAI=5.5

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-150	-150	-150
Fencing	0		-280	-280	-280
Planting	0		-275	-275	-275
Grant 1st Inst.	0		420	420	420
Weeding yrs0-4	2		-420	-420	-396
Beating Up yrs1&3	2		-77	-77	-73
Grant 2nd Inst.	5		90	90	78
Cut Coppice	8		0	0	0
Grant 3rd Inst.	10		90	90	67
Cut Coppice	28	90	9	810	354
Cut Coppice	48	110	9	990	240
Cut Coppice	68	110	9	990	133
Cut Coppice	88	110	9	990	73
Cut Coppice	108	110	9	990	41

Annual management cost = -5
Net benefit = 3630 Net disc. revenue = 70
Land Expectation Value = 100

L.E.V. with 60% tax relief until D/B switch at year 0 = 70
L.E.V. with 60% tax relief until D/B switch at year 25 = 500
Additional discounted revenue from branchwood = 150

Net Revenue and Land Expectation Values for : Planting with Simple Coppice

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
3.0-LO	-670	-480	-240	-1270	-900	-480	-700	-480	-270	-1270	-870	-490	-690	-470	-270	-1230	-850	-490
3.0-MED	1800	1990	2230	1200	1570	1990	-250	-20	190	-810	-420	-40	-490	-280	-70	-1040	-660	-290
3.0-HI	4270	4460	4700	3670	4040	4460	210	430	640	-360	40	420	-310	-90	110	-860	-470	-110
5.5-LO	-190	0	240	-790	-420	0	-620	-390	-180	-1180	-790	-410	-650	-440	-230	-1200	-820	-450
5.5-MED	4320	4510	4750	3720	4090	4510	210	430	640	-360	40	410	-310	-100	110	-860	-480	-110
5.5-HI	8830	9020	9260	8230	8600	9020	1040	1260	1470	470	870	1250	30	240	450	-520	-140	230
8.0-LO	290	480	720	-310	60	480	-530	-300	-90	-1090	-700	-320	-620	-400	-200	-1160	-780	-410
8.0-MED	6840	7030	7270	6240	6610	7030	670	900	1100	110	500	880	-130	90	290	-680	-300	70
8.0-HI	13390	13580	13820	12790	13160	13580	1870	2090	2300	1300	1700	2080	360	580	780	-190	200	560

Table 2.20

DISCOUNTED CASH FLOW : Convert to Simple Coppice MAI=5.5

Operation	Year	Volume	Price	Value	Disc.val.
Misc Costs	0		-50	-50	-50
Cut Coppice	25	137	9	1233	589

Annual management cost = -5
Net benefit = 1060 Net disc. revenue = 450
Land Expectation Value = 870
L.E.V. with 60% tax relief until D/B switch at year 0 = 830
Additional discounted revenue from branchwood = 190

Net Revenue and Land Expectation Values for : Convert to Simple Coppice

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
3.0-LO	-50	-50	-50	-50	-50	-50	-160	-160	-160	-160	-160	-160	-130	-130	-130	-130	-130	-130
3.0-MED	720	720	720	720	720	720	380	380	380	380	380	380	100	100	100	100	100	100
3.0-HI	1490	1490	1490	1490	1490	1490	910	910	910	910	910	910	330	330	330	330	330	330
5.5-LO	80	80	80	80	80	80	-40	-40	-40	-40	-40	-40	-80	-80	-80	-80	-80	-80
5.5-MED	1240	1240	1240	1240	1240	1240	1030	1030	1030	1030	1030	1030	410	410	410	410	410	410
5.5-HI	2420	2420	2420	2420	2420	2420	2090	2090	2090	2090	2090	2090	910	910	910	910	910	910
8.0-LO	150	150	150	150	150	150	80	80	80	80	80	80	-10	-10	-10	-10	-10	-10
8.0-MED	1510	1510	1510	1510	1510	1510	1770	1770	1770	1770	1770	1770	810	810	810	810	810	810
8.0-HI	2870	2870	2870	2870	2870	2870	3460	3460	3460	3460	3460	3460	1640	1640	1640	1640	1640	1640

Table 2.21

DISCOUNTED CASH FLOW : Naturally Regenerated Birch YC6 Med. Price

Operation	Year	Volume	Price	Value	Disc.val.
Ground Prep.	0		-150	-150	-150
Fencing	0		-280	-280	-280
Grant	0		300	300	300
Grant	7		180	180	146
Grant	12		120	120	84
Thin	25	18	9	162	77
Thin	33	34	9	306	115
Thin	41	34	9	306	91
Clear Fell	50	184	10.7	1969	449

Annual management cost = -5
Net benefit = 2660 Net disc. revenue = 700
Land Expectation Value = 910
L.E.V. with 60% tax relief until D/B switch at year 0 = 880
Additional discounted revenue from branchwood = 100

Net Revenue and Land Expectation Values for : Birch Natural Regeneration

YC-Price	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
NF/F	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
4-LO/LO	710	710	710	110	110	110	130	130	130	-510	-510	-510	10	10	10	-510	-510	-510
4-LO/HI	3740	3740	3740	3140	3140	3140	880	880	880	240	240	240	260	260	260	-260	-260	-260
4-MED/MED	1990	1990	1990	1390	1390	1390	450	450	450	-180	-180	-180	130	130	130	-400	-400	-400
4-HI/LO	2190	2190	2190	1590	1590	1590	490	490	490	-150	-150	-150	130	130	130	-390	-390	-390
4-HI/HI	3740	3740	3740	3140	3140	3140	880	880	880	240	240	240	260	260	260	-260	-260	-260
6-LO/LO	1210	1210	1210	610	610	610	370	370	370	-320	-320	-320	110	110	110	-430	-430	-430
6-LO/HI	4730	4730	4730	4130	4130	4130	1640	1640	1640	960	960	960	600	600	600	50	50	50
6-MED/MED	2880	2880	2880	2280	2280	2280	980	980	980	290	290	290	340	340	340	-200	-200	-200
6-HI/LO	3670	3670	3670	3070	3070	3070	1200	1200	1200	520	520	520	410	410	410	-130	-130	-130
6-HI/HI	4730	4730	4730	4130	4130	4130	1640	1640	1640	960	960	960	600	600	600	50	50	50
8-LO/LO	2680	2680	2680	2080	2080	2080	860	860	860	170	170	170	280	280	280	-270	-270	-270
8-LO/HI	6210	6210	6210	5610	5610	5610	2260	2260	2260	1570	1570	1570	840	840	840	300	300	300
8-MED/MED	5400	5400	5400	4800	4800	4800	1840	1840	1840	1150	1150	1150	650	650	650	110	110	110
8-HI/LO	7000	7000	7000	6400	6400	6400	2340	2340	2340	1650	1650	1650	810	810	810	270	270	270
8-HI/HI	8220	8220	8220	7620	7620	7620	2880	2880	2880	2180	2180	2180	1040	1040	1040	500	500	500

The fuelwood yields are largely determined by the price of fuelwood. At medium price levels three thinnings may be used as fuel. The total fuelwood yield over the rotation is estimated at 137 m^3/ha, branchwood contributing 39 per cent.

Although unlikely, it is possible that grants may be obtainable for encouraging the natural regeneration. As with the other low cost options LEV's are often positive but low at both 3 and 5 per cent discount rates. Only on low yielding sites without grants will LEV's be negative at 3 per cent although high fuelwood prices assists profitability significantly.

18. Shelterwood system for ash and sycamore (Table 2.22)

The use of a shelterwood system for regenerating ash and sycamore has great potential as ample amounts of seed are produced in most years. With the right site conditions natural regeneration of these species can be dense. Though the seedlings are shade tolerant, the remaining canopy should be removed soon after the regeneration has been established. This system consists of carrying out a heavy thinning to leave seed trees, removal of the timber and gradual removal of the remaining canopy - determined by the success and condition of the natural regeneration - over the following 10 years. A little soil cultivation may help the germination of the seeds, eg, using a disc harrow (Newbould and Goldsmith, 1981). The canopy retention will help reduce weed growth and thus weeding costs. On felling the remaining canopy, respacing and clearing of the natural regeneration will be required to attain suitable stocking. Browsing damage from deer or rabbits can be a problem and some control may be necessary. Because markets other than fuelwood are frequently available for small diameter ash and sycamore much of the fuelwood yield, estimated at 159 m^3/ha, is branchwood.

The reduced costs that can be achieved through successful natural regeneration, the relatively short rotation lengths and high timber prices of these species makes potential profitability very high. It is potentially the best pure broadleaf option. If grants are obtained for natural regeneration LEV's are usually positive and often high at a discount rate of 3 per cent. Except for low yielding sites LEV's are usually positive without grants. This system will also make a positive return at 5 per cent for high yielding sites, especially if grants are obtained. The profitability of the option would be improved by electing for income tax assessment under schedule D during the regeneration operations although this has the disadvantage of felling revenues being taxable which would probably more than compensate for any relief on establishment costs.

2.4 CONCLUSIONS

This Chapter assesses the profitability, in terms of Land Expectation Values, of 18 management options and presents notes on their management and fuelwood yields. The profitabilities are summarised in Table 2.23 in a very simplified form. LEV's at a discount rate of 3 per cent are presented for three tax and grant conditions: 1) without grants or tax relief; 2) grants included but no tax relief and 3) grants included and tax relief through election for income tax assessment under schedule D at 60 per cent for the costly establishment period. The values in Table 2.23 include estimated revenues from branchwood.

Table 2.22

DISCOUNTED CASH FLOW : Shelterwood System Ash/Sycamore YC6

Operation	Year	Volume	Price	Value	Disc.val.
Groud Prep.	0		-205	-205	-205
Cultivation	0		-50	-50	-50
Grant 1st Inst.	0		300	300	300
Fencing	0		-280	-280	-280
Weeding yrs1-5	3		-250	-250	-229
Grant 3rd Inst.	5		146	146	126
Clean/Respace	10		-120	-120	-89
Grant 3rd Inst.	10		120	120	89
Thin	30	40	10.2	408	168
Thin	42	50	13	650	188
Thin	54	50	19.2	960	195
Seed Felling	66	90	31.6	2844	404
Sec. Felling	71	70	52.3	3661	449
Final Felling	76	70	52.3	3661	387

Annual management cost = -11
Net benefit = 11010 Net disc. revenue = 1130
Land Expectation Value = 1260
L.E.V. with 60% tax relief until D/B switch at year 25 = 1580
Additional discounted revenue from branchwood = 160

Net Revenue and Land Expectation Values for : Shelterwood System Ash/Sycamore

YC-Price NF/F	0% Disc. Rate						3% Disc. Rate						5% Disc. Rate					
	+ Grants			- Grants			+ Grants			- Grants			+ Grants			- Grants		
	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%	B	D/B 30%	D/B 60%
4-LO/LO	1430	1650	1840	830	1230	1600	-250	-60	100	-860	-490	-140	-400	-240	-100	-930	-610	-310
4-LO/HI	3690	3910	4100	3090	3490	3860	280	460	630	-340	30	380	-220	-60	90	-750	-430	-120
4-MED/MED	3330	3550	3740	2730	3130	3500	120	300	470	-490	-120	230	-290	-130	10	-820	-500	-200
4-HI/LO	4190	4410	4600	3590	3990	4360	260	440	610	-350	20	370	-250	-90	60	-780	-460	-150
4-HI/HI	5310	5530	5720	4710	5110	5480	520	700	870	-90	280	630	-160	0	150	-690	-370	-60
6-LO/LO	7150	7340	7520	6550	6920	7280	620	800	960	10	370	710	-160	-10	130	-690	-380	-80
6-LO/HI	9600	9800	9980	9000	9380	9740	1280	1460	1620	670	1030	1380	100	260	400	-430	-110	190
6-MED/MED	11750	11950	12120	11150	11530	11880	1430	1600	1760	820	1180	1520	80	240	380	-450	-130	160
6-HI/LO	14770	14960	15140	14170	14540	14900	1890	2070	2230	1280	1640	1980	210	360	500	-320	-10	290
6-HI/HI	16430	16620	16800	15830	16200	16560	2280	2450	2610	1670	2030	2370	350	500	640	-180	130	430
8-LO/LO	16220	16400	16560	15620	15980	16320	2290	2450	2600	1680	2030	2360	350	500	630	-180	130	420
8-LO/HI	19060	19230	19390	18460	18810	19150	3160	3330	3480	2550	2900	3230	740	890	1030	210	520	820
8-MED/MED	23510	23680	23840	22910	23260	23600	3690	3850	4000	3080	3430	3760	800	950	1090	280	580	880
8-HI/LO	28790	28970	29120	28190	28550	28880	4600	4770	4920	3990	4340	4670	1070	1220	1360	540	850	1150
8-HI/HI	30890	31070	31230	30290	30650	30990	5140	5300	5450	4520	4870	5210	1290	1440	1580	760	1070	1360

Table 2.23 Summary showing LEV's (in £ at 1986 values) at 3 per cent discount rate for each option under mean yield and price levels

Option			YC	Tax Schedule B - Grants	Tax Schedule B + Grants	Tax Schedule D/B at 60% + Grants
				Land expectation values at 3% in £/ha		
1.		Douglas fir	14	2150	2430	3640
2.		Corsican pine	12	1590	1870	2910
3.		Japanese larch	10	1400	1710	2690
4.		Sitka spruce	12	1550	1830	2830
5.		Douglas fir/oak mixture	14/5	930	1270	2100
6.		Oak	5	-660	- 80	590
7.		Corsican pine/beech mixture	12/6	540	900	1850
8.		Beech	6	-670	- 70	830
9.	i)	Oak/ash/cherry mixture	5/6/8	- 60	520	1240
	ii)	30 year conversion to oak/ash/cherry	5/6/8	-130	520	880
10.		Coppice-with-standards	medium	380	-	1110
11.		Underplant with western red cedar	14	2300	2570	(3070)
12.	i)	Convert to pure oak coppice	4.5	700	-	-
	ii)	30 year conversion to oak coppice	4.5	375	-	-
13.		Oak/ash group felling system	5/6	150	930	-
14.		Beech - natural regeneration	6	30	610	(1080)
15.		Planting simple coppice	5.5	-360	210	640
16.		Convert to simple coppice	5.5	1030	-	-
17.		Birch - natural regeneration	6	290	980	-
18.		Ash/sycamore - shelterwood system	6	820	1430	(1760)

Notes

1. Blanks signify situations in which grants and/or tax relief may not be available or suitable. 2. Brackets surround values where tax relief from schedule D may not be desirable due to other revenues being earned such as the removal of residual canopy. 3. Medium yield class for coppice-with-standards refers to a coppice yielding 5 m^3/ha/yr declining as standards increase in size and average site quality for the oak standards.

Broadleaved crops, whether pure or in mixtures with conifers, tend to produce the greatest quantities of fuelwood. This is particularly because of the greater branchwood production of broadleaves, but for species such as oak many of the thinnings may also be sold for fuel though the price of fuelwood strongly influences how many thinnings are sold into this market. Coppice crops can produce substantial quantities of roundwood fuel on relatively short rotations.

The results illustrate that the most profitable options are the pure conifer crops under any of the three tax and grant conditions illustrated. The conifer/broadleaved mixtures tend to be the next most profitable and result in a final crop which is broadleaved. New plantings of pure broadleaves can be profitable at a discount rate of 3 per cent, but only with the most favourable levels of tax relief and planting grants. In such situations the most profitable option is planting mixtures of oak, ash and cherry. Without the benefits of tax relief and grants, however, such options tend to make a loss at 3 per cent and it is more advantageous to manage the lower cost broadleaf options which rely, at least partly, on natural regeneration or retention of part of the overstorey to reduce weeding and other establishment costs. Shelterwood systems for ash and sycamore natural regeneration can provide a good return in such situations. With grants only but no tax relief, the group felling system for ash and oak can be very profitable due to the high planting grants received for the small areas planted.

If fuelwood prices are reasonable, as has been assumed for the examples in Table 2.23, then systems such as reviving coppicing in neglected coppice, and rehabilitating neglected coppice-with-standards woodlands are very favourable broadleaved options. Planting grants would normally be essential to make the planting of new coppice of native species appear profitable at a 3 per cent discount rate. It is also interesting to note that very low cost options, such as encouraging birch natural regeneration on relatively short rotations, can also be profitable when fuel prices are reasonable.

PART 2

WOODLAND MANAGEMENT DECISIONS - A USER'S GUIDE

CHAPTER 1

USER DOCUMENTATION

1.1 INTRODUCTION TO THE PROGRAM

The program is designed to help owners choose suitable silvicultural regimes for their woodlands. It calculates Land Expectation Values (LEV's) for a wide range of possible woodland management options. Adjustments can be made according to the particular circumstances of the owner in terms of likely costs, revenues, tax situations, etc.

The LEV's generated provide a basis for choosing between management options since they accurately reflect their relative profitabilities. Land expectation values are used to compare management options of different rotation lengths. The LEV's will only give rough estimates of the revenue expected. They should not be relied upon as sources of information concerning the actual revenues generated for particular management options.

The program allows much flexibility in adjusting to a particular situation however the user can not alter the data that holds the fundamental assumptions.

In summary, the program generates LEV's for different management systems and different personal situations. The LEV's are used as a basis for comparison between possible management options and the effects of various factors, such as planting grants, within an option.

Table 1.1 Determining variables included in the computer program

Variable	Levels
Management Option	18 options grouped as high, medium or low intensity
Productivity Level (Yield Class)	Low, medium or high productivity selection for each option
Produce Value	Five price level combinations for fuelwood and timber
Discount Rate	0, 2, 3, 4 or 5 per cent
Annual Managment Costs	Low, medium or high
Revenue from Lop and Top	Included or not included at selected price level
Sporting Rental	None, low, medium or high
Grants scheme (BWGS of FGS)	Five levels for appropriate grant
Adjusting Establishment Costs	Increase of decrease from 0 to 99 per cent
Income Tax Rate	10 to 99 per cent inclusive

Computer Compatibility

The program is designed to run on the IBM PC and compatible computers. PC DOS 2.1 and MS DOS 2.11 were tested. These and later versions will be suitable.

2.1 USING THE SOFTWARE

Loading the program

From DOS (i.e. after switching on the computer and "booting up") go into BASIC using your own disk. If you do not know how to do this then:

i. Ensure the system (DOS) disk is in the A: drive.

ii. Type; A: BASICA (for PC DOS)

OR Type; A: GWBASIC (for MS DOS)

OR If your computer has a hard disk you will probably not need a system floppy disk (in which case use the same commands but omit 'A:')

Next insert the WOODLAND MANAGEMENT DECISIONS disk into the A: drive of the computer.

To run the program type;

CHAIN "A: ETSU MENU

Controlling the program

i. The program will now be running. Before proceeding further, ensure that the 'NUM LOCK' button is 'ON' so that you can use the number pad.

ii. The program is very user-friendly, when decisions have to be taken only the relevant keys will function. These are frequently number buttons or 'Y' and 'N' buttons. You do not need to press the 'RETURN' button.

iii. If at any time you require a print out of the present screen depress 'SHIFT' and press 'PRTSCR'.

iv. Pressing 'X' will always return you to the main menu. (A menu is a set of fundamental choices).

v. To stop the program depress 'CTRL' and then 'BREAK' or alternatively the system reset 'CTRL', 'ALT', 'DELETE' combination.

The program: a step by step explanation

A brief description of the program is displayed when it has loaded:

WOODLAND MANAGEMENT DECISIONS.

M.J. Spilsbury.
Oxford Forestry Institute.
South Parks Road, Oxford OX1 3RB.

This program is designed to help owners choose suitable silvicultural regimes for their woodlands. It calculates Land Expectation Values (LEV's) in pounds for a wide range of possible options. Adjustments to the LEV's can be made according to the particular circumstances, in terms of likely costs, revenues and tax situations.

The LEV's derived give a general guide to the relative profitabilities of different options. They are intended to be used for making comparisons between possible initial choices, and not for providing absolute values.

The work was financed by the Energy Technology Support Unit of the UK Atomic Energy Authority under agreement No. E/5A/CON/1156/1166.

1. Options Menu

Pressing any key will display the following 'OPTIONS MENU'

```
                    HIGHER INTENSITY MANAGEMENT                 OPTIONS MENU
(A) Plant with Douglas fir.                                     ============
(B) Plant with Corsican pine.
(C) Plant with Japanese larch.
(D) Plant with Sitka spruce.
                    MEDIUM INTENSITY MANAGEMENT
(E) Plant with Douglas fir / Oak mixture.
(F) Plant with Oak.
(G) Plant with Corsican pine / Beech mixture.
(H) Plant with Beech.
(I) Plant with Oak / Ash / Cherry.
(J) 30 year conversion to Oak / Ash / Cherry plantation.
(K) Underplant neglected woodland with Western red cedar.
(L) Convert neglected coppice to coppice-with-standards.
                    LOW INTENSITY MANAGEMENT
(M) Re-coppice neglected Oak coppice (normal age structure).
(N) Re-coppice neglected Oak coppice (immediate conversion).
(O) Plant simple coppice.
(P) Re-coppice neglected woodland of pure or mixed coppice species.
(Q) Convert neglected woodland to an Oak / Ash group system.
(R) Shelterwood system for Ash / Sycamore.
(S) Beech natural regeneration supplemented with native hardwood whips.
(T) Birch natural regeneration.                  ENTER LETTER OF OPTION REQUIRED
```

Any letter from 'A' to 'T' will select the corresponding option. See later for description of silviculture and assumptions.

From this point onwards, until you return to the OPTIONS MENU, all data and decisions refer to the selected option. However, pressing 'X' will always return you to this menu.

2. Cash Flow

The first table to be displayed is the cash flow for the management option. This gives the basic establishment costs which have been assumed, revenues expected and their timing during the rotation. Costs which occur over a number of years, such as weeding, are shown in the cash flow as one entry at the mean year. The magnitude of costs can be adjusted later, if necessary. The figures shown are for medium yield classes, and medium price regimes, and a 3 per cent discount rate. Any planting grants are included at the lowest, i.e. 10 ha, level. A full account of the assumptions made for each management option is given later.

Beech.

CASH FLOW FOR MEDIUM YIELD, PRICES, GRANTS & 3% DISC RATE

OPERATION	YEAR	VOLUME cu.m	PRICE	VALUE	CUM VAL	DISC VAL
Ground prep.	0	-	-205	-205	-205	-205
Planting.	0	-	-660	-660	-865	-660
Fencing.	0	-	-280	-280	-1145	-280
Grant 1st Inst.	0	-	420	420	-725	420
Beat up 1&3.	2	-	-115	-115	-840	-109
Weeding 0-4.	2	-	-420	-420	-1260	-396
Grant 2nd Inst.	5	-	90	90	-1170	77
Cleaning 6&10.	8	-	-180	-180	-1350	-143
Grant 3rd Inst.	10	-	90	90	-1260	66
Thin.	35	28	9	252	-1008	89
Thin.	45	42	9	378	-630	99
Thin.	55	42	9	378	-252	74
Thin.	65	42	9	378	126	55
Thin.	75	42	12.1	508	634	55
Thin.	85	42	14.6	613	1247	49
Clear fell.	95	332	43.9	14574	15821	879

Estimated fuel-wood yield is 265 cu.m/ha/rotation for medium yield class.
Of this 74 % is from branchwood. PRESS ANY KEY

3. Productivity Level (Yield Class)

By pressing any key the data for the selected management option will be accessed, and the following information is displayed.

Beech.

YOU MUST SELECT A PRODUCTIVITY LEVEL FOR THIS OPTION.

(1) LOW PRODUCTIVITY, YIELD CLASS 4

(2) MEDIUM PRODUCTIVITY, YIELD CLASS 6

(3) HIGH PRODUCTIVITY, YIELD CLASS 8

PRESS NUMBER FOR CHOICE (1-3)

Press 1, 2 or 3 for the desired choice, according to where you are growing trees, and how well you think the species will perform on this site.

4. Fuel-Wood and Timber Prices

The next display will be;

Beech.

YOU MUST SELECT THE PRICE REGIME FOR FUEL-WOOD AND TIMBER MARKETS

(1) LOW TIMBER / LOW FUEL-WOOD PRICES

(2) LOW TIMBER / HIGH FUEL-WOOD PRICES

(3) MEDIUM TIMBER / MEDIUM FUEL-WOOD PRICES

(4) HIGH TIMBER / LOW FUEL-WOOD PRICES

(5) HIGH TIMBER / HIGH FUEL-WOOD PRICES

PRESS NUMBER FOR CHOICE (1-5)

It is necessary to compare your local markets with the national averages when making your decision.

5. Discount Rate

Following this, the discount rate for the calculations must be selected;

Beech.

YOU MUST SELECT A DISCOUNT RATE (TO TEST RATE OF RETURN)

(1) DISCOUNT RATE = 0% (NET REVENUE)

(2) DISCOUNT RATE = 2%

(3) DISCOUNT RATE = 3%

(4) DISCOUNT RATE = 4%

(5) DISCOUNT RATE = 5%

PRESS NUMBER OF CHOICE (1-5)

6. Management Costs

The next decision to be taken is the level of annual management costs or overheads expected. Again the choice is taken by pressing the relevant numbers.

Beech.

SELECT LEVEL OF MANAGEMENT COSTS EXPECTED

(1) LOW 5/ha/yr

(2) MEDIUM 8/ha/yr

(3) HIGH 12/ha/yr

PRESS NUMBER OF CHOICE (1-3)

7. Revenue from Lop and Top

You are now presented with the opportunity to include revenue generated by the sale of lop and top for fuelwood. It may not be advantageous if the fuelwood market is low. 'Y' and 'N' control this decision.

Beech.

WILL YOU GENERATE EXTRA REVENUE FROM THE SALE OF LOP AND TOP FOR FUEL-WOOD ?.

(Y) YES

(N) NO

8. Sporting Rental

Sporting rental is the next consideration.

Beech.

WILL YOUR WOODLAND BE GENERATING ANY SPORTING RENTAL ?.

(Y) YES

(N) NO

If you decide to include it the following choice is displayed:

Beech.

SELECT LEVEL OF SPORTING RENTAL

(1) LOW £1/ha/yr

(2) MEDIUM£8/ha/yr

(3) HIGH £15/ha/yr

PRESS NUMBER FOR CHOICE (1-3)

9. Planting Grants

For the majority of management options planting grants are available. The computer will select the appropriate grant scheme (BWGS or FGS) for the particular management option. The level of grant will depend upon the size of the area being planted or regenerated.

Beech.

SELECT APPROPRIATE GRANT LEVEL (GRANT VARIES WITH SIZE OF AREA PLANTED)

(1) NO GRANTS

(2) 0.25-0.9ha.

(3) 1.0-2.9ha.

(4) 3.0-9.9ha.

(5) 10ha OR MORE

PRESS NUMBER FOR CHOICE (1-5)

10. Adjustment to Establishment Costs

If your establishment costs differ significantly from those assumed in the option (displayed in the cash flow and discussed in greater detail later in this booklet) then the opportunity to adjust these costs is presented.

Beech.

WILL YOUR PARTICULAR SITUATION REQUIRE ADJUSTMENT TO ESTABLISHMENT COSTS?.
(refer to documentation for full account of costs already considered)

(Y) YES

(N) NO

You may also study the cash flow again. Adjustments to establishment costs are made by entering the percentage difference from the costs already entered (negative numbers for reduced costs, positive numbers for increased costs).

The display shows how pounds can be expressed as percentage costs for each management option.

Beech.

DO YOU WISH TO EXAMINE THE CASH FLOW BEFORE MAKING COST ADJUSTMENTS ?.

(Y) YES

(N) NO

Beech.

ENTER PERCENTAGE VALUE FOR ESTABLISHMENT COSTS
Any two figure number between -99 and 99, the computer expects two figures so use -01, -02, 06, 07 etc. Negative values indicate reduced costs.

PERCENTAGE	10%	20%	30%	40%	50%	60%	70%	80%	90%
EQUIVALENT POUNDS	178	357	536	715	893	1072	1251	1430	1609

DISCOUNT RATE = 3 % YIELD CLASS = 6

The computer requires two numbers with, or without a minus sign hence 1% or 9% must be entered as 01 and 09, similarly for negative numbers.

You are strongly advised to read the section that discusses the costs and revenues assumed in the management options, in order to make effective use of this adjustment.

11. Income Tax

Finally you should enter your income taxation rate. The computer only accepts a number between 10 and 99 per cent inclusive. If your entry falls outside this range you will be instructed to 'TRY AGAIN'.

Beech.

ENTER THE LEVEL OF TAXATION AT WHICH YOUR INCOME IS TAXED
(enter a two figure number between 10 and 99)

If you are not taxed enter any figure in the range and refer to the results section below.

12. Calculation of Results

The computer then carries out the calculations and displays a list of all the decisions taken, along with the 'answers', which are the two figures at the bottom of the list.

```
   MANAGEMENT OPTION = Beech.

(1) YIELD CLASS = 6 cu.m/ha/yr
   ROTATION LENGTH = 95 years
   YEAR OF TAXATION SWITCH FROM SCHEDULE 'D' TO SCHEDULE 'B' = 30
(2) MEDIUM TIMBER / MEDIUM-FUEL WOOD PRICES
(3) DISCOUNT RATE = 3 %
(4) MANAGEMENT COSTS = 8£/ha/yr
   PRAIRIE VALUE UNDER SCHEDULE 'B'=£1/ha/yr
(5) ADDITIONAL REVENUE FROM THE SALE OF LOP & TOP ? YES
(6) SPORTING RENTAL = 1£/ha/yr
(7) GRANT LEVEL FOR 0.25-0.9ha, SCHEME BWG
(8) PERCENTAGE ALTERATION OF ESTABLISHMENT COSTS = 0 %
(9) LEVEL OF INCOME TAXATION = 60 %


LEV FOR SCHEDULE  'B' IN  PERPETUITY =£570
LEV FOR SCHEDULE D/B WITH TAX RELIEF =£1091

TYPE A NUMBER BETWEEN 1 & 9 TO TO ALTER THE SITUATION DISPLAYED ABOVE.
TYPE 'P' FOR A PRINTOUT.                TYPE 'X' TO EXIT TO MAIN MENU.
```

LEV for SCHEDULE 'B' IN PERPETUITY This is the Land Expectation Value to use if you are registered under schedule B income taxation for your woodland. There is no tax relief on expenditure. If you are not taxed use this value and see Table 1. All the adjustments made by the user except tax relief are included in this value.

LEV FOR SCHEDULE D/B WITH TAX RELIEF This is the Land Expectation Value for your situation including a change of income taxation schedule from D to B before first thinning. This allows tax relief on expenditure during the establishment phase (but any income during this period is taxed e.g. grants).

The LEV for B in perpetuity and the LEV for a D/B switch are the two values that can be used to compare between management options. It is best to get a print out of the decisions taken, and the result before considering another management option.

13. Alteration of Assumptions

If you wish to alter this situation you may do so. Any of the decisions taken can be altered as many times as you like. Press the number adjacent to the variable you wish to change on the screen.

e.g. press '7' to alter grant level.

If you select a new grant rate, the display is altered to show the new values, the previous LEV's are displayed to the right of the new ones, along with information on the variable you altered.

```
    MANAGEMENT OPTION = Beech.

(1) YIELD CLASS = 6 cu.m/ha/yr
    ROTATION LENGTH = 95 years
    YEAR OF TAXATION SWITCH FROM SCHEDULE 'D' TO SCHEDULE 'B' = 30
(2) MEDIUM TIMBER / MEDIUM-FUEL WOOD PRICES
(3) DISCOUNT RATE = 3 %
(4) MANAGEMENT COSTS = 8£/ha/yr
    PRAIRIE VALUE UNDER SCHEDULE 'B'=£1/ha/yr
(5) ADDITIONAL REVENUE FROM THE SALE OF LOP & TOP ? YES
(6) SPORTING RENTAL = 1£/ha/yr
(7) GRANT LEVEL FOR 3.0-9.9ha, SCHEME BWG
(8) PERCENTAGE ALTERATION OF ESTABLISHMENT COSTS = 0 %
(9) LEVEL OF INCOME TAXATION = 60 %

                                              HAVE ALTERED GRANT LEVEL
LEV FOR SCHEDULE  'B' IN  PERPETUITY =£170    PREVIOUS LEV VALUE =£570
LEV FOR SCHEDULE D/B WITH TAX RELIEF =£931    PREVIOUS LEV VALUE =£1091

TYPE A NUMBER BETWEEN 1 & 9 TO TO ALTER THE SITUATION DISPLAYED ABOVE.
TYPE 'P' FOR A PRINTOUT.              TYPE 'X' TO EXIT TO MAIN MENU.
```

Pressing 'P' when this display is shown will cause a print-out of this situation.

Pressing 'X' (at any time) will return you to the MAIN OPTIONS MENU.

The program will run almost identically for each management option. However if a tax switch or grants are not possible in an option the computer knows better than to ask you the question.

14. Errors

If the computer senses an error it will try to return to the main menu. If it does not do this it will probably display a "file not found" or a "disk not ready" error.

The problem will be:

i. Incorrect disk, or no disk in drive A:

ii. The disk drive door has not been shut.

In the unlikely event of repetitive errors please contact the author (M J Spilsbury, Oxford Forestry Institute, South Parks Road, Oxford, OX1 3RB).

CHAPTER 2

METHODS AND ASSUMPTIONS

2.1 INTRODUCTION AND GENERAL ASSUMPTIONS

This section summarises the methods and assumptions included in the data and methods of calculation within the program. Further detail on the management and general profitability of these options are presented in Part 1.

General assumptions

1. Some form of woodland management must be considered. Comparisons with alternative land-uses, such as agriculture, can not be made with this system.

2. Only financial comparisons between management options are made. Other possible important criteria, such as landscape and conservation values are not considered and these may influence the initial selection.

3. Woodland management is assumed to continue to at least as long as the final felling age of the crops considered.

4. Felling revenues from any existing woodland are not included in the financial analyses.

General methods

1. Discounting theory is used in all calculations concerning costs and revenues, both in the program and the data that drives it. Discounting is a means of expressing the disadvantage of having to wait for revenues that will be generated in the future, and the advantage of deferring the payment of costs. Discounting allows all costs and revenues, whether future or present, to be expressed in terms of present values. Part 1 discusses the theory and use of discounting in this study.

2. Land Expectation Values (LEV's) are an extension to discounting theory. They are used because management systems often have different rotation lengths and direct comparison of Net Discounted Revenues (NDR's) is not therefore suitable because the land is occupied for different periods. LEV's are NDR's converted onto an infinite timescale (i.e. an infinite number of rotations) and thus, since different management options now theoretically occupy the land for the same length of time, these values can be compared. This comparison is the basis of choice between management options considered.

3. LEV's obtained from data stored in the program can be adjusted by the user to match any particular situation. Details about how these calculations may be carried out manually can be obtained from Commonwealth Forestry Institute Occassional Paper No 19 Vol 1 'An Economic Analysis of Silvicultural Options for Broadleaved Woodland', S.N. Pryor (1982).

2.2 ASSUMPTIONS FOR COSTS AND REVENUES

Each management option assumes a pre-determined plan of operations. The magnitude and timing of establishment costs are assumed to be constant within a management option and do not vary with the productivity level of the subsequent crop. Specific timings and the levels of revenues will vary within a management option depending upon the productivity level being considered. Not surprisingly, different management options will assume

different sets of costs and revenues. The levels of costs are derived from the national averages for private woodlands on a per hectare basis (Dolan and Russell, 1985). Examples of the types of costs often considered are; ground preparation, planting, weeding, cleaning etc.

Fencing presented a problem because variations in perimeter lengths can significantly affect costs and hence the profitability of small woodlands. Fencing costs per hectare increase substantially with decreasing woodland size. Additionally, the area fenced by an owner may, for various reasons, be greater than the area actually planted. It is assumed that the owner will be managing, and fencing, the same area regardless of which option is chosen. Inclusion of fencing costs at a standard 10 ha level for all management options will therefore make no difference to their relative profitabilities, but will serve to make rough estimates of profitability more accurate. Similarly this is true for any cost that is constant between the management options considered, eg. ground rent for tenants.

If, however, any cost is likely to vary between management options for a particular situation the program allows the user to make adjustments to the establishment costs assumed. The user should study carefully the cash flow presented for the option and note any differences for a particular situation. The program allows either an increase or decrease in the costs assumed and this is achieved by entering a positive or negative percentage value. The program displays the £'s equivalent over one rotation for a range of percentage values. It is unlikely that establishment costs will vary by more than 99 per cent in either direction; this is therefore taken as the maximum possible adjustment. Altering these costs for a particular option alters the default cost assumptions taken, because all assumptions are reflected in cash terms. If a cost is likely to be constant between options, then adjusting costs will make no difference to their relative profitabilities. Also as the level of establishment costs varies between options, entering an identical percentage of additional costs does not represent an identical adjustment in cash terms. The cost adjustment facility should not be used to correct for increased revenues. This is because costs are incurred at the beginning of a rotation and revenues are generated towards the end. Equivalent cash values for costs and revenues therefore have different present values.

Revenues are generated primarily by the sale of timber and fuelwood. The program assumes a separate market for each type. The size of the produce determines the price in the timber market according to average price-size curves for each species. Division between markets is decided by optimization of price for a given size and species. Revenues have been calculated for the stem wood harvested and are converted to present values. In mixtures the calculations are made for each species, and for all options, yields and sizes are calculated from Forestry Commission tables. The sale of lop and top for fuelwood may generate extra revenue. The program contains volume data for branchwood and it is assumed that all lop and top is sold into the fuel-wood market if it is profitable to do so.

Grant schemes assist the profitability of the management options. The program only considers the Broadleaved Woodland Grant Scheme (BWGS) and the Forestry Grant Scheme (FGS). Grants of the correct types are selected, including grants for natural regeneration. Management options where grants are not applicable do not allow their inclusion, some management options may or may not be eligible, and the choice of inclusion is at the discretion of the user. Tax registration and the switch from schedule D to schedule B (with a change of ownership) has been calculated for every option where it would be economically favourable and logistically possible. The LEV for schedule B in perpetuity is also calculated and presented. Options that involve gradual felling of an overstorey allow the D/B switch but presents a

warning that revenues and costs are generated at the same time and taxation would probably make the switch unfavourable. Theoretically the switch would increase LEV's because no account of existing woodland is taken. In reality the taxation of felling revenues would reduce profitability.

If the owner is not subject to taxation then the relavent LEV is the one considering schedule 'B' taxation in perpetuity. This figure is not quite accurate as it assumes payment of the 'prairie value'. Refer to Table 1 below and add the relevant number to the final LEV displayed for schedule 'B' in perpetuity. Taking advantage of the D/B tax rate switch can increase profitability quite significantly.

TABLE 2.1

Adjustments to LEV's for schedule 'B' in perpetuity for situations where income is not taxable.

Discount Rate	0%	2%	3%	4%	5%
Add the following values to the LEV for schedule 'B' in perpetuity	R*	50	33	25	20

* For 0% discount rate add £1 for every year of the rotation.

2.3 ASSUMPTIONS TAKEN IN PLANS OF OPERATIONS

High Intensity Management Options

1. Pure conifer options

These assume standard clearfell systems. The possible species in different options are Douglas fir, Corsican pine, Japanese larch and Sitka spruce. Their respective cash flows show timings of operations for medium yield classes. Obviously, higher yield classes have earlier times of first thinning and final felling whilst these occur later in the low yield class. Final fellings occur at or just before the age of maximum mean annual increment. Conifer options assume complete clearance of the site (with the exception of underplanting with western red cedar), and planting at standard Forestry Commission stockings. These options are eligable for FGS grants.

Medium Intensity Management Options

2. Broadleaved and conifer mixtures

The proportion of the area occupied by each species is assumed to be equal, and decisions on timing and intensity of thinnings have been designed to favour the broadleaves which constitute the final crop. Mixtures include oak/Douglas fir and beech/Corsican pine.

The thinning cycle is determined by means of average yield classes over the entire area and the volume contributed by each species is relative to their respective yield classes. The Forestry Grant Scheme applies to these options with the rate determined by the relative areas occupied. The underplanting with western red cedar option, although strictly speaking has conifers and broadleaves growing on the same site, assumes planting of western red cedar under a mature broadleaved canopy. As the conifer matures the neglected overstorey is gradually removed, so that the final crop is pure conifer.

A schedule D/B taxation switch may not be advantageous due to the felling of the overstorey. Any felling revenues are liable to income tax and may outweigh any tax relief on establishment costs. FGS grants are based on pure conifer rates.

3. Pure broadleaved plantations.

Typical silvicultural treatments are assumed for beech and oak. Costs and timings of operations are displayed in the cash flow. Felling ages of broadleaved species are determined by their price size curves. Broadleaved species have a stepped curve and fellings take place when stem diameter reaches the most profitable level. However low yield classes take too long to reach valuable size classes, and it is more profitable to fell slow growing oak when it reaches saw-log dimensions. This is the assumption taken for low yield class oak. Broadleaved plantations are eligable for grants under the BWGS.

Oak/ash/cherry plantation. The proportion of the area planted with each species is assumed to be equal, and management assumptions concerning time and intensity of thinnings favour the oak for the final crop. The cash flow indicates the time of thinning and felling for each species (at medium yield class) but the rotation length is given as that of the oak. The management option that considers a 30 year conversion to oak, ash and cherry plantation, assumes that, for example, small coupes of 1-3 hectares are felled and replanted every 5 years for about 30 years. This is not a group system. LEV's are expressed per hectare for an infinite number of rotations.

Converting to coppice with standards. This option assumes that broadleaved woodland is already present and that it is probably (but not necessarily) of coppice origin. The woodland is (re-)converted to a coppice with standards system. Standards are planted and are therefore even-aged and of known quality. Some stools will die and new ones must be planted in their place and thus planting costs have been included for this. Planting grants may not be applicable due to wide spacings though if many stools die they may be allowed, but only in the first rotation. The grant rates have been adjusted to take account of this. Similarly a D/B switch is only worthwhile for the establishment of first rotation, after the existing woodland is cleared, and this has also been taken into account.

Low Intensity Management Options

4. Coppice options.

Re-coppice neglected oak coppice ('normal' age structure and immediate conversion). It is assumed that no grants are applicable because no planting is carried out. Taxation remains on schedule 'B' as establishment costs are small and so the benefit from a tax switch would be so small as not to be worthwhile. In the normal age structure option it would be logistically very awkward to make such a switch anyway. The normal age structure is achieved by felling $^{1}/_{30}$th of the area each year for 30 years, and LEV's are reduced as a consequence. A normal age structure (equal proportions of different, well spread, age classes of trees) ensures continuous production of wood. The LEV's are calculated on a per hectare basis over the rotation for both of the management options. Immediate conversion assumes all the woodland is cut and coppiced at the beginning of the rotation.

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APPENDIX 1 TIMBER AND FUELWOOD PRICES

All the prices used in this study are 'standing prices', i.e. net of felling, extraction, conversion and transport. Smaller timber is generally sold standing, but sawlogs are more often sold felled and sorted, such ride- or road-side prices would include felling and extraction costs in addition to the standing prices discussed below. All the prices are quoted in £'s of December 1985 value, and have been brought to that level using an inflation factor based on changes in the Retail Price Index. All prices are 'per cubic metre' over-bark and any prices relating to weight have been converted. Three levels of prices are determined corresponding to low, medium and high prices.

1. Coniferous Timber

The prices of coniferous timber are based on published figures of the average prices received by the Forestry Commission for standing coniferous timber. These values are averages for a wide range of species, localities and conditions and consequently are not minimum or maximum values. The mean values were based on the average prices received in England and Wales in the 12 month period ending September 1985. High price values were obtained from published auction data such as the Monmouth sale in the autumn of 1985 and the Ilminster Auction of February 1986. In real terms, prices for coniferous timber were very low in 1981 and 1982. The Forestry Commission average prices for this period, inflated to December 1985 values, were used to represent low prices. The values for each price level were smoothed using non-linear regressions to produce equations to describe the price/size curves. These are shown in Fig. 1.1 and the values presented below.

Mean Volume (m^3)	Low Price £/m^3	Medium Price £/m^3	High Price £/m^3
$\leq$ 0.074	3.2	5.2	6.5
0.074 - 0.124	3.5	6.6	7.6
0.125 - 0.174	4.8	9.0	11.1
0.175 - 0.224	6.0	11.0	14.0
0.225 - 0.274	7.2	12.7	16.5
0.275 - 0.424	9.3	15.6	20.4
0.425 - 0.499	11.4	17.8	23.3
0.500 - 0.599	12.8	19.7	25.3
0.600 - 0.699	14.2	21.2	26.7
0.700 - 0.799	15.3	22.8	27.8
0.800 - 0.899	16.2	24.2	28.1
0.900 - 0.999	16.8	25.3	29.1
$\geq$ 1.000	17.0	26.0	31.3

2. Broadleaved Timber

Information on the prices of broadleaved timber are extremely scarce. It was decided to base prices on the experimental price size curves produced by Mike Garforth of the Forestry Commission which were used for the broadleaved policy review and consultation papers. These presented four price curves, representing low and high prices each with two levels of poor and good out-turn of products, for oak, beech, sycamore and ash. These values were expressed in pounds per cubic metre in 1983 and for this study they were inflated to December 1985 values using inflation factors. Recently updated

price/size curves for 1986/87 have been received and comparison of these with the inflated values used in this study showed very close similarities. For this study only three price levels were used: low, medium and high. The high price was selected as the high price/good out-turn curve whilst the low was either low price/good out-turn or low price/poor out-turn, this depending on which curve appeared generally the most appropriate. Medium prices were subsequently calculated as the mean between these two levels. Although the out-turn of products is not directly considered in these three curves, for a selected productivity level such an affect can be considered by using different price levels. The price/size relationships for oak, beech, ash and sycamore are presented below.

Price Level	Diameter Breast Height (cm) 12	12-17	18-23	24-29	30-35	36-41	42-47	48-59	60
a. Oak	£/m^3 standing								
Low	0	5.1	8.4	10.1	14.6	24.8	38.3	41.2	44.0
Medium	1.1	6.8	12.4	16.3	34.3	50.1	63.1	66.5	69.9
High	2.3	8.4	16.3	22.5	54.0	75.4	87.8	91.8	95.7
b. Beech									
Low	0	6.7	8.4	10.1	18.0	31.5	36.0	36.0	36.0
Medium	1.1	9.0	12.1	14.6	27.0	43.9	47.3	47.3	47.3
High	2.3	11.3	15.8	19.1	36.0	56.3	58.5	58.5	58.5
c. Sycamore									
Low	0	2.3	5.6	7.9	12.4	18.0	28.1	34.9	41.6
Medium	0	6.8	10.7	15.8	27.0	42.8	61.3	72.0	82.7
High	0	11.3	15.8	23.6	41.6	67.5	94.5	109.1	123.8
d. Ash									
Low	0	6.8	9.0	12.4	20.3	37.1	50.6	51.8	52.9
Medium	4.5	10.2	13.0	19.2	31.6	52.3	67.5	69.5	71.5
High	9.0	13.5	16.9	25.9	42.8	67.5	84.4	87.2	90.0

Good prices for cherry timber were obtained from Pryor (1985) with low and medium prices assumed to be similar to ash. The prices used for the high level are given below.

dbh (cm)	10	12	14	16	18	20	22	24	26	28	30	32	34/43	45
Cherry (high)	2	5	8	13	15	17	19	20	23	26	30	40	51/72	80

3. Fuelwood

Different values are used for roundwood and chipped fuel. Roundwood fuel prices are derived from those encountered in the domestic fuelwood market. Although many prices were at ride-side, road-side or delivered to the consumer the costs of felling, extraction, and any processing costs (e.g. cross cutting and splitting) were deducted to arrive at equivalent standing prices. The low and medium prices for roundwood fuel are the normal range if it were sold standing, whereas if it is sold at the roadside all three levels (net of felling and extraction costs) are possible. Fuelwood delivered to customers should be able to command the medium and high prices depending on distance and strength of demand.

The prices for chipped wood, appropriate mainly for the branchwood in this study, were calculated from comparative industrial prices of coal to represent those prices that may be expected for industrial fuelwood. Coal at £55/tonne with an energy content of 27.2 GJ/tonne was considered, with dry wood having an 'effective' calorific value of 17.5 GJ/dry tonne. Assuming 20 per cent 'value added' this corresponds to a fuelwood value of £28.3/dry tonne. The standing price per cubic metre is affected by wood density (e.g. softwood or hardwood), harvesting and transportation costs. A range of costs were considered for different woodland types and ages and the maximum price was found to be about £10/m^3. Prices could also frequently be negative but a zero value was used as minimum to suggest that fuelwood for industrial markets was not worth harvesting if prices are low. The three price levels for roundwood and chipped fuel are presented below.

Fuel Type	Price Level (£/m^3) Low	Medium	High
Chipped	0	5	10
Roundwood/logs	2	9	16