SILSOE COLLEGE

CRANFIELD UNIVERSITY

THE ECONOMICS OF SUSTAINABLE HEDGE CUTTING

Report to the Devon Hedge Group

Funding partners:

English Nature
Countryside Commission
Devon County Council, Environment Department
Exmoor National Park

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The economics of different hedge cutting practices: A report by Silsoe College for the Devon Hedge Group.

Independent summary

1. Most hedges in Britain are now cut every year. This means that trees and shrubs in them produce very few flowers, berries or nuts - important foods for many of our butterflies, birds and mammals. Close-cut hedges also support fewer nesting birds. Cutting every year may also reduce the diversity of woody plants, and decrease the life span of hedges through speeding up gap development. Many consider the predominance of close-cut hedges within the landscape to be unattractive.

2. The Devon Hedge Group (see notes) has commissioned a report on the economics of hedge cutting, to provide farmers with accurate information on the costs and savings associated with changing to environmentally-friendly practices. The research was done by Silsoe College, an independent body with a good track record on hedge research. English Nature, the Countryside Commission, Devon County Council and Exmoor National Park provided the funding, with advice from the Devon Farming and Wildlife Advisory Group.

3. The report compares the costs of cutting hedges every year with those for the following environmentally-friendly practices:

   - Raising the height of cutting by 75mm (3 in) every year
   - Cutting both top and sides once every three years
   - Cutting the sides every year and the top once every three years
   - Leaving hedgerow trees to grow up every 50m (54 yd)

4. If labour and machinery costs are considered, although the first option is 50% more expensive than cutting every year, the second one is *59% less expensive* and the third *19% less*. Leaving hedgerow trees increases the cost by 17%. These costs apply to both typical Devon hedgebanks and Midland hedges, cut to the now traditional square profile with a flail mower. The calculations were based on hedges containing slow growing shrubs such as hawthorn and hazel: the costs of cutting three years' growth of fast growing species like ash, willow or sycamore are greater, but still show considerable savings.

5. The study also looked at the additional costs of reduced crop yield on adjacent land through increased shading and land loss due to hedges becoming taller and thicker. (Financial gains from increased shelter to stock and crops were considered insignificant, as were losses from any increase in weeds or pests in nearby fields.) Four representative types of farm were considered:

   - A 65ha (160 acre) dairy farm typical of the Culm Measures of northern Devon
   - A 46ha (114 acre) beef cattle and sheep farm typical of Exmoor
   - A 78ha (192 acre) arable farm typical of the Devon Redlands or south Devon
   - A 116ha (287 acre) arable farm typical of the English Midlands

6. Raising the height of cutting each year still proves an expensive option, with increased costs of about 50% for the three Devon farm types and 185% for the Midlands farm. Cutting the sides every year and top once every three years is the most economic option for the Devon dairy and arable farms, with increases of 11% and 29% respectively over the costs of cutting every year. But with the Devon beef and sheep farm, cutting the whole hedge every three years is most economic, with *savings of 15%*. On the Midlands farm there is not much to choose between cutting the whole hedge or only the top every three years, with increased costs over cutting every year of just 10% and 8% respectively. Leaving hedgerow trees results in increased costs of 17 - 20% for the Devon farms and 44% for the Midlands one.

7. Costs increase rapidly with speed of hedge growth: fast growing hedges occupy more land and cast more shade, and the thicker growth takes longer to cut. *The Devon dairy and arable farm models assume moderate to fast-growing hedges: if they have slow-growing ones then even taking into account loss of yield it would still make economic sense to cut once only every three years.*

8. Where fields are under setaside or have conservation headlands loss of yield is not relevant, and cutting once every three years will always result in large savings.

9. The Silsoe report concludes with a cost effectiveness analysis which subjectively balances the cost of each hedge management practice against the environmental gains for wildlife, landscape and amenity. This analysis strongly suggests *that for all four types of farm examined cutting hedges on a three-year cycle leads to environmental gains that far outweigh any increased costs.* This is especially true if hedgerow trees are encouraged.

10. **To conclude, the research shows, for Devon and Midland farms, that:**

- **If labour and machinery costs alone are considered, cutting hedges once every three years results in considerable economic savings for all major farm types in comparison to cutting every year.**
- **If crop yield losses are also allowed for, cutting once every three years still results in savings for Devon hedgebanks provided the hedges contain mainly slow-growing species such as hawthorn, hazel or oak. For Midland hawthorn hedges, costs increase by 8 - 10%.**
- **If hedges contain fast-growing species like ash, sycamore or willow then with reduction in crop yields, leaving them to grow up and out for three years before cutting increases costs by 10 - 30 %.**
- **Where gross margins are large, as with arable and dairy farms, cutting the sides of hedges every year but the tops on a three-year cycle is most cost effective option. Otherwise, cutting the whole hedge once every three years is cheaper.**
- **Leaving hedgerow trees has major environmental benefits but increases costs by about 20% for Devon hedgebanks and 44% for Midland hedges.**

Notes

1. The Devon Hedge Group is a forum of organisations and individuals interested in the conservation and management of hedges. It was formed in 1994 and includes among its members farmers and their representatives, nature conservation organisations, archaeologists and local authorities.

2. The Group is interested in promoting good, sustainable hedge management. In response to public concern, it pays particular attention to hedge cutting, with the aim of offering advice to farmers and other land managers on best practice. The Group supports the provision of financial incentives to help farmers manage their hedges.

3. Silsoe's report *The economics of sustainable hedge cutting* was submitted to the Hedge Group in March 1995. The Group wishes to distribute the results widely, and plans to launch the report on 1 May. Copies of the report are available from English Nature, 37 North Street, Okehampton, Devon, or from The Environment Department, Devon County Council, County Hall, Topsham Road, Exeter, Devon.

Robert Wolton
Chairman - Devon Hedge Group

ABSTRACT

The Devon region currently retains one of the highest concentrations of hedges in the country. However, the Devon Hedge Group believes that the present hedge management of repeated annual flailing has a detrimental effect on the wildlife value, longevity and integrity of these hedgerows. To counteract this decline, a number of alternative management methods that would produce sustainable hedgerows were proposed. These were defined as:

- *incremental growth*: raising the height of the cut each year to a maximum height of 4 m;
- *tree*: incorporating trees into the hedgerow every 50 m;
- *3 and 1*: allowing the top of the hedge to grow up and be cut every 3 years but continuing to trim the sides of the hedge annually; and
- *3 year*: letting the entire hedge grow for three years before being cut back to its original size.

This study set out to identify the economic implications associated with these alternative systems. Two main areas of financial impact on farmers were identified:

- the labour and machinery costs of hedge management; and
- the effect on land use and productivity in the adjacent field

Hedge management costs varied depending on the size of the hedge, the frequency of cut, the growth rate of the hedge, and the presence of obstacles to cutting such as trees. The hedge also affects shade, shelter, land loss and weed and pest incidence on the adjacent field. These in turn influence crop yields, stocking rates and the financial performance of farming activities. Generally the larger the hedge the greater the losses incurred by farmers.

The costs borne by individual farms when changing their hedge management system will vary depending on the individual characteristics of the farm. Factors such as size, composition and growth rate of the existing hedge, field size and the type and intensity of the main enterprises on the farm will all affect the final cost.

EXECUTIVE SUMMARY

The Devon Hedge Group believes that the repeated annual flailing of hedges has a detrimental effect on the wildlife value, longevity and integrity of hedgerows in the Devon area. To counteract this decline, associated with the so called 'standard' hedge, a number of alternative management methods that would produce sustainable hedgerows were proposed. These were defined as:

- *incremental growth*: raising the height of the cut each year to a maximum height of 4 m;
- *tree*: incorporating trees into the hedgerow every 50 m;
- *3 and 1*: allowing the top of the hedge to grow up and be cut every 3 years but continuing to trim the sides of the hedge annually; and
- *3 year*: letting the entire hedge grow for three years before being cut back to its original size.

This study set out to identify the economic implications for the farmer of the introduction of these alternative management systems. The study drew on previous research work, secondary data and a limited survey of Devon farmers and contractors. Two broad categories of financial impact on farmers were identified:

- the labour and machinery costs of hedge management; and
- the effect on land use and productivity in the adjacent field

With respect to hedgerow management, Table 1 shows the estimated direct costs per 100 m of hedgerow for each of the alternatives, assuming the use of contractors. The costs of farmers undertaking the operations themselves are marginally higher than for contractors, assuming full labour and machinery costs are charged.

Table 1 Annual hedge cutting costs (£ / 100 m)

	Costs (£ / 100 m)				
Management methods	Std	Incremt	Tree	3 and 1	3 Year
No of passes	6	9 (Avg)	6	6	6
% cut / year	100	100	100	100/33	33
Contractor	£6.40	£9.60	£7.47	£5.18	£2.64
Index (Std hedge = 100)	100	150	117	81	41

As seen from Table 1 the annual cost of cutting a hedge once every three years is less than half the cost of cutting the same size of hedge every year.

With respect to the effect on productivity, the configuration of the hedge influences shade, shelter, land loss and weed and pest incidence. These in turn influence crop yields, stocking rates and the financial performance of farming activities in areas adjacent to the hedge. Generally the larger the hedge the greater the losses incurred by farmers.

Table 2 combines hedge management costs and the productivity impacts to give total annual recurrent costs per 100 m incurred by farmers for different hedge management systems, assuming the hedges are cut by contractor. The dairy farm has an average hedge growth rate of 0.5 m per year, the cattle and sheep farm and the midlands farm have a slow growing hedge, 0.2 m per year, and the arable farm has hedges with a fast growth rate of 1 m per year.

Table 2: Summary of recurrent annual costs of hedge management systems per 100 m for farmers using contractors

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Dairy					
Hedge system costs per 100 m	£28.55	£43.39	£33.50	£31.78	£36.43
Index	100	152	117	111	128
Cattle & sheep					
Hedge system costs per 100 m	£14.11	£21.30	£16.74	£13.59	£11.96
Index	100	151	119	96	85
Arable					
Hedge system costs per 100 m	£20.55	£30.99	£24.71	£26.42	£31.22
Index	100	151	120	129	152
Midlands					
Hedge system costs per 100 m	£8.40	£23.91	£12.13	£9.07	£9.21
Index	100	285	144	108	110

The costs borne by individual farms when changing from a standard hedge system will vary from those above depending on the individual characteristics of the farm. Factors such as size, composition and growth rate of the existing hedge, field size and the type and intensity of the main enterprises on the farm will all affect the final cost. However, the following points may be summarised from the analysis;

- In general, due to the large hedge size, the incremental growth system is the most expensive option independent of farm type and hedge growth rate.

- Where the hedge has a slow growth rate, the 3 and 1, and the 3 yearly systems have a lower annual cost than the standard Devon hedge.

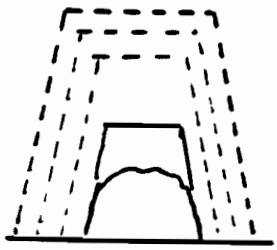
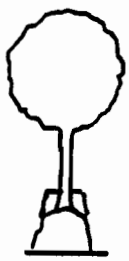
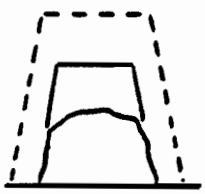
- If the hedge has a fast growth rate, and is managed using either the 3 and 1, or the 3 yearly system, the losses in the gross margin dominate the hedge cutting costs and result in higher annual costs.

- The effect on contractors' income is relatively small at ± 5 % over the range of management systems assuming no other work is displaced or taken on.

The preceding analysis examined the cost of delivering different types of hedgerow. These differ in terms of their environmental attributes, with respect to habitat, food production for wildlife, and landscape and amenity. Figure 1 shows the visual appearance of the systems and scores the systems against these environmental criteria. The cost effectiveness ratio of the alternative systems in terms of delivering environmental benefit is apparent. The tree and 3 & 1 combination is particularly efficient. It is recognised that this approach is coarse and subjective. It does, however, emphasise the link between the environmental objectives and the costs of meeting those objectives.

In conclusion, the study identifies the costs to farmers of alternative hedgerow management strategies, and the incremental costs associated with a change towards preferred, environmentally sensitive options. It indicates the type of incentives that may be necessary to encourage farmer adoption of preferred practices. The study also indicates in broad terms the cost effectiveness ratio of alternative hedgerow management systems in terms of achieving environmental enhancement.

Figure 1. Summary of Hedgerow Characteristics

Hedge type	Environmental benefits and scores	habitat	food	landscape	total	Costs/ 100 m (dairy)	Cost/unit envirnmtl benefit
Standard 	possibly very few if annual flailing continues	1	1	1	3	£28.65	£9.52
Incremental 	Stops callus development, increased habitat area	3	1	3	7	£43.39	£6.20
Tree 	Good habitat and landscape features	4	3	4	11	£33.50	£.3.05
3 and 1 	Some winter food production, increased hedge height preferred by song birds	3	3	2	8	£31.78	£3.97
3 Year 	Maximum winter food production, low cutting costs and increased habitat area	4	4	2	10	£36.43	£3.64
Tree and 3 and 1	as above	5	4	5	14	£35.65	£2.55

1. INTRODUCTION

The Devon Hedge Group initiated this report on the understanding that modern hedge cutting practices, especially annual machine flailing, have a detrimental effect on the hedgerow. This is shown by a reduction in the vigour of a number of hedgerow species in mixed hedges and the mop-headed and gappy appearance of many others. This annual trimming also reduces the establishment of hedgerow trees, and the wildlife value of the hedgerow, both in terms of the habitat and winter food production.

It was therefore suggested that the management of the hedgerow needs to be altered in favour of management systems that will enhance and sustain the vigour and integrity of hedgerows as an important element of the rural environment.

1.1 Objectives

The overall objective of this project is to provide an analysis of the economic costs and benefits associated with the introduction of hedge management which will result in sustainable hedge systems in the Devon region.

This analysis was carried with regard to the following groups;

- farmers who use their own cutting equipment;
- farmers who hire contractors to cut hedges; and
- hedge cutting contractors.

1.2 Methodology

A meeting was held with Devon Hedgerow Group to outline the current and preferred management practices in the Devon region. Literature was reviewed to identify the features and characteristics of hedgerows that would be affected by a change in management and therefore had potential cost and benefit implications for farmers.

A telephone survey covering seven farmers and five contractors was carried out, which, in conjunction with five farm visits, gave information specific to the Devon area. The interviewees were randomly selected from the yellow pages and from a list provided by the Devon Hedge Group.

The costs of selected alternative hedge management practices were calculated from first principles and observations of local practice. Estimates were drawn regarding the impact of sustainable hedge management practices on cropped area, yields and regular farm labour requirements.

Costs and benefits of the current hedge management were compared with the alternative hedge management systems. The analysis was conducted using four farm models, three relevant to Devon: a 65 ha dairy farm representative of the Culm Measures; a 46 ha cattle and sheep farm typical of Exmoor; and a 78 ha arable farm reflecting the Devon Redland or South Devon areas, and the forth a typical Midlands arable farm of 116 ha. Estimates of the costs per 100 m of hedgerow were derived for the different hedge management systems.

2. HEDGEROW FEATURES AND CHARACTERISTICS

2.1 Features

The Devon hedgerow varies in its composition and form between areas of Devon and between farms within those areas. However, a fairly universal feature of field boundaries is the positioning of the hedge on the top of an earth bank. The composition of the hedge varies from virtual monoculture of beech in some of the upland areas, to highly mixed hedges in many parts of the county. A fence is also included on a number of field boundaries, normally in stocked fields, and in some cases a ditch or grass margin is also incorporated. Trees have been allowed to establish on a number of farms.

Bank and hedge sizes also vary considerably between farms; the main reasons being local practice and the traditional management of the farm. Obviously the type of field boundary that exists on a particular farm will effect the costs of any change of practice. However, for the purposes of this analysis, on the basis of the survey findings, the hedgerow size of a typical Devon farm is taken as 2.2 m high (hedge plus bank) and 2.3 m wide at the base.

2.2 Economic implications

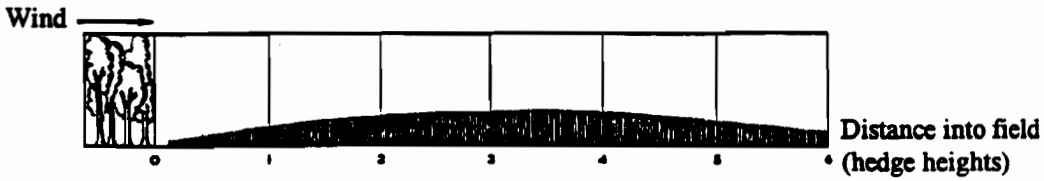
There are a number of the hedgerow features which have been identified as having potential economic implications for the type of management system used (Semple, Bishop and Morris, 1994). These features are listed below.

2.2.1 Shelter

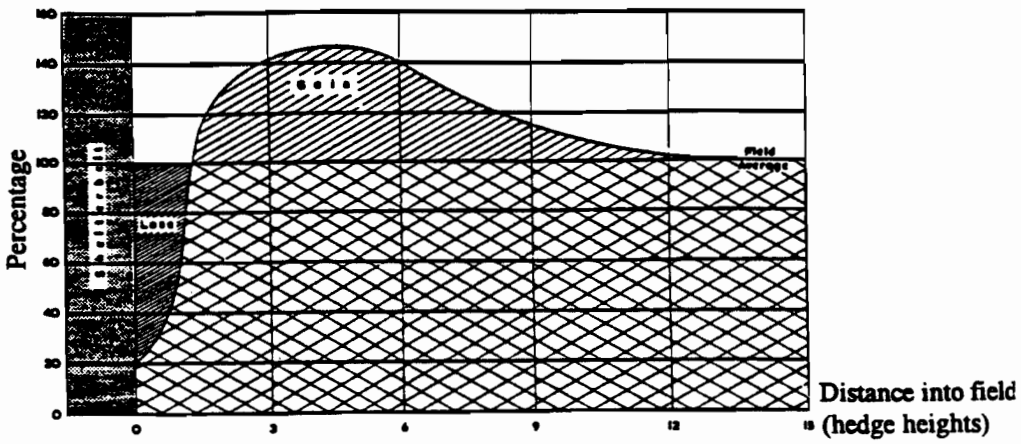
The main reason cited for retaining non-stock proof hedges on farms, apart from tradition, is the shelter benefit that the hedge provides. As a windbreak, a semi-permeable structure such as a hedge is often more beneficial than a solid barrier; it slows the airflow down but does not create adverse turbulence.

This reduction in air speed has been shown to have an effect on crop yield (Caborn, 1965 and Wadsworth, 1964). Figure 2.1 demonstrates the overall benefit in having a windbreak at the crop edge. These results are confirmed by the work of Jensen (1961) and by Hurst and Rumney (1971).

Figure 2.1: The effect on crop yield protected by a windbreak



Diagramatic cross section through shelterbelt and corn crop



Percentage loss or gain in crop growth

Source: Caborn (1965)

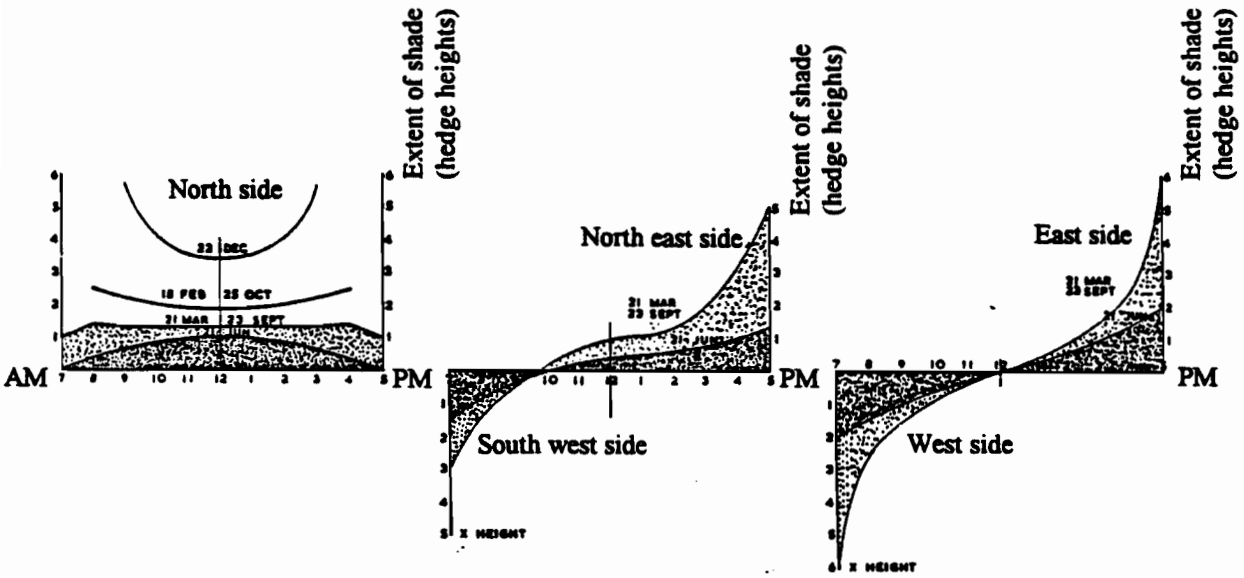
It is also claimed that livestock derive benefits from the shelter effect provided by hedges. Investigations into the environmental stress on exposed sheep and cattle indicated that heat production by animals rose by 30%: unsheltered stock required more energy from feed for maintenance (Blaxter, 1964). Reports of increased yield in dairy cattle and weight gain in beef herds are also cited as a benefit of shelter (Caborn, 1965), as well as a reduction in the incidence of toxaemia in sheep.

However, as the in-wintering of beef and dairy stock is common agricultural practice, the benefit of additional shelter over the winter period is limited. Indeed some research shows derogatory effects in terms of slight reduction in winter hardiness of new born lambs (Grace, 1985).

2.2.2 Shade

The shading effect of a hedge depends on the height and the orientation of the hedge and the incidence angle of the sunlight. The length of shadow produced by a hedge positioned in three orientations is shown in Figure 2.2.

Figure 2.2: Shading effect by hedge orientation



(a) (b) (c)

Guide to the shading effect of windbreaks running (a) from East to West, (b) from North-West to South-East, and (c) from North to South. Shadow lengths expressed in multiples of windbreak height, H.

Source: Caborn (1965)

From the figure it can be seen that the shading effect is concentrated around one hedge height distance from the hedge. This shading of field plants adversely effects the growth rate and yields in this area (Caborn, 1965).

The transpiration rate of the crop and ground may also be reduced. Depending on the prevailing climatic conditions, the speed of harvest and timeliness of field operations are adversely affected.

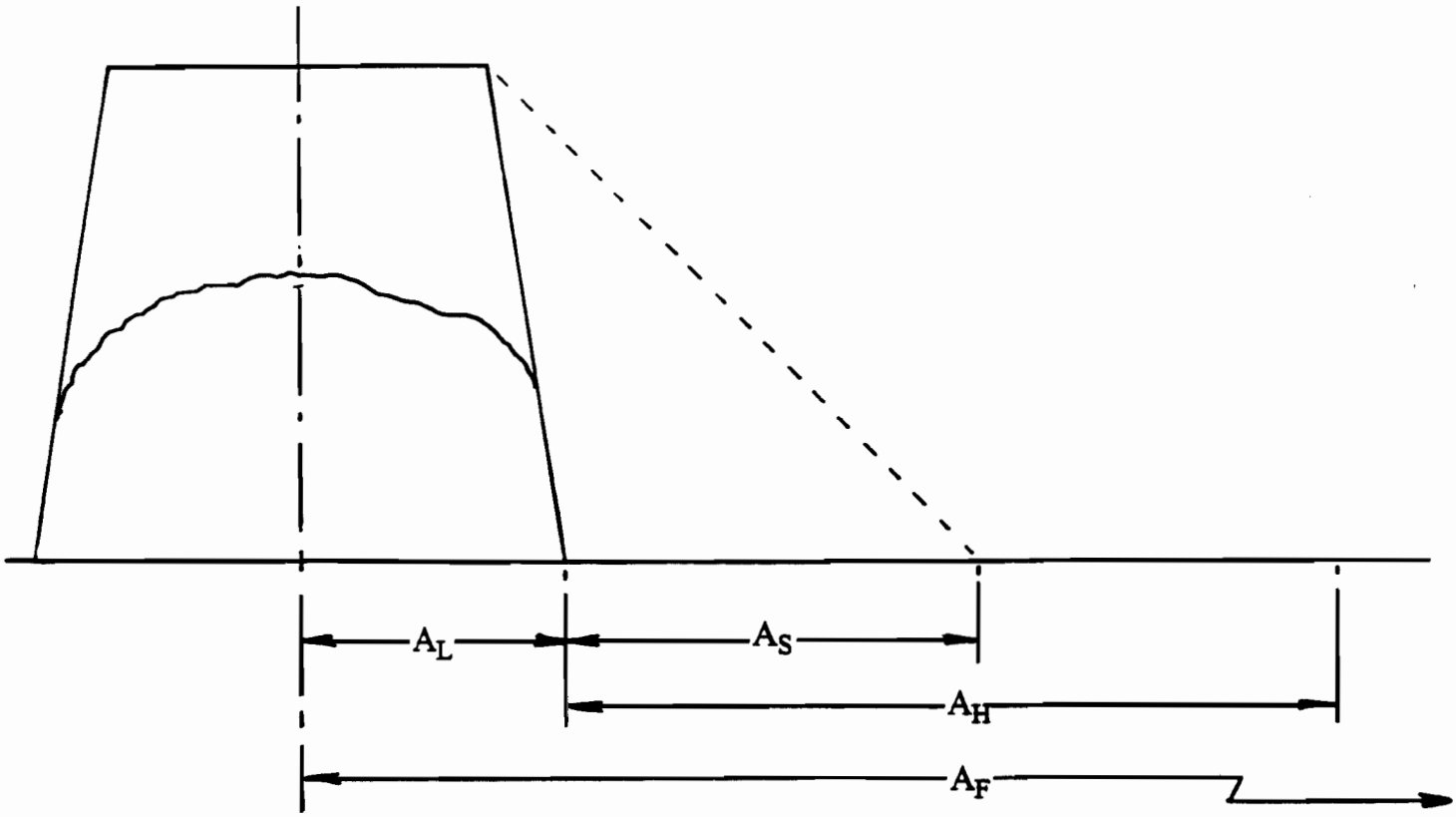
2.2.3 Aggregation of shelter and shade effects

The beneficial effects of shelter only relate to hedges lying in the direction of the prevailing wind whereas the shade effects are relevant to hedges oriented in easterly, southerly and westerly directions. Thus the shade effects have dominated the assumption that there is 50% reduction in yield in the area shaded by a hedge (one hedge height distance from the hedge) or a 50% reduction in stocking rates in shaded areas. For the most part land adjacent to the hedge constitutes a headland which is often compacted by animals or turning machinery. Yields on headlands are observed to be less than elsewhere in the field. Thus the shelter and shade effect on the headland have a lower impact. A headland of 5 m is assumed on the field margin in which the yield is 85% of the nominal field level. Figure 2.3 and the formulae below indicate how these various features along with land loss have been calculated.

2.2.4 Land loss

The land lost to agricultural production due to a change in hedgerow management is a function of any increase in the width of the hedge. It can be expressed as a constant per 100 m length of hedgerow. The linear extent of hedgerows on a farm is affected by the number, size and shape of the fields, and the percentage of field boundaries that are enclosed by hedgerows. Details of the boundary length calculation are shown in Appendix 1.

Figure 2.3: Calculations for land loss and shade effects



$$GM = GM_N [A_F - A_L - A_H] + GM_H [A_H - A_S] + GM_S [A_S]$$

GM = farm gross margin
GM_N = nominal gross margin
GM_H = gross margin on headland
GM_S = gross margin under shade
A_F = area of field
A_L = area of land loss
A_H = area of headland
A_S = area of increased shade

The gross margin is taken as the value of the crop output less the direct variable costs such as seed and fertilizer.

2.2.5 Farm labour and machinery costs

Labour and machinery requirements for field operations fall (rise) in proportion to the loss (increase) of cropped land. In some cases, a change in labour requirements may be accommodated by a change in overtime; in others, it could change the loading of existing regular labour force without a change in the labour costs. For the analysis, changes in labour requirements have been valued at the standard hourly wage rate (£4.74).

In a similar context, changes in the cropped area could lead to changes in machinery operating costs such as fuel and repairs. It is unlikely that machinery inventories will be affected; hence machinery ownership costs such as depreciation are not likely to change. For the purpose of this analysis, average machinery running costs have been estimated at £75 / ha for cereals, £150 / ha for root crops and £31.25 / ha for grassland (Nix, 1994).

2.2.6 Hedgerow trees

Where trees are included in the hedgerow they will affect the speed of the cutting operation and the shading on the field. For the purpose of the analysis it has been estimated (from flail operator estimates) that it will take one minute to manoeuvre round the tree on each pass in which the tree is encountered, and the effective shading area of a tree is 10 m by 5 m from estimations of average tree growth.

2.2.7 Growth rates

The growth rate of the hedge depends on the plant species and the area in which it grows. The rate of growth will effect the area of shading and the forward speed of the tractor when the hedge is cut. To accommodate the range of growth rates reported in the county three rates are used in the analysis; 0.2 m, 0.5 m, and 1 m per annum. These figures reflect the increase in effective shadow and not the yearly growth in the hedge itself.

2.2.8 Soil compaction

One consequence of increasing the height of a hedge is to increase the number of passes required by a tractor and flail in order to cut it. The average hedge requires six passes of a flail mower to trim it, but if the hedge is allowed to increase in size to the maximum reach of the flail it would require twelve passes. This increased traffic on the field margin is not likely to have any effect on soil compaction as long as the bearing capacity of the soil is greater than the load produced by the cutting unit (Smith et al, 1989). This is the case for undisturbed soil in a reasonably dry condition which is usual during hedge cutting operations. Hence it has been assumed that there is no additional soil compaction effect on yield.

2.2.9 Weeds and pests

Although the hedge is generally thought to be a harbour for weeds and pests, relatively few of the field edge plant species are potential weeds (Marshall, 1986). There are some exceptions and species such as *Bromus sterilis* are capable of invading fields. Where weeds are allowed to spread into the field unchecked, yield losses in the order of 5% to 10% have been recorded (Boatman and Sotherton, 1988). However, normally some weed control is exercised and so it has been assumed in the analysis that weeds and pests have no impact on yields

2.3 Summary of hedgerow characteristics

The assumptions drawn from this section regarding the economic cost and benefit effects of selected hedgerow characteristics are summarised in Figure 2.4. These fall into two categories, distinguishing between those effects which have an impact on gross margins (through altering the area cropped or yields) and those influencing costs which are conventionally called 'farm fixed costs' (especially labour and machinery).

The impact on gross margins and fixed costs in relation to field operations would be borne by the farmer regardless of who was undertaking the hedge cutting. The impact of fixed costs associated with hedgerow management would affect only the person undertaking the hedge cutting, namely either the farmer or contractor.

Figure 2.4: Summary of hedgerow characteristics

1. **Impact on gross margin**	**Assumptions**
(i) Area cropped	
Land loss due to hedge type	area loss valued in terms of loss of gross margin
(ii) Yields	
shade and shelter, hedgerow trees, and growth rates	50% reduction in yield in area shaded and sheltered by the hedge (one hedge height distance from the hedge). For fields with livestock, 50% reduction in stocking rate in shaded areas. Yield of headland is 85% of normal field yield.
soil compaction	nil
weeds and pests	nil
2. Impact on fixed costs	
(i) Labour	
field operations	proportional to change in cropped area
hedgerow management	proportional to frequency of cut, number of passes and hedge growth rate.
(ii) Machinery	
field operations	proportional to change in cropped area
hedgerow management	proportional to frequency of cut, number of passes and hedge growth rate.

3. HEDGEROW MANAGEMENT

This section summarises the hedge cutting costs associated with different management practices. The full data and calculations are presented in Appendix 2.

3.1 Current Situation

From the farm surveys and Devon Hedgerow Group, it was found that the normal form of hedge maintenance is annual cutting using a tractor mounted flail. The reasons given for this annual cutting were the perceived need for a tidy appearance, traditional practice, control of bramble encroachment, visibility and access (roadside). A number of farmers did lay or coppice some of their hedgerows especially in areas of poor access due to slope and/or soil wetness.

Thus the 'standard' hedge in the Devon region has the following features; 2.2 m high (including the bank) and 2.3 m wide, and is cut annually requiring six passes of a normal flail cutter, four on the sides and two on the top of the hedge.

A comparison has also been drawn with a typical Midlands farm. In this area the 'standard' hedge is much smaller (1 m high by 0.75 m wide) and is planted at field level. It is cut annually and requires three passes of a normal flail, one on each side and one on the top.

3.2 Proposed Management

The main management methods proposed by the Devon Hedge Group to promote sustainable hedge systems are:

- raising the height of the cut each year (referred to as 'Incremt', in the model);

- incorporating trees into the hedge every 50 m (referred to as 'Tree');

- cutting the sides of the hedge annually and the top of the hedge every three years ('3 and 1'); and

- cutting the hedge once every two to three years ('3 Year').

The implications of these methods with reference to the standard hedge ('Std') are shown diagramatically in Figure 3.1.

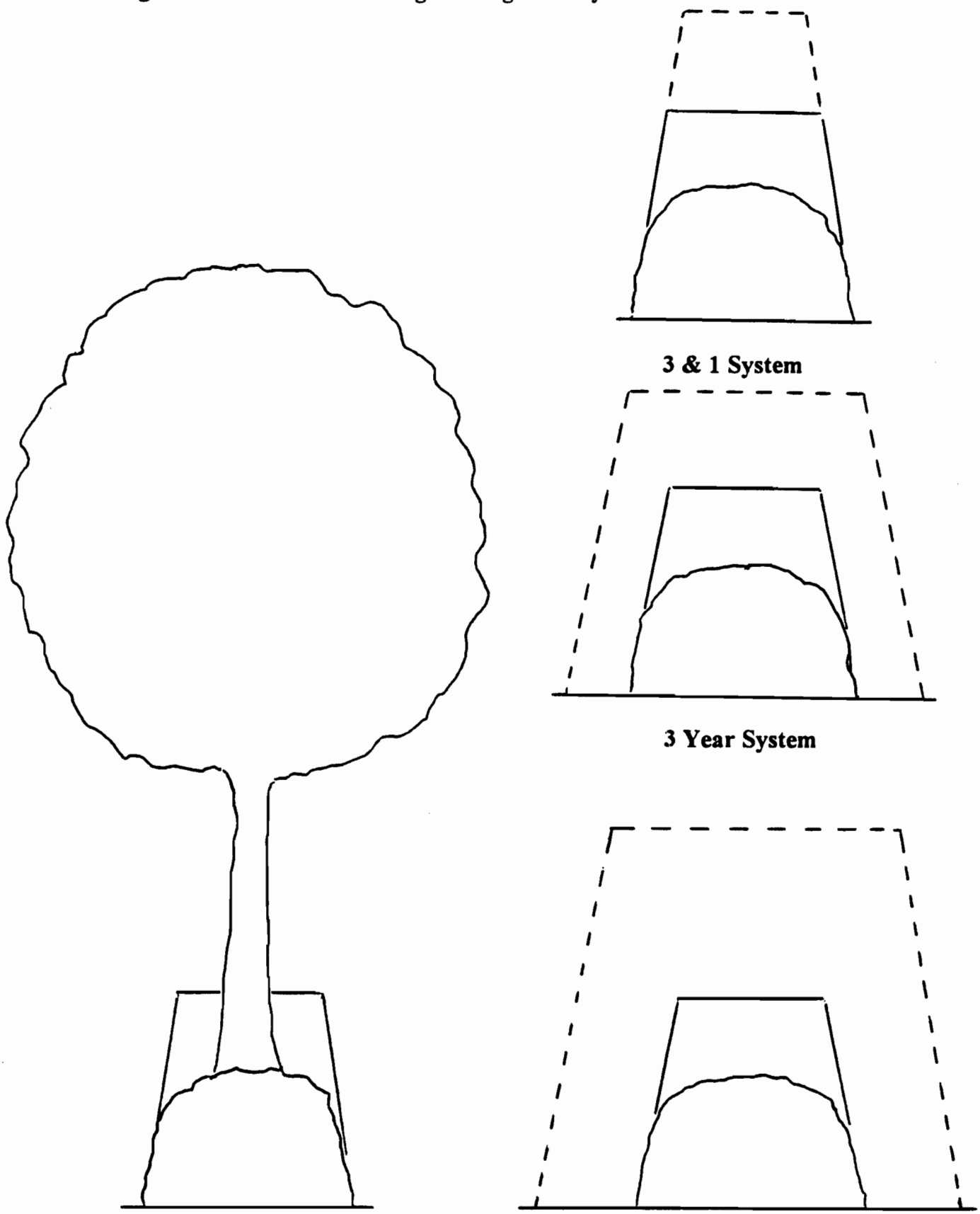
3.2.1 Incremental Growth

Raising the height of the cut each year would stop the hedge plants being successively cut at the same point which seems to cause callus development in some species. The size of the hedge would be allowed to increase in increments of 75 mm, to the maximum height of the flail trimmer. This height varies between manufacturer and model of the machine but the average maximum horizontal cut is 4 m. This means the hedge would take a period of 24 years to reach its maximum size at which time it may be coppiced or laid and the incremental growth cycle restarted. The current costs for laying and coppicing are £200 - £400 and £50 - £100 per 100 m respectively excluding grant aid. When these costs are amortised at 6% over the 24 year period they are equivalent to £16 - £32 and £4 - £8 per 100 m per annum.

3.2.2 Incorporating Hedgerow Trees

For this management method trees are planted or allowed to establish at an average spacing of 50 m within the hedgerow. In the analysis it is assumed that the hedge below the trees would be maintained at the same size as the standard hedge and cut on an annual basis. The trees would only affect the speed of cutting on the top of the hedge, with an average delay of one minute each time a tree is encountered.

Figure 3.1 Alternative hedge management systems



3.2.3 Three and One

In this hedge system the sides of the hedge would be cut annually but the top of the hedge would be left to grow for three years between cuts. Normally this cut would be done in rotation on the farm, so that one third of the farm hedgerows would be cut on the top each year. By spreading the cutting in this way the costs and labour requirements are evenly distributed, and a variety of habitats and food sources are left intact. In the analysis the cutting rate of three year old wood is normally taken as 20% slower than that of one year old wood. This equates to the reduction in forward speed achieved by the selection of the next lower gear on the tractor.

3.2.4 Three Yearly Cut

For this type of management the whole hedge is allowed to grow and is cut every three years, back to its original 'standard' size. Again, this would normally be done in rotation so that only one third of the farm hedgerow is cut each year, for the reasons given above.

3.3 Hedgerow management costs

The relative costs of the different types of hedgerow management proposed are given in Tables 3.1 and 3.2. These show the average annual cost for each 100 m of hedgerow. The index expresses the total cost of hedge cutting for each proposed management method in comparison to the standard hedge costs.

Hedgerow management costs per 100 metres of hedgerow vary depending on whether a farmer uses his own machinery and labour, or hires a contractor. From the total cost figures the contractor offers the cheapest option for all the management variants. However, if the farmer already owns the equipment and the labour is available, the extra cost incurred in cutting the hedges is shown by the variable cost fraction.

Table 3.1 Hedge cutting costs for the Devon region (£ / 100 m)

Management methods	Costs (£ / 100 m) Std	Incremt	Tree	3 and 1	3 Year
No of passes	6	9 (Avg)	6	6	6
% cut / year	100	100	100	100/33	33
Own labour & machinery					
Variable	£2.11	£3.17	£2.46	£1.70	£0.87
Fixed	£6.01	£9.01	£7.01	£4.85	£2.48
Total farmers costs	£8.12	£12.18	£9.47	£6.55	£3.35
Contractor	£6.40	£9.60	£7.47	£5.18	£2.64
Index (Std hedge = 100)	100	150	117	81	41

Table 3.2 Hedge cutting costs for the Midland region (£ / 100 m)

Management methods	Costs (£ / 100 m) Std	Incremt	Tree	3 and 1	3 Year
No of passes	3	7.5 (Avg)	3	3	3
% cut / year	100	100	100	100/33	33
Own labour & machinery					
Variable	£1.06	£2.64	£1.23	£0.85	£0.43
Fixed	£3.00	£7.51	£3.51	£2.41	£1.24
Total farmers costs	£4.06	£10.15	£4.74	£3.26	£1.67
Contractor	£3.20	£8.00	£3.73	£2.57	£1.32
Index (Std hedge = 100)	100	250	117	81	41

As can be seen from Tables 3.1 and 3.2 the most expensive operation is the incremental growth system. This is due to the size of the hedge and hence, the increased number of passes required to trim it. The cost of any additional management such as coppicing or laying is not included in the annual costs since this is dependent upon individual management practices and would only be incurred once in the 24 year growth period.

The lowest cost option is that of cutting once every three years. Although the cutting speed is slower than annual cutting due to the increased thickness and length of the hedge material, only one third of the length of hedgerow is cut each year, giving rise to the obvious saving. However, this method does have implications for shading and land loss, as detailed in Chapter 4.

3.4 Growth rate of hedges

As described in Chapter 2 a range of growth rates were reported in the Devon area, and for the analysis the rates used were 0.2, 0.5, and 1 metre per annum. Where annual cutting is employed in the management the rate of growth would have little effect on the speed of the cutting operation, although flails may leave a more uneven cut on the faster growing hedges. However, if the hedge is three years old when cut, it would be expected that the fastest growing hedges would have a greater effect on the speed of operation compared to slow and normal rates of growth. This is reflected in the analysis with operational speeds reduced by 20% for slow and normal growth rates, and reduced by 40% for fast growth rates. The effect of the growth rate on the cutting costs is shown in Table 3.3.

Table 3.3: Effect of growth rate on cutting costs of Devon hedge

	Costs (£ / 100 m)					
Management	Standard	Standard	3 and 1	3 and 1	3 Year	3 Year
Growth rate	slow / normal	fast	slow / normal	fast	slow / normal	fast
Annual cost	£8.12	£8.12	£6.55	£6.92	£3.35	£4.47
Index	100	100	81	85	41	55

3.5 Related Management Issues

A number of other issues arise in the discussion of hedge management, these include the selection of the hedge cutter, timing of the cutting operation, shape of the hedge, and possible effects to the hedge bank. These topics are dealt with in the following paragraphs.

3.5.1 Alternative Hedge Cutters

The most common mechanical cutter is the flail hedge trimmer and this is used for the cost calculations in the main report. However, there are alternative cutters to the flail although their availability is limited. The main options are the shape or circular saw and the finger bar reciprocating cutter. The finger bar cutter is mainly intended for cutting light annual growth and leaves a very clean cut in these conditions. The shape saw performs best in heavy growth or when coppicing mature hedges. Both of these mechanical cutters require a second operation to collect and dispose of the hedge cuttings which are left full length compared to the short mulched cuttings of the flail trimmer. In general both the saw and the cutter bar operate at slower forward speeds than flail cutters and normally have a lower effective width of cutter head. This results in a significantly higher cost of hedge maintenance due to the higher cost of the cutting operation and the additional cost of clearing the trash.

3.5.2 Time of Cut

In general hedge cutting is viewed as a low priority job and is fitted in around other more time sensitive operations such as harvest, silaging and sowing. From the survey hedge cutting is carried out between August and March with the majority between the months of September and December. The main constraint to the timing of the cut, apart from the availability of labour and machinery, is access to the field. Access is generally limited to the period before autumn ploughing takes place, in the case of arable land, or during periods when grassland is dry enough to support the tractor and cutter. This normally limits hedge cutting to the late summer / autumn period. Roadside hedges are normally cut annually at the same time as the rest of the farm except where visibility or obstruction to traffic and pedestrians becomes a problem in which case they are cut as required.

3.5.3 Hedge shape

The generally preferred hedge profile from the survey of farmers is a topped 'A' shape with slightly sloping sides. The contractors stated that they normally cut the hedge to a square profile as this is the traditionally accepted shape. However, the contractors did cut topped 'A' shapes when asked, and as both of the above profiles require six passes of the flail to cut a hedge of the size generally found in Devon, there would be no change in cost. A full 'A' shape, which is thought to have the greatest benefits to the hedge, would require 8 passes with the associated increase in cost.

3.5.4 Detrimental effects of non annual cutting

A number of concerns were raised over the possibility of changing hedge management from an annual cut to a system such as the 3 Year where the side of the hedge was allowed to grow over two or three seasons before being cut back to the original size. Where brambles had established in the hedge it was felt that they would encroach into the field over the uncut period. Also, the bank vegetation may die back due to the extra shading over the uncut period. Thus, when the hedge was cut back to its original size, the hedge bank stability may be reduced and the bank would be more susceptible to animal damage.

4 COST BENEFIT ANALYSIS

This section summarises the annual costs associated with the alternative hedge management systems by farming type. Typical calculations for the dairy farm are shown in Appendix 3.

4.1 Farm models

Four models were used to demonstrate the effect of the alternative hedgerow management practices on different farming systems. The main details of these farm models are given in Table 4.1. The models were constructed from the survey data, MAFF census figures for the Devon and Midland regions (MAFF, 1992) and data from McInerney (1994) and Nix (1994).

The models are:-

- a dairy farm in the Culm Measures with the average hedge growth of 0.5 m per year;
- a cattle and sheep farm in the Exmoor region with slow growing beech hedges (0.2 m per year);
- a mainly arable farm with fast growing mixed hedges (1 m per year) situated in the Devon Redlands or South Devon areas; and
- an arable farm with slow growing Hawthorn hedges (0.2 m per year) typical of the Midlands area

Table 4.1: Farm model characteristics

Farm type	Dairy	Cattle & sheep	Arable	Arable
Natural region classification	Culm Measures	Exmoor	Devon Redland/ South Devon	Midland
Farm size (ha)	65	46	78	116
Main enterprises	cows beef sheep	beef sheep barley wheat	wheat barley beef sheep potatoes	wheat barley oil seed ra winter bea potatoes sugar bee
No of fields	20	15	14	10
Average field size (ha)	3.25	3.1	5.6	11.6
Total length of field boundary (m)	14422	10507	13218	13624
% of field boundary under hedge (m)	100	100	100	75
Total length of hedge after adjustments for adjoining fields, roads etc. (m)	10816	7880	9914	7664
Growth rate of hedge	normal	slow	fast	slow
metres / year	0.5	0.2	1.0	0.2

4.2 Analysis

For each farm model, the following points were examined with respect to different types of hedgerow practices:

- the shade and field effects on gross margins;
- the impact on labour requirements for existing farm operations and for hedge management; and
- the impact on machinery costs for existing farm operations and for hedge management.

Distinction is drawn between the impact on costs when farmers use their own machinery and farmers who hire contractors. The costs are shown as the total recurrent annual costs of each of the hedge management systems. Index values of the costs incurred under the different management options are calculated with reference to the cost of the standard hedge for each of the models.

The figure taken as the index value can be calculated in different ways to enable other comparisons to be made and this is expanded on in Appendix 4.

4.3 Farmers using their own machinery

The results of this farm analysis are presented in the Tables 4.1 to 4.4, with the costs of each hedge system shown compared to the existing standard hedge per 100 m of hedgerow. An indexed value of the hedge system costs is also shown. These costs tend to vary between farm types according to the reduction in gross margin due to shading and land loss. The more intensive the farm system, the greater the cost of a change in hedgerow practice.

4.3.1 Dairy farm

The results for the dairy farm are shown in Table 4.1. It can be seen that all of the proposed hedge management systems result in an increased cost to the farmer compared to the standard hedge.

Table 4.1: Recurrent annual costs of hedge management systems per 100 m on a 65 ha dairy farm in Devon.

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Gross margin	£25.95	£39.81	£29.83	£30.42	£39.81
Labour					
Field	-£3.32	-£5.25	-£3.32	-£3.32	-£5.25
Hedge	£2.03	£3.04	£2.37	£1.64	£0.84
Machinery					
Field	-£0.48	-£0.76	-£0.48	-£0.48	-£0.76
Hedge	£6.09	£9.13	£7.10	£4.91	£2.51
Hedge system costs per 100 m	£30.27	£45.97	£35.50	£33.16	£37.14
Index	100	152	117	110	123

The incremental growth system is the most expensive, at 1.52 times the standard, due to the fact that it results in the largest hedge size. This incurs the greatest cutting costs and has the greatest effect on gross margin, both in terms of shading and land loss. Land loss does, however, generate some savings in terms of reduced labour and machinery running costs.

Where trees are established in the hedgerow the cost of the system is 1.17 times greater than the standard hedge. As the trees affect the gross margin by increasing the area of shade, but do not incur any land loss, the gross margin losses are much lower than the incremental system.

The least expensive option compared with annual trimming (standard) is where the hedge is managed by annual trimming on the sides and three yearly cutting on the top of the hedge. Again the gross margin effects are relatively low as only the shading of the field is affected, and combined with the low cutting costs, this management method gives the cheapest alternative.

Managing the hedge by cutting every three years is a relatively expensive option even though it has the cheapest hedge cutting costs. This is due to the relatively high gross margins per hectare of the dairy farm, combined with the considerable shading and land loss factors of this hedge system at normal growth rates. The gross margin costs thus dominate over the low cutting costs to give a high total. The costs of this option are, of course, sensitive to the assumptions regarding the productivity of headlands.

4.3.2 Cattle and sheep farm

The combination of lower gross margins per hectare and the slow growth rate give quite different results for the cattle and sheep farm as seen in Table 4.2. In this case although the incremental growth and hedgerow trees are more expensive than the standard hedge, 3 and 1, and 3 yearly cutting show overall savings. This follows the same pattern as the hedge cutting costs (Table 3.1).

Table 4.2: Recurrent annual costs of hedge management systems per 100 m on a 46 ha cattle and sheep farm in Devon.

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Gross margin	£9.95	£15.24	£11.50	£10.67	£12.08
Labour					
Field	-£1.67	-£2.64	-£1.67	-£1.67	-£2.06
Hedge	£2.03	£3.04	£2.37	£1.64	£0.84
Machinery					
Field	-£0.57	-£0.90	-£0.57	-£0.57	-£0.70
Hedge	£6.09	£9.13	£7.10	£4.91	£2.51
Hedge system costs per 100 m	£15.83	£23.88	£18.74	£14.97	£12.67
Index	100	151	118	95	80

4.3.3 Arable farm

Table 4.3 shows the costs of hedgerow management on an arable farm. Where the growth rate of the hedge is fast, and the hedge is not cut annually, the effect on the gross margins tend to dominate the overall costs. In this case the cost of the incremental cut and the 3 yearly cut are almost the same, approximately 1.5 times the standard hedge system. In the incremental system this is due to high cutting costs, and in the 3 yearly system due to large shading and land loss effects on the gross margin. The Tree and 3 and 1 systems are 1.2 and 1.27 times the cost of the standard system respectively.

Table 4.3: Recurrent annual costs of hedge management systems per 100 m on a 78 ha arable farm in Devon.

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Gross margin	£16.54	£25.18	£19.63	£23.65	£33.74
Labour					
Field	-£1.30	-£2.06	-£1.30	-£1.30	-£2.81
Hedge	£2.03	£3.04	£2.37	£1.73	£1.12
Machinery					
Field	-£1.09	-£1.72	-£1.09	-£1.09	-£2.35
Hedge	£6.09	£9.13	£7.10	£5.19	£3.35
Hedge system costs per 100 m	£22.27	£33.57	£26.71	£28.18	£33.04
Index	100	151	120	127	148

4.3.4 Midlands farm

The results for the Midlands farm are shown in Table 4.4. The combination of the larger field size, and a slow growing incomplete hedge, result in very little increased cost when the 3 & 1 and 3 year systems are implemented. Where trees are incorporated into the hedgerow the cost increases by a factor of 1.42 over the standard hedge. This is due to the relatively high shading effect on the gross margin cost combined with higher cutting costs. The large hedge size attained by the incremental system means it is very much more expensive than the standard hedge at a factor of 2.81.

Table 4.4: Recurrent annual costs of hedge management systems per 100 m on a 116 ha Midlands farm

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Gross margin	£5.90	£18.56	£9.10	£7.19	£9.08
Labour					
Field	-£0.33	-£1.24	-£0.33	-£0.33	-£0.56
Hedge	£1.01	£2.54	£1.18	£0.82	£0.42
Machinery					
Field	-£0.37	-£1.41	-£0.37	-£0.37	-£0.63
Hedge	£3.04	£7.61	£3.55	£2.45	£1.26
Hedge system costs per 100 m	£9.26	£26.05	£13.14	£9.76	£9.56
Index	100	281	142	105	103

4.4 Farmers using contractors

Table 4.5 summarises the costs for farmers using contractors. The costs per 100 m for each of the farm models follow the same pattern as farmers using their own machinery. However, in absolute terms, the use of contractors results in lower overall costs per 100 m compared to farmer operated equipment.

Table 4.5: Summary of recurrent annual costs of hedge management systems per 100 m for farmers using contractors

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Dairy					
Hedge system costs per 100 m	£28.55	£43.39	£33.50	£31.78	£36.43
Index	100	152	117	111	128
Cattle & sheep					
Hedge system costs per 100 m	£14.11	£21.30	£16.74	£13.59	£11.96
Index	100	151	119	96	85
Arable					
Hedge system costs per 100 m	£20.55	£30.99	£24.71	£26.42	£31.22
Index	100	151	120	129	152
Midlands					
Hedge system costs per 100 m	£8.40	£23.91	£12.13	£9.07	£9.21
Index	100	285	144	108	110

4.5 Hedge cutting contractors

The contractors that were questioned in the survey tended to view hedge cutting as low priority work, both in terms of when the work is carried out and the income that it generates. It was normally undertaken in-between major operations such as silaging and harvesting and used as a 'filler' when labour and machines were available. On average it was estimated to generate 10% of the contractors income. Table 4.6 shows the potential change to total income if the contractor adopted a given hedge management system.

Table 4.6: Potential change to the contractors income after universal adoption of management system

Management	Incremt	Tree	3 and 1	3 Year
Effect to income (%)	+5	+1.7	-1.9	-5.9

4.6 Sensitivity analysis

Table 4.7 shows the effects on the annual costs for the hedge systems on the dairy farm if the yield levels, gross margins, machinery and labour or hedge cutting costs change by ± 10 %. This may be due to changes in the shade and shelter effects, weed and pest incidence, intensity of farming or machinery used.

From Table 4.7 it can be seen that variation in the machinery and labour cost has little effect on the annual costs of any of the management systems. However, some of the management systems are relatively sensitive to variation in yield, gross margin and hedge cutting costs.

Table 4.7: Sensitivity analysis: The percentage (±) change to the annual costs of hedge management on the dairy farm model after ±10% variation of the main assumptions

	Percentage change in costs				
	Standard	Incremt	Tree	3 and 1	3 Year
Yield loss	3.5	3	2.5	4.5	4
Gross margin	9	9	8.5	9.5	10
Field machinery and labour	2	2	1	1	2
Hedge cutting costs	3	3	3	2	1
Growth rates	0	0	0	3	5

4.7 Summary

The following points may be summarised from the above discussion;

(i) In general, due to the large hedge size, the incremental growth system is the most expensive option independent of farm type and hedge growth rate.

(ii) Where the hedge has a slow growth rate, the 3 and 1, and the 3 yearly systems have a lower annual cost than the standard Devon hedge.

(iii) If the hedge has a fast growth rate, and is managed using either the 3 and 1, or the 3 yearly system, the losses in the gross margin dominate the hedge cutting costs and result in higher annual costs.

(iv) The effect on contractors' income is relatively small at ± 5 % over the range of management systems assuming no other work is displaced or taken on.

5 HEDGEROW COST EFFECTIVENESS ANALYSIS

The preceding analysis identified the relative monetary costs of delivering different types of hedgerow system. These systems differ in terms of their environmental attributes (habitat, food for wildlife, and landscape and amenity). These latter qualities are difficult to value in monetary terms. (There are methods which attempt to do this, but these go beyond the remit and resources of this study). For this reason it is not possible to define the hedgerow system which generates the greatest benefit to cost ratio.

It is possible however to construct a cost : effectiveness analysis, which attempts to determine the relative costs of delivering an arbitrarily defined unit of environmental quality. On the basis of informed judgement, a matrix which scores the alternative hedgerow systems against selected environmental criteria can be produced (Hooper, 1992). Table 5.1 shows such an analysis of the alternative hedge management methods relative to the Standard hedge. At this stage these are subjective assessments undertaken by the authors, but they could be reformulated against objective measurable criteria (such as quantity of food generated) or revised to reflect other viewpoints.

The attribute scores in Table 5.1 are simply added to give an aggregate score for the hedge type. For example, this is 11 for the tree system and 10 for the three year cut system. These relative scores are then divided into the cost per 100 m of hedgerow to determine cost per unit of benefit obtained. This ratio gives an estimate of the relative cost effectiveness of the hedgerow options in terms of delivering desired environmental enhancement.

The analysis contained in Table 5.1 suggests that Trees (within a standard hedge) are particularly cost-effective, followed by the 3 Year and 3 and 1 systems. There would seem to be advantage in combining these to produce a hybrid of Trees within a 3 Year or 3 and 1 system. As shown in the table the combined systems incur an increased cost but results in a much higher benefit index than any single management.

Table 5.1 Environmental Enhancement and Cost Effectiveness Matrix (dairy farm)

Criteria	Management systems						
	Std	Incremt	Tree	3 and 1	3 Year	Tree / 3 and 1	Tree / 3 Year
habitat	1	3	4	3	4	5	5
food	1	1	3	3	4	4	5
landscape and amenity	1	3	4	2	2	5	5
sum total (a)	3	7	11	8	10	14	15
cost £/100m (b)	£30.27	£45.57	£35.50	£33.16	£37.14	£37.14	£41.13
cost / unit benefit (b/a)	£10.09	£6.51	£3.23	£4.15	£3.71	£2.65	£2.74
benefit index	100	155	312	243	272	380	368

NOTES: scores relative to standard hedge:

1 = no change, +/-2 small , +/-3 moderate, +/-4 large gain/loss, +/-5 max gain/loss

Assumes farmer using own hedge cutting equipment

Table 5.2 summarises the results of the cost effectiveness calculations for the other farm models, assumming the same attribute scores are used.

Table 5.2 Summary of Cost Effectiveness and benefit index

Farm type	Management systems						
	Std	Incrmt	Tree	3 and 1	3 Year	Tree / 3 and 1	Tree / 3 Year
Cattle & sheep							
£/100m cost / unit	£15.83	£23.88	£18.74	£14.97	£12.67	£17.0	£14.70
benefit	£5.28	£3.41	£1.70	£1.87	£1.27	£1.21	£0.98
benefit index	100	155	311	282	416	436	539
Arable							
£/100m cost / unit	£22.27	£33.57	£26.71	£28.18	£33.04	£31.28	£36.16
benefit	£7.42	£4.80	£2.43	£3.52	£3.30	£2.23	£2.41
benefit index	100	155	305	212	225	333	308
Midlands							
£/100m cost / unit	£9.26	£26.05	£13.14	£9.76	£9.56	£13.11	£12.91
benefit	£3.09	£3.72	£1.19	£1.22	£0.96	£0.94	£0.86
benefit index	100	83	260	253	322	329	359

The method is very coarse and liable to a lot of bias. It does, however, force decision makers to clarify the environmental objectives to be achieved and assesses the relative cost of alternative strategies for meeting these objectives. The method could be developed to incorporate the varied, and sometimes conflicting interests in the hedgerow debate.

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APPENDICES

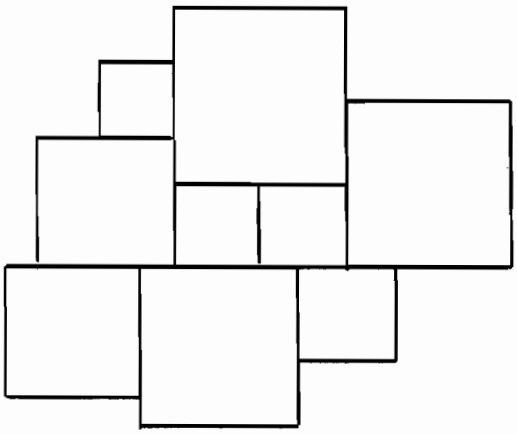
APPENDIX 1

Formulae used in the Area and Boundary Length Calculation.

(i) If the field is assumed to be square and is of area A, then the boundary length B is given by:

$$B = \sqrt{A} \times 4$$

(ii) If the field is part of a completely adjoining system,



then the total boundary length BT, neglecting edge effects, is given by :

$$BT = \sum BN \times 0.5$$

where N is the number of fields.

(iii) For a farm system with roads between some of the fields, the boundary length is taken to be :

$$BT = \sum Bn \times 0.75$$

APPENDIX 2

Spreadsheet calculations for hedge cutting costs

		Costs per hour Tractor	Flail
Depreciation		2.48	4.25
Tax + insurance		0.35	0.00
Repairs + maint		1.55	2.75
Fuel + oil		1.10	0.00
Opportunity cost of capital		1.18	1.90
Labour		4.74	
TOTAL COSTS/HOUR		11.40	8.90
COSTS/100m PASS	Normal	1.35	
	0.8 Normal	1.69	
	Tree	2.03	
	0.6 Normal	2.26	

Assumptions

	Price	Hrs/pa
1. Tractor: 2 wheel drive, 43 - 49 kW	15500.00	
2. Flail: tractor mounted	5000.00	100.00

	% rate of purch p	Flail costs pa
Depreciation	8.50	425.00
R and M	5.50	275.00
TOTAL		700.00

3. Real interest rate (%)	0.08	
4. Distance cut per hour (m)	Normal	1500.00
	0.8 Normal	1200.00
5. Data taken from Nix (1994)	Tree	1000.00
	0.6 Normal	900.00

Hedge cutting costs per annum by hedge type

		Cost/100m	Hedge type STANDARD	INCREMENTAL	TREE	3 AND 1	3 YEAR
CUTTING SPEED							
No of passes			6.00	9.00	6.00	4.67	6.00
% cut pa			1.00	1.00	1.00	1.00	0.33
Own labour + machinery	Normal	1.35	8.12	12.18	5.41	5.41	
	0.8 Normal	1.69				1.13	3.35
	Tree	2.03			4.06		
	0.6 Normal	2.26					
TOTAL			8.12	12.18	9.47	6.55	3.35
	INDEX		100.00	150.00	116.67	80.63	41.25
Contractor	NORMAL	1.07	6.40	9.60	4.27	4.27	
	0.8 NORMAL	1.33				0.89	2.64
	TREE	1.60			3.20		
	0.6 NORMAL	1.78					
TOTAL			6.40	9.60	7.47	5.16	2.64
			100.00	150.00	116.67	80.63	41.25

Assumptions

1. Contractor costs/hour	16.00

APPENDIX 3

Typical spreadsheet calculations for the dairy farm

Farm size (ha)	65
No of fields	20
Ave field size (ha)	3.25
Boundary length (m)	721.11
Total boundary length (m)	14422.21
Adjusted boundary length (m)	10816.65

SHADED AREA

Enterprise	No of fields	Total area	Shaded area m**2 Base 0	Standard 2.2	Increm 3.2	Tree 2.48	3 and 1 3.2	3 3.2	Tree 0.5
Dairy	12		0	14277.98	20767.98	16095.18	20767.98	20767.98	3244.996
Beef	6		0	7138.992	10383.99	8047.59	10383.99	10383.99	1622.498
Sheep	2		0	2379.664	3461.329	2682.53	3461.329	3461.329	540.8327

LAND LOSS

Enterprise	No of fields	Total area	Headland 5	Land loss m**2 Base 0	Standard 1.15	Increm 1.82	Tree 1.15	3 and 1 1.15	3 1.82
Dairy	12	390000	43266.62	0	9951.322	15749.05	9951.322	9951.322	15749.05
Beef	6	195000	21633.31	0	4975.661	7874.524	4975.661	4975.661	7874.524
Sheep	2	65000	7211.103	0	1658.554	2624.841	1658.554	1658.554	2624.841

GROSS MARGINS GM = (GMn(Af-Al-Ah-At) + GMh(Ah-As) + GMs(As) + GMt(At)

Enterprise	GM	0.85GM	0.5GM	0.425GM	Base	Standard	Increm	Tree	3 and 1	3
Dairy	1505	1279.25	752.5	639.625	57718.26	55307.33	54019.65	54946.91	54892.21	54019.65
Beef	388.5	330.225	194.25	165.1125	7449.682	7138.504	6972.304	7091.985	7084.925	6972.304
Sheep	316.68	269.178	158.34	134.589	2024.166	1939.615	1894.457	0 1926.975	1925.057	1894.457
Total gross margin					67192.1	64385.45	62886.41	63965.87	63902.19	62886.41

LABOUR REQUIREMENTS

Enterprise	No of fields	Total area	Field area Base	Standard	Increm	Tree	3 and 1	3
Dairy	12	39	39	38.00487	37.4251	38.00487	38.00487	37.4251
Beef	6	19.5	19.5	19.00243	18.71255	19.00243	19.00243	18.71255
Sheep	2	6.5	6.5	6.334145	6.237516	6.334145	6.334145	6.237516
Total area		65	65	63.34145	62.37516	63.34145	63.34145	62.37516

Labour costs at 4.74

Enterprise	No of fields	Total area	Base	Standard	Increm	Tree	3 and 1	3
Dairy		11204.36	11204.36	10918.47	10751.91	10918.47	10918.47	10751.91
Beef		1746.927	1746.927	1702.352	1676.382	1702.352	1702.352	1676.382
Sheep		1121.484	1121.484	1092.868	1076.196	1092.868	1092.868	1076.196
Total costs		14072.78	14072.78	13713.69	13504.49	13713.69	13713.69	13504.49

APPENDIX 4

Alternative methods of calculating index values

The index values in the main report are calculated with reference to the standard hedge cost which include the shading and land loss of the existing hedge. However, an alternative calculation can be done if the shading and land loss effect of the existing hedge is discounted and the cost of the standard hedge taken only as the hedge management cost. The figures then generated allow direct comparison between the hedge cutting cost element and the additional costs incurred on the farm from the change in hedge management. A further alternative is to include the shading effect of the existing hedge, but discount the land loss involved, in the calculation of the standard hedge cost.

Tables of the costs to the dairy farm showing both these calculations and the resulting change to the index values are shown below.

Table 1: Recurrent annual costs of hedge management systems per 100 m on a 65 ha dairy farm

Recurrent costs	Management systems			
	Incremt	Tree	3 and 1	3 Year
Gross margin	£13.86	£3.88	£4.47	£13.86
Labour				
Field	-£1.93	£0.00	£0.00	-£1.93
Hedge	£3.04	£2.37	£1.64	£0.84
Machinery				
Field	-£0.28	£0.00	£0.00	-£0.28
Hedge	£9.13	£7.10	£4.91	£2.51
Hedge system costs per 100 m	£23.82	£13.35	£11.01	£14.99
Index (Std hedge management costs of £8.12 = 100)	293	164	136	185

Table 2: Recurrent annual costs of hedge management systems per 100 m on a 65 ha dairy farm including standard hedge shading

Recurrent costs	Management systems				
	Standard	Incremt	Tree	3 and 1	3 Year
Gross margin	£9.83	£23.69	£13.71	£14.30	£23.69
Labour					
Field	£0.00	-£1.93	£0.00	£0.00	-£1.93
Hedge	£2.03	£3.04	£2.37	£1.64	£0.84
Machinery					
Field	£0.00	-£0.28	£0.00	£0.00	-£0.28
Hedge	£6.09	£9.13	£7.10	£4.91	£2.51
Hedge system costs per 100 m	£17.95	£33.65	£23.18	£20.84	£24.82
Index	100	188	129	116	138