Evaluating the Benefits from Farm Woodland Planting

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Summary

The public benefits from incentives for planting under the Farm Woodland Premium Scheme were assessed in terms of timber production, biodiversity benefits and gains in landscape quality. There was clear evidence for benefits to biodiversity at site level, and the great majority of sites contributed to landscape character and its aesthetic qualities. However, only a minority of farmers expected to produce a commercial crop of timber. A number of proposals are made for increasing the public benefits from farm woodlands, principally in terms of improved woodland design. The main policy conclusions from the evaluation are discussed.

Introduction

This paper describes the evaluation of the Farm Woodland Premium Scheme (FWPS) in Scotland undertaken for the Scottish Office Agriculture, Fisheries and Environment Department (SOAEFD). While concentrating on the assessment of the benefits derived from public expenditure the paper also investigates a number of future policy options that may enhance the effectiveness of farm forestry policy. In particular it examines the scope for better woodland desig issues of the geographic location of planting and considers t more selective targeting of public investment in farm forest

The Farm Woodland Premium Scheme (FWPS) was launched on 1st April 1992 (MAFF, 1992a). It superseded th Farm Woodland Scheme (FWS) which was the first scheme specifically designed to provide farmers with financial incentives for conversion of land to woodland. It is a voluntary scheme in which annual payments are offered for the conversion of agricultural land to woodland either by ne planting or natural regeneration. Applications to the FWPS must have already been accepted for the Woodland Grant Scheme which currently offers planting incentives of betwee £700 and £1,350 per ha, together with supplements dependent on land type and the location of planting.

The structure of the FWPS annual payments is given in Table 1. Rates of payment vary with the type of land. The period over which payments are made is 15 years for woodland containing more than 50% of broadleaved trees(including native Scots pine) and 10 years for woodland containing 50% or less of broadleaved trees (MAFF, 1992b). To be eligible for the FWPS, farmers must satisfy the requirements for block size, species choice and landscape design under the WGS and also satisfy limits on the maximum area that may be planted per farm under the FWPS.

Any policy evaluation takes as its starting point the stated objectives of the policy. For the FWPS these were 'to encourage the creation of new woodlands on farms both to enhance the environment and as a productive land use' (MAFF, 1992b). These objectives were not specific enough to provide a basis for evaluation and, given a reasonable level of uptake, it was difficult to envisage how they would not have been achieved. Discussion with SOAEFD focused the evaluation on the following more specific benefits:

- success in encouraging timber production on farms
- the extent of gains to biodiversity
- the contribution to landscape.

Table 1. Annual Payments under the Farm Woodland Premium Scheme

Type of Land	Payment (£ per hectare per year)
Arable Land/Improved Grassland	
Outside Less Favoured Areas	£250
Disadvantaged Areas of the Less Favoured Areas	£190
Severely Disadvantaged Areas of the Less Favoured Areas	£130
Unimproved Land	
Less Favoured Areas (whether Severely Disadvantaged or Disadvantaged Areas)	£60

Of these the first is less obviously a public benefit than the other two. Encouragement of timber production has to be interpreted either as a contribution to the wider objectives of forestry policy in the UK (Scottish Office Environment Department, 1994) or in terms of providing incentives for farmers to diversify their income in the face of adjustment pressures following progressive reform of the Common Agricultural Policy (CAP) (Crabtree, 1995). The payment of incentives to increase the flow of environmental services from farmers, where market mechanisms do not operate, is a well-established element of government and EU policy (MAFF, 1991; Council Regulation 2078/92).

However, to produce public benefits or contribute to the adjustment of farming, the incentives offered under a voluntary scheme must first elicit a satisfactory uptake. Indeed it could be said that the prime determinant of benefits is the level of planting induced by the payments offered: without participation by farmers the scheme will be unable to deliver public benefits. Since FWPS falls within the auspices of the CAP, the distribution of payments between different types of farmer operating in different circumstances will also be of interest to policy makers. Uptake by a wide range of farmers and particularly those facing some income vulnerability would contribute to the wider income support objectives of the CAP.

Methods

Data on the uptake of the scheme were obtained from the SOAEFD database on entrants. By linking this to other Forestry Commission and SOAEFD databases it was possible to identify the location of planting and the agricultural characteristics of the farms involved. In order to obtain more detailed information on individual plantings a random sample survey of 10% of FWPS entrants at May 1995 (99 farms) was undertaken. In each case the farmer was interviewed to assess the planting objectives and the costs involved. A field analysis was undertaken on the woodlands planted in this FWPS sample, and also on a random sample of 53 FWS sites, included for comparative purposes. The FWPS sites were all relatively newly planted and did not have well-developed woodland features. It was assumed that the conditions associated with the payments would result in satisfactory woodland establishment and management. Results from the FWS survey are not presented in detail. Complete results are in Crabtree (1996).

Although the impacts of new planting on biodiversity and landscape will clearly change over time as the woodlands mature, the main focus of the analysis was to concentrate on those determinants of environmental benefits that were either directly measurable or predictable at the establishment stage. Important here were the design characteristics of blocks (size, shape, species, structure), location and associated land use and landscape, establishment methods and previous land use. Emphasis was on comparative assessment both between plantings and with the land use prior to afforestation.

For biodiversity assessment, the approach adopted was to visit the sample sites and record site characteristics, species planted, vegetation structure and composition, and management features. The aim was both to produce an inventory of the sites and collect data that could indicate how far the plantings had enhanced or detracted from biodiversity. Biodiversity was taken to include the diversity of species and communities and the spatial complexity of the site. Scoring systems were developed to quantify the contribution to biodiversity in terms of fauna, flora, naturalness, and structural diversity (see Crabtree, 1996 and below).

The contribution of new planting to landscape on the sample sites was determined by following accepted landscape assessment procedures (Land Use Consultants, 1991; Countryside Commission, 1993; Landscape Institute, 1995) to assess changes in landscape fabric, and visual impacts. Full details of the procedures are given in Crabtree (1996). Changes in the fabric of the landscape were mainly recorded in terms of changes in its overall character. These were made through an informed professional judgement based on field observation from a selected viewpoint. For all visual impacts, the appearance of the block was assessed as if mature, *i.e.* with the woodland at canopy stage. Although field observations were also made of the impact of planting in its current stage of growth, it was considered that a visual

estimate of the potential long-term impact represented the more useful measure for the evaluation purposes.

While changes in the fabric of the landscape represent the real effects of the scheme, it is the appearance of those changes, *i.e.* their visual impact, which is of primary significance in terms of public benefit. The visibility of sites determines their prominence within the landscapes; hence highly visible sites will be perceived as having greater impact, whether positive or negative. Visibility measures the absolute visibility of the area of land surfaces where the planting scheme is located. The basis for the calculation of visibility was the Ordnance Survey 1:50,000 digital elevation model (Ordnance Survey, 1995). Visibility was calculated for each 50m x 50m cell within a radius of 1 km from the planting. The visibility ratio was also calculated. This measures the relative visibility of a planting location within its local context, and hence how prominent it is likely to be in local views. The ratio was calculated as the ratio between the site visibility and the highest absolute visibility recorded in an area of radius 2 km from the planting. Aesthetic impacts were measured against three criteria: scale, shape and edge treatment, selected from guidance on key design principles published by the Forestry Commission (Forestry Commission, 1994).

Uptake

The FWPS was attractive to a wide variety of farmers on a range of different types of holding. Planting occurred throughout most of Scotland where conditions were satisfactory (Figure 1). Whilst a proportion of the planting was located in the arable and mixed farming areas in the east and north-east, there were substantial areas planted on poorer land, and in the south and south-west. A fuller analysis of planting location by region and land quality is given in Crabtree (1996). The FWS, by way of comparison, had a more limited geographical spread of uptake, with a higher proportion of planting in the arable and mixed farming areas of the east and north-east of Scotland (Appleton and Crabtree, 1991). In May 1995, when the evaluation commenced, there were 875 holdings with planting approval covering 14,272 ha, an average of 16.3 ha per holding (Table 2). Most of the planting (83% by area) was located in the Less Favoured Areas (LFA) and nearly all of this was on SDA land. This contrasts with the FWS where 55% (by area) occurred on lowland (non-LFA) farms (Appleton and Crabtree, 1991) and indicates

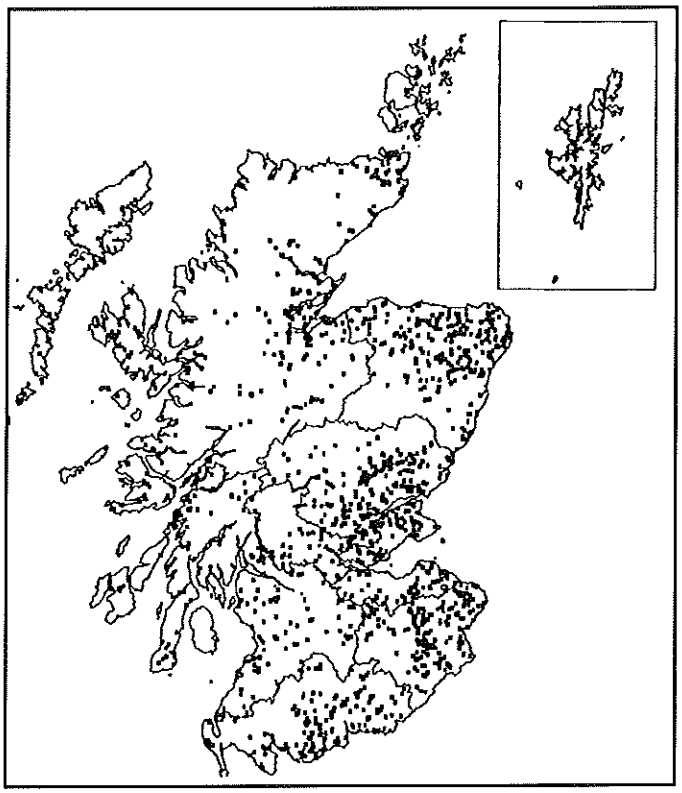

Figure 1. The location of FWPS sites

Table 2. Total area of land approved by planting type and land type at May 1995

Land Type	Percent of total planting			
	mainly conifer	mixed planting	mainly broadleaves	Total
Non-LFA	4.4	6.7	5.9	16.9
DA (improved/arable)	0.2	1.1	0.7	1.9
SDA (improved/arable)	8.7	17.0	11.6	37.3
LFA (unimproved)	10.7	10.1	23.2	43.9
Total	23.9	34.8	41.3	100.0

Note: Mainly conifer/broadleaves defined as >80% conifer/broadleaves.

a significant shift in new planting under the FWPS to the Less-Favoured Areas. Slightly more than half of the LFA planting (53% by area) was on unimproved land.

Discussion with Scottish Office revealed that the uptake of the scheme exceeded the expectations of policy makers and the budget originally allocated for payments. In terms of area planted in Scotland, the scheme was much more successful than its predecessor, the FWS. The planting was 11% of the area of woodland on Scottish farms recorded in the 1994 Agricultural Census (Table 2). Even so, uptake was concentrated on relatively few farms - with planting on 2.6% of the total number of holdings recorded at the 1994 Census. Uptake rates were highest (7.6%) on very large farm category (exceeding 100 ESUs) but limited to 1.1% on small farms

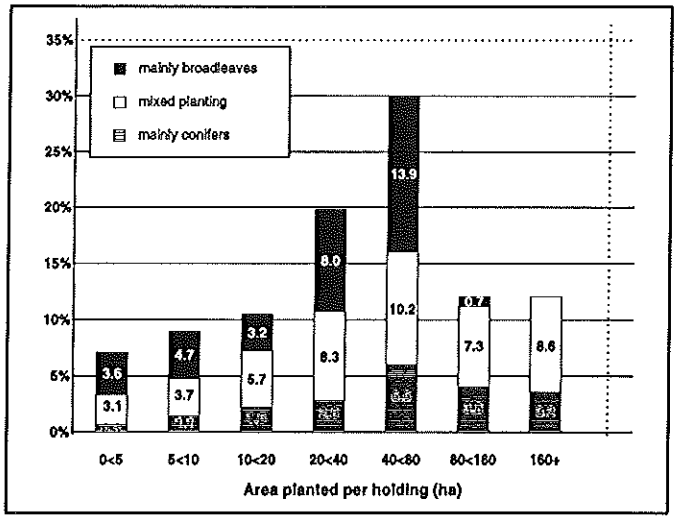

Figure 2. Proportion of total planting in the scheme by species type and area planted per holding

(<8 ESUs). See Crabtree (1996) for definition of European Size Units, a standardised measure of business size. The total area planted on individual holdings under the scheme varied enormously. Almost half of the holdings (47%) planted under 5 ha per holding: this represented 7.3% of the total area planted (Figure 2). Only 13% of farms planted more than 40 ha, with some individual blocks exceeding 200 ha, and this accounted for 55.1% of the total area planted under the scheme. The rules of FWPS require that planting must not exceed 50 % of the agricultural area or exceed 40 ha of unimproved land. These large plantings are thus on sizeable farms planting on improved land.

Types of Woodland Planted

The types of woodland planted are important to the evaluation for two reasons. First, the choice of species is likely to have a major impact on the benefits produced by a woodland, whether from timber, amenity, sport or enhanced biodiversity. Second, there may be implications for the way in which payment rates are structured since manipulation of the incentives can be used to influence the ratio of broadleaved to coniferous planting.

Of the total area planted, only 24% was mainly conifers (broadleaves < 20%), the bulk of the planted area consisting of mixed planting (broadleaves between 20% and 80%) or mainly broadleaves (broadleaves > 80%) (Table 2). For the purposes of payment under the scheme native Scots pine was treated as broadleaved planting. In the SOAEFD data base it was impossible to distinguish native pine planting from areas planted with broadleaved species. Thus in the analysis of data for the whole scheme (rather than the farmer survey) broadleaved planting was understood to include native pine. Thus the dominant type of planting was broadleaved and 10.5 % of the area was in pure broadleaved species (including native pine). A reasonable expectation for the coniferous planting was that it would be mainly located on poorer quality (unimproved) LFA land where the main objective would be to produce a commercial timber crop. However, this proved not to be the case: 45% (by area)of the mainly coniferous planting took place on improved land, although most of this was in the LFA.

Timber Production

When questioned on their planting objectives only 7% of farmers said that the production of a commercial timber crop was very important, and 65% responded that it was not important. In terms of the area planted the corresponding figures were 12% and 56% respectively, indicating that timber objectives were more prevalent where planting involved larger blocks of land. Nevertheless, in the majority of cases timber production was relatively unimportant in the decision to join the scheme: making use of poor quality land, provision of shelter and enhancement of wildlife, landscape and amenity were all more common objectives (Crabtree, 1996). Whilst the scheme did provide incentives for timber production and facilitated some large blocks of mainly coniferous planting, the incentives mainly resulted in the planting of smaller blocks of mixed or predominantly broadleaved species.

Impacts on Biodiversity

The habitat types planted under FWPS were classified into five broad categories: grassland (permanent grassland or long-term ley), arable, woodland (remnant or partially tree-covered site acceptable within the scheme), heather moorland and wetlands. Plantings on grassland accounted for about half of all FWPS sites sampled. A further 25% of sites were planted on arable areas and 15% on heather moorland. The remainder of sites were previously woodland (8%), and no wetland sites were found in the FWPS sample.

The species planted at the largest proportion of FWPS sites was rowan (*Sorbus aucuparia*) (53% of sites) but sessile or pedunculate oak (*Quercus petraea, Q. robor*), birch (*Betula*

Table 3. Frequency (%) of predominant deciduous, coniferous and shrub species >15% planted under the FWPS.

	Frequency (%)
Deciduous Species	
Rowan (*Sorbus aucuparia*)	53
Oak (*Quercus* Spp.)	50
Birch (*Betula pendula*)	48
Ash (*Fraxinus excelsior*)	42
Gean (*Prunus avium*)	42
Sycamore (*Acer pseudoplatanus*)	38
Beech (*Fagus sylvatica*)	25
Alder (*Alnus glutinosa*)	25
Hazel (*Corylus avellana*)	17
Willow (*Salix* Spp.)	17
Total number of species planted	27
Coniferous Species	
Sitka spruce (*Picea stchensis*)	31
Scots pine (*Pinus sylvatica*)	28
Larch (*Larix* Spp.)	23
Douglas fir (*Pseudotsuga menzesii*)	16
Total number of species planted	12
Shrub Species	
Hawthorn (*Crataegus monogyna*)	30

pendula, B. pubescens), ash (*Fraxinus excelsior*) and gean (*Prunus avium*) all occurred at more than 40% (Table 3). There were some unusual species recorded, including tulip tree (*Liriodendron tulipifera*), horse chestnut (*Aesculus castaneum*) and walnut (*Juglans regia*). However, these species occurred at very low frequencies (usually a single site). Sitka spruce (*Picea sitchensis*) was the most widely planted conifer in both farm woodland schemes, and Douglas fir (*Pseudtsuga menzesii*) the least frequent, with Scots pine (*Pinus sylvestris*) and larch (*Larix spp.*) intermediate. The total number of coniferous species recorded with the FWPS planting (12) was much smaller than in the case of deciduous plantings (27).

Biodiversity Scores

For the purposes of this study biodiversity is taken to include the diversity of species and communities and the spatial complexity of a site. High biodiversity is seen to be a desirable target. Separate scores were computed for fauna (principally birds and invertebrates), flora (the variety of species and communities), naturalness (conformity to semi-natural woodland) and structural diversity (the range of three-dimensional patterning present). The list of attributes included and their added value scores are shown in Table 5. For each new woodland a linear additive score was developed by summing the attributes present multiplied by their weighting as indicated in the Table. This procedure took into account the previous land use prior to establishment of the woodland and therefore represented the incremental change in biodiversity attributable to afforestation. When aggregated across the four measures, the maximum and minimum possible scores for the combined biodiversity measurements were +35 and -14.

Table 4. Comparison of biodiversity scores for FWPS and FWS

Biodiversity	FWPS	FWS
flora	+2.9	+2.5
fauna	+2.0	+1.3
naturalness	+0.9	+0.5
structural diversity	+1.4	+0.7
aggregate score	+7.2	+5.0

The highest aggregate score recorded was 29 and the lowest was 5. Only 3% of sites had negative scores, *i.e.* the calculated biodiversity rank was lower than the baseline comparison site. The aggregate score across the four biodiversity measures was 7.2 for FWPS sites and 5.0 for woodlands planted under FWS. This indicates an overall positive contribution to biodiversity from both schemes (Table 4). Compared with the FWS sites, FWPS were associated with a higher frequency of positive attributes such as shrub planting, moorland sites, and patch features such as glades, rides and wet areas.

With the FWPS there were few pronounced differences in added value between the three categories of land planted (Non-LFA aggregate score 7.9, improved LFA, 6.6 and unimproved, 8.1). However, inspection of the scores shows that there were some more substantial differences for individual attributes. Shrubs were, for example, little planted at unimproved sites. Conversely, a high proportion of Non-LFA sites were in arable cropping and had the lowest score for glades and other features within sites. There were few differences in contributions of FWPS to biodiversity between regions, with the exception of plantings in Lothian where the aggregate score was substantially lower at 5.9. This low score reflected a predominance of small plantings with few gaps or other features present, on mainly grassland sites.

Table 5. Scoring system for indicators of biodiversity

Attribute	Qualifiers	Added value score: Fauna	Flora	Naturalness	Structural diversity
Block shape	Blocks> twice as long as broad[1]	+1	+1		+1
Block size	Blocks > 2 ha[2]	+1			+1
Woodland type	Coniferous[3]	-1	-1	-1	-1
Shrub species	Shrub species planted[3]	+1	+1	+1	+1
Native species	Only natives planted[4]	+1	+1	+1	
Hedges, shelter belts, scrub, woodland	One feature within 100m[5]	+1	+1		
	>1 feature within 100m	+2	+2		
Glades, wet patches, rides	One feature within block[6]	+1	+1	+1	+1
	>1 feature within block	+2	+2	+2	+2
Vermin	Rabbits in block[7]	-1	-1	-1	-1
Planting method	Natural regeneration[8]	+1	+1	+1	+1
Habitat planted	Arable[9]	+1	+1	+1	+1
	Moorland	+1	+1		
Ploughing	Ridge ploughed before planting[10]	-1	-1	-1	-1
Sward height	Tall dense swards suppressing other species[11]	+1	-1		-1

Assumptions

1. *Long or irregular shaped blocks have a relatively large perimeter and are more likely to be colonised by invading woodland species. They also have a large amount of edge habitat, and high associated structural diversity.*
2. *Plots larger than 2 ha are beneficial for bird communities, and also for floral diversity (Fuller* et al., *1995).*
3. *Coniferous woodland tends to be less diverse floristically and faunistically than either mixed or deciduous woodland. Scrub species, in contrast are very beneficial to bird populations, particularly species of edge habitats. Scrub also creates extra layers of habitat in woodland and therefore contributes to increased species and structural diversity.*
4. *Native tree species tend to have a higher number of associated invertebrate species.*
5. *Woodland type features within 100m are a source of colonising species and help link planted blocks to wildlife corridors.*
6. *Topographic features within a block increase habitat and structural diversity.*
7. *Rabbits tend to reduce species diversity by killing trees, undermining banks and creating uniform closely grazed swards. The impacts of deer can also be deleterious but are not so clear-cut so have not been included. Voles are beneficial as a source of food for raptors but can also destroy young trees. Their impacts have been included with sward height (note 11 below).*
8. *Natural regeneration results in patchy colonisation and varied age structure, giving higher temporal and structural diversity.*
9. *Both moorland and arable sites have low intrinsic diversity and support many more species and are structurally more varied after planting.*
10. *Ridge ploughing reduces wetness gradients within the site, and disrupts soil profiles and leads to reduced diversity.*
11. *Sward height suppressing other species is judged to be beneficial for some species of birds in providing nest sites and a supply of voles as food for raptors. Impacts on vegetation composition and structural diversity are, however, negative since other species tend to be suppressed.*

Biodiversity Benefits

The analysis indicates that, collectively, the FWPS sites produced increases in biodiversity as assessed by all four of the criteria used: fauna, flora, naturalness and structural diversity. The scheme appears to have contributed more to site level biodiversity than the earlier FWS. This partly reflects the changes in payment structure and conditions associated with the two schemes. The FWPS (and associated WGS) provides higher incentives for broadleaved planting and greater emphasis on planting shrubs as well as trees, on encouraging natural regeneration as well as planting rooted stock, and on managing sites to minimise impacts of grazing and competition from excessive sward growth.

Impacts on Landscape

Landscape Fabric

Impacts on landscape character were generally good, with 94% of all sites having a positive impact. Natural regeneration sites had the highest positive impact. The impact on landscape character differed little with block size, region or land type. The absolute visibility of the majority of sites was quite low, three quarters of schemes having a visibility value of 40% or less of the theoretical maximum. Within their local context (a 2 km radius), the visibility ratio was high, with 75% of schemes having a visibility ratio exceeding 0.5 (*i.e.* sited in the most visible 50% of the surrounding land).

Visual Impacts

The majority of blocks (72%) related well to the scale of landscape elements and features in their immediate surroundings. The impact of block shape was generally positive or neutral, with only 7% of negative impacts. The highest proportion of blocks of positive shape was in the small size category (79%). Sites on improved LFA land were notable for the relatively low proportion of positive shape scores (58%). By contrast, for sites on unimproved LFA land, positive shapes were dominant (85%). Well-graded (40%) and intermediate (43%) edge types accounted for the majority of blocks in both samples. However, a significant minority of schemes (17%) was adjudged to have sharp edges which would detract from the landscape scene. Unsurprisingly, the natural regeneration sites were considered to have well-graded edges. Grampian and Strathclyde had the highest proportions of well-graded sites (53% and 50% respectively). Lothian and Borders had the highest proportion of 'sharp-edged' plantations (53%).

Landscape Benefits

The results of the evaluation show that, in the overwhelming majority of cases, the overall impact on the landscape character was positive. Only a small percentage of sites had a visually intrusive shape, which was encouraging since shape is the single most important factor in woodland design (Forestry Commission, 1994). Where sites tend to be more visually prominent (*e.g.* in Highland Region), the public perception of the impact will be further accentuated.

The analysis indicated a number of key areas where improvement might be targeted:

- a small percentage of sites which relate poorly to the local landscape character or of visually intrusive shape
- a sizeable minority of sites with visually intrusive edge design or which are perceived to be out-of-scale with their surroundings.

Policy Appraisal

The scheme succeeded in creating a substantial area of new woodlands in Scotland, provided opportunities for timber production, and contributed to the enhancement of biodiversity and landscape. The geographical spread of planting indicated that farmers throughout most of Scotland had the opportunity to benefit from the incentives offered. In the context of the objectives set for the scheme, the evaluation concluded that it had been broadly successful. However, the policy objectives were stated in the vaguest terms. Whilst this can be identified as a strategy that minimises the risk of policy failure, it results in a scheme that is poorly focused as regards the desired scale, species composition and geographical distribution of planting. Even so, it was possible to raise a number of pointers for policy review.

As with the FWS (Appleton and Crabtree, 1991), the public benefits from FWPS were primarily in terms of environmental output. Timber production was an objective in planting in only a minority of cases (35%) and timber has little to recommend it as a form of diversification for farmers facing financial pressure from agricultural policy reform (Crabtree,

1995). The long-term nature of the investment and its uneven cash flows limit its attraction as an alternative crop. Those farmers who had timber production objectives were typically those on large LFA farms, where low opportunity costs coupled with sizeable WGS and FWPS incentive payments made commercial planting attractive. More detailed analysis of the additionality of FWPS incentives (Crabtree, 1996) pointed to the low effectiveness of FWPS payments in these circumstances, since much of the planting would have taken place under WGS alone.

There was little question that the FWPS increased biodiversity at site level and provided a greater net contribution to biodiversity than the FWS. WGS guidelines had successfully prevented planting on sites where losses in biodiversity would have occurred. However, more detailed analysis of the field data (Crabtree, 1996) indicated surprisingly little regional diversity in the species planted under FWPS. There may be potential for greater matching of species composition and site layout to suit local landscape and ecological characteristics (Soutar and Peterken, 1989). Both from a visual and wildlife perspective, a major concern about new plantings is that they should be as appropriate as possible, with native species and mixtures that blend together and with the landscape setting. The indication is that at a broader scale, policy should aim to increase regional biodiversity by creating woodlands with varying characteristics to suit different regions and localities.

The evaluation found that the Forestry Commission landscape guidelines and procedures for WGS approval generally worked well. Only in a small percentage of cases did sites have undesirable landscape characteristics. There is scope both for ensuring greater compliance with current guidelines and for providing specific incentives to enhance biodiversity and landscape benefits. In particular policy could:

- encourage natural regeneration schemes
- ensure more rigorous guidelines in the design of large blocks, to which the landscape is more sensitive
- increase the minimum size of blocks
- encourage the inclusion of a network of rides, glades and fringe areas to increase site patchiness
- encourage greater use of inclusion of shrubs to promote development of a tiered structure to woodland and as components of good edge design
- encourage the maintenance of open areas near to water and discourage draining
- encourage the planting of blocks close to other woodland or scrub to create wildlife corridors.

The main issue in a review of FWPS policy concerns the structure and magnitude of the incentive payments since the payment is the principal instrument by which FWPS seeks to achieve its objectives. The current incentives had resulted in 83% of the area planted being on LFA land, a much higher proportion than under FWS. High opportunity costs on mixed and arable land in the lowlands limited non-LFA uptake and additionality on LFA land was relatively low (Crabtree, 1996). There is thus a case for shifting the balance of payments in favour of planting on non-LFA land, and varying the incentives in relation to opportunity cost.

Finally, the FWPS is not a locationally targeted scheme and this raises the issue of whether the planting might be better targeted to contribute to biodiversity and landscape in specific areas of the country. It is evident, for example, that the benefits from visual appreciation of woodland are much greater where woodlands are within close proximity to centres of population (Bateman *et al.*, 1995). In addition, the lack of regional differences in species composition suggested that firmer regional guidelines might be introduced in order to maximise the regional contribution of FWPS to biodiversity.

In the event (SOAEFD, 1996), and as suggested in this evaluation, the scheme has been re-focused to concentrate on environmental enhancement. Payment differentials have been adjusted to reduce the relative attraction of planting on unimproved and LFA land, and to increase scheme effectiveness by greater differentiation of payments according to land type. Specific environmental issues are to be addressed through improved advice and promotional literature.

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References

Appleton, Z.E.D. and Crabtree, J.R. (1991): The Farm Woodland Scheme in Scotland: An Economic Appraisal. *SAC Economic Report* **27**. Scottish Agricultural College, Aberdeen.

Bateman, I.J., Brainard, J.S. and Lavett, A.A. (1995): Modelling Woodland Recreation Demand using Geographical Information Systems: a Benefit Transfer Study. *CSERGE Working Paper GEC* **95-06**. School of Environmental Sciences, University of East Anglia.

Countryside Commission (1993): Landscape Assessment Guidance. *CCP* **423**. Countryside Commission, Cheltenham.

Crabtree, J.R. (1995): Agricultural Policy Reform and Farm Forestry. In Forestry, Agriculture and the Environment. OECD, Paris.

Crabtree, J.R. (Ed). (1996): Evaluation of the Farm Woodland Premium Scheme, Economics and Policy Series No. 1. Macaulay Land Use Research Institute, Aberdeen.

Forestry Commission (1994): Forest Landscape Design Guidelines. HMSO, London.

Fuller, R.J., Gough, S.J. and Marchant, J.H. (1995): Bird Populations in New Lowland Woods: Landscape, Design and Management Perspectives. In The Ecology of Woodland Creation. Richard Ferris-Kaan (Ed), 163-182.

Land Use Consultants (1991): Landscape Assessment: Principles and Practice. A report to the Countryside Commission for Scotland.

Landscape Institute (1995): Guidelines for Landscape and Visual Impact Assessment. E and F Spon, London.

MAFF (1991): Our Farming Future. MAFF, London.

MAFF (1992a): The Farm Woodland Premium Scheme - Rules and Procedures. MAFF, London.

MAFF (1992b): The Farm Woodland Premium Scheme. Statutory Instrument 1992, 905. HMSO.

Ordnance Survey (1995): Digital Data Catalogue. Ordnance Survey, Southampton.

SOAEFD (1996): More Flexibility and Increased Payments Rates for Farm Woodland Premium Scheme. Press Notice 2137/96. Scottish Office, Edinburgh.

Scottish Office Environment Department (1994): Our Forests - the Way Ahead. HMSO, Edinburgh.

Souter, R. and Peterken, G.F. (1989): Native Trees and Shrubs for Wildlife. *Tree News*, Sept. 1989, 14-15.