Impacts of the Woodland Grant Scheme and the Farm Woodland Premium Scheme in Scotland

Report for the Scottish Executive

Environment and Rural Affairs Department

CJC CONSULTING

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Abbreviations

AMG	Annual Management Grant
BAP	Biodiversity Action Plan
BLS	Better Land Supplement
CAP	Common Agricultural Policy
CSA	Council for Scottish Archaeology
CWS	Community woodland supplement
DMG	Deer management group
DMP	Deer management plan
FC	Forestry Commission
FHN	Forest Habitat Networks
FTE	Full time equivalent
FWAG	Farm and Wildlife Advisory Group
FWPS	Farm Woodland Premium Scheme
FWS	Farm Woodland Scheme
HAP	Habitat Action Plan
ITE	Institute for Terrestrial Ecology
LCA	Landscape character assessment
MAFF	Ministry of Agriculture, Fisheries and Food
MLURI	Macaulay Land Use Research Institute
NGO	Non-governmental organisation
NSA	Nitrate Sensitive Area
PEC	Pan-European Criteria
PR	Public Relations
RCAHMS	Royal Commission on the Ancient and Historic Monuments of Scotland
RDPS	Rural development plan for Scotland
RDR	Rural Development Regulation
RSPB	Royal Society for the Protection of Birds
RSS	Rural Stewardship Scheme
SAC	Special areas of conservation (Habitats Directive)
SEERAD	Scottish Executive Environmental & Rural Affairs Department
SEPA	Scottish Environmental Protection Agency
SFS	Scottish Forestry Strategy
SNH	Scottish Natural Heritage
SPA	Special Protection Area (Birds Directive)
SSSI	Site of Special Scientific Interest
UKFS	United Kingdom Forestry Standard
UN	United Nations
WGS	Woodland Grant Scheme
WIG	Woodland Improvement Grant
WO	Woodland Officer
WTS	Woodland Trust Scotland
YC	Yield class

Executive Summary

Remit: This study was commissioned by the Scottish Executive to assess the extent to which the Woodland Grant Scheme (WGS) and Farm Woodland Premium Scheme (FWPS) were meeting their objectives and were in keeping with broader rural development objectives in Scotland. The aim of the research was to identify and assess the economic, environmental, social and community, and administrative impacts of forestry and farm woodlands under the grant schemes. (1.1)

Methods: The time scale of the study did not allow for on-site assessment of WGS/FWPS woodlands. We obtained information about the impacts of the grants schemes from previous evaluations and Forestry Commission studies, the academic literature, an analysis of the WGS and FWPS databases, and interviews or surveys of scheme entrants, non-entrants, forestry agents, stakeholders and technical experts. The study concentrated on the period from 1992 to the present. The entrant survey involved a stratified sample of 960 scheme entrants covering both recently planted (1999-2001) and older woodlands (1992-1993). There were 392 usable replies. (1.3)

WGS/FWPS expenditure: Over the 10-year period 1992-2001 WGS expenditure (excluding restocking and FWPS) was £114.8m with the majority (72%) spent on planting and Better Land Supplement. Management and improvement grants took a further 18.6%, and community woodland and forest supplements 2.1%. The more recent years (2000-2002) show little overall change in the balance of expenditure. Allocated FWPS expenditure on approved planting to end 1999 (including future payments) was £61.9 m. Most FWPS planting (82.6%) has been on LFA land (mainly severely disadvantaged). (3.2)

Trends in new woodland planting: The WGS/FWPS have supported 105,307 ha of new planting since 1992, with 39% receiving FWPS incentives. The total planting reached a maximum of just under 16,000 ha in 1994/95 and has fallen in recent years to around 10,000 ha per year. The area of new WGS/FWPS planting now seems reasonably stable and FWPS planting has become a relatively stronger element within WGS. New ‘commercial’ conifer planting has largely shifted to farmland and receives FWPS payments. The proportion of broadleaf planting is now 63%, with a further 12% in native pine and 25% in conifers. (3.4).

Objectives in planting and advice received: The main motives for planting under the schemes were to enhance amenity, encourage wildlife, and improve habitats and the landscape. Timber was only an objective in 25% of cases. 90% of participants used external advice and in the great majority of cases they were satisfied with the advice received. (4.3, 4.4)

Additionality of the grant schemes: The survey responses received from 392 participants suggest that only 10.5% of the woodland area would have been planted without grant aid. Additionality was higher for FWPS applicants (92.9% of the area) than for non-FWPS applicants (84.1%). The additionality of the challenge funding supplement was lower at 59.0% of the area planted. (3.6).

Challenge funding: Allocated expenditure for the seven challenge funded projects was £16.2m (including WGS and FWPS payments), 90% of which has been disbursed on challenges to expand the woodland area. These expansion challenges were successful in planting up a sizeable additional area and contributing to the Scottish Forestry Strategy (SFS) priority to ‘expand the area of well-designed productive forest’. Challenge funding has a clear role where costs vary substantially and where the Commission has difficulty in deciding on a suitable fixed rate of grant. The sharper targeting of challenge funding, as

compared with the WGS planting grants and FWPS, is a strong case for maintaining or increasing the proportion of expenditure devoted to challenges. However, judging from the additionality statistics, challenges may be a relatively expensive route for achieving their objectives. Fixed supplements may perform better once appropriate incentive rates have been discovered. (3.3 and see below).

FWPS payments to non-farmers: We asked those entrants receiving FWPS payments if they 'would have created the woodland if the full annual payments were only payable to farming owners (e.g. if the FWPS rates were to be reduced by 50% if the owner ceased to farm or sold the land to a non-farmer). 30.8% said that they would not have planted and this suggests that reducing payments to non-farmers would reduce total planting under FWPS. (3.6.1)

Management and Improvement grants: There is a case for a shift in the balance of WGS expenditure in favour of management and improvement of existing woodlands in order to extend the public benefits they can deliver. The effectiveness of Annual Management Grants (AMGs) and Woodland Improvement Grants (WIGs) could be improved. The current arrangements are limited in their flexibility and ceiling rates appear low when the public benefit element in the work is high. The evidence supports the case for a greater concentration of expenditure on the enhancement of existing woodlands particularly in relation to achieving environmental objectives. Many woodlands planted over the past three decades could be substantially improved for biodiversity by relatively moderate investment in management schemes. (3.7, 6.1, 8.6)

Commercial returns from new planting: Discounted cash flow calculations revealed that the main types of planting all show very low returns to capital at current costs and prices. This is a factor explaining the downturn in commercial planting and a disinclination to thin. 50% of applicants said that the grant aid they received covered the costs of planting and income foregone; the reminder said it did not. The 'under-funding' appeared to be higher on non-FWPS land, on small woodlands and with coniferous planting. However, this does not indicate that the incentives are pitched incorrectly. What is important is that funding is directed at procuring additional public benefits. There may be a case for offering greater support to established woodlands but only if environmental benefits are at risk from reduced management (5.2)

Impacts on employment - planting and maintenance: The impact of WGS/FWPS planting on rural employment was estimated using employment coefficients derived from an input-output study on Scottish forestry. From 105,000 ha of new planting over the last decade, around 600-1,180 net additional jobs are estimated to have been created in the planting/establishment phase. Thee include all multiplier effects within the Scottish economy. The range reflects uncertainty about the extent of job displacement from the planted land. (5.4)

Total impacts on employment – timber harvesting and processing: When timber harvesting is included, we derived indicative estimates for the total FTEs created of 1,560-2,140 FTEs. The range depends on the extent of job displacement. They are based on the assumption that 30% of the broadleaved and farm woodland area is harvested. The harvesting jobs will not materialise for another 25 to 50 years and should not be given the same weight as current jobs. At least two-thirds of all the jobs created are expected to be located in rural parts of Scotland. (5.4)

Other employment impacts: There will be some jobs created from grant expenditures on forest management and indirect benefits to tourism through landscape and recreational impacts on tourist spending. We were unable to estimate the magnitude of these but the tourism effects could be significant. (5.4, 5.6)

Social impacts: The main social impacts of the schemes are through access creation and enhancement using the Community Woodland Supplement (CWS), AMGs and WIGs. The CWS had successfully created over 300 new accessible woodlands near centres of population in Scotland. The majority of the woodlands were highly valued by the public but a significant proportion did not represent good value for money because of their poor quality and low rates of use. No evaluation had been undertaken of the recreational benefits derived from AMGs and WIGs. The CWS evaluation suggests that problems of additionality, information to the public and integration within wider access networks may need to be addressed. The Land Reform Bill will change the policy framework for access. There is scope for an incentive based policy to build enhanced public opportunities and benefits on to the expanded rights of public access. (5.5)

Impacts on biodiversity: There is great potential for new planting to substantially increase biodiversity in the short term; however the habitat initially created is not suitable for woodland species. Without support for woodland management the anticipated increases in woodland biodiversity may not be met. In recent years there has been an increase in management and establishment practices that are likely to increase diversity, although this needs further encouragement. (6.2)

Impacts on habitats: The WGS and FWPS objectives to create new woodlands and provide new habitats have been fulfilled. There was confidence that funds targeted through challenge funds, woodland initiatives and forest planning are leading to locally appropriate planting. However, concerns were raised about the standard grant procedures, which it was felt tended to produce a uniform woodland that did not reflect the local region. (6.3)

Landscape enhancement: It was difficult to assess the impacts on the landscape as there is no landscape strategy upon which to base such an evaluation. However, the evaluation by ITE demonstrates that most of the woodlands created under FWPS made a positive contribution to the landscape (Crabtree, 1996). Assuming similar results are applicable to the WGS, this would imply landscape improvement, therefore fulfilling the FWPS and WGS objectives to improve the landscape. (6.4)

Pollution reduction: The WGS/FWPS new woodland plantings are likely to be contributing to pollution reduction in Scotland. The change in land use from agriculture to forestry will immediately reduce methane, ammonia and nitrous oxide emissions. There will be reductions in soil methane emissions and the soils and trees will gradually lock up carbon over long periods. All new plantings are likely to scavenge atmospheric pollution and the broadleaf-native dominated plantings will have lesser impacts on water yields than coniferous planting. (6.5)

Sustainable use of land and resources: There has been a greater emphasis on the linking of woodlands, which will provide increased conservation value and support the formation of Forest Habitat Networks. Sustainability is a core theme in the SFS and UKFS and the UKFS establishes performance indicators for sustainability. However, there are no publicly available results from the Commission's monitoring programme on which we could base an assessment of the sustainability of the forest estate. (6.6)

Impacts on designated areas (SSSI, NSA), waterways and archaeological sites: Over 15% of sites are on or adjacent to SSSI, SAC or SPA and it is inevitable that the schemes are having an impact on these sites. The technical interviews suggested there was a varied treatment of designated sites and the literature suggested some evidence of damage to these sites. It was felt that there was protection of the archaeological resource under WGS/FWPS during the establishment phase of woodland planting. However, there was no information available about the post-planting phase. Therefore it is not possible to evaluate the impacts of the grant schemes on the archaeological resource. (6.7)

Impacts of deer: Deer management has implications for biodiversity and the protection of priority habitats and species. This issue spans a number of the priorities and objectives detailed in the SFS, UKFS and those of the WGS and FWPS. The increase in forested land and resulting increase in deer is a contentious issue and over a third of the participants' woodlands were suffering from deer damage. Technical interviews suggested deer control was not sufficiently coordinated locally. (6.10)

Administration of the schemes: The great majority of scheme participants found the administration of the scheme satisfactory. Ten per cent found it unsatisfactory although criticism in most case appeared relatively minor. The total numbers of slow approvals (unapproved after 18 months) and expired plans (no grant claim within 6 years of approval) were not unreasonably large. Protracted consultation was a problem for a small number of applicants (7.5)

Performance of the schemes in relation to the Scottish Forestry Strategy: The impacts of the schemes were compared with the SFS priorities and indicators. The summarised assessment is given in Table 8.1. It indicates that the grant schemes contribute to achieving the relevant priorities in most cases. In some cases a lack of monitoring restricted the extent to which performance could be assessed. (8.6)

Performance of the WGS: The WGS incentives have delivered on all the scheme's objectives. The additionality of the fixed incentives is high which means that little planting will take place without them. The administration of the WGS and the advice offered by Commission staff appears good with a low level of dissatisfaction.

There may be potential to improve effectiveness as follows:

- Discretionary selection for planting based on scoring of expected benefits. This will prioritise expenditure on planting. An even more effective measure would be to link benefit to cost and select on a value for money basis.
- More targeted initiatives with challenge funding and special supplements. But there is also a danger that if challenges may lead to much increased levels of incentive (and expenditure) and this may not always represent good value for money. Special supplements are preferred, with the prior use of challenges to discover the incentive levels required.
- A shift in the balance of expenditure towards the management and improvement of existing woodlands. The performance of AMGs and WIGs could be improved. There is a strong case for paying more than 50% on WIGs where a higher proportion of public benefits is delivered (e.g. with public access) and for moving away from one-off capital payments.
- The current poor returns from commercial forestry may need to be addressed by increased grant aid if the environmental output from existing plantations is at risk. (8.6)

Performance of the Farm Woodland Premium Scheme: The FWPS has delivered a substantial area of new planting on farmland and remains a central source of finance for woodland expansion. Its key objectives are to improve the landscape, provide new habitats and increase biodiversity. In reality, it derives its mechanisms for achieving this from standards set by the WGS, and becomes a financial mechanism that compensates farmers for income foregone. It is untargeted in terms of the environmental objectives it is aiming to achieve.

FWPS will increasingly be compared as an RDR mechanism alongside the Rural Stewardship and other schemes. The RSS is strongly targeted with well-specified environmental objectives, is linked well to the BAP and has competitive participation to enhance value for money. The aims of FWPS are admittedly not the same as those for the RSS. But there is a case for FWPS to move in the same direction. Objectives better linked to BAP and more clearly defined in terms of landscape contributions would enhance its environmental performance. Selective entry would improve value for money. (8.6)

1 Introduction

1.1 Remit

This study was commissioned by the Scottish Executive to assess the extent to which the Woodland grant Scheme (WGS) and Farm Woodland Premium Scheme (FWPS) were meeting their objectives and were in keeping with broader rural development objectives in Scotland. The aim of the research was to identify and assess the economic, environmental, social and community, and administrative impacts of forestry and farm woodlands under the grant schemes. The specific objectives stated in the remit were to assess the following impacts of the schemes:

- on rural businesses and the rural economy
- the environmental impacts achieved and anticipated under the schemes
- the social and community impacts
- impacts of the administration
- long-term benefits

After discussion with the advisory group responsible for the study, it was agreed that it was not possible within the budget allocated to evaluate the complete range of incentives available within the WGS and FWPS. The main focus was to be on woodland creation under the grant schemes with more limited consideration given to woodland management. The 1992-2001 period was used as the period for analysis in order to allow a range of new and older plantings to be studied, dating back to the inception of FWPS.

1.2 Policy context

1.2.1 Policy development 1992-1999

There were a number of important policy developments that shaped the objectives and structure of the grant schemes from 1992. After the commitments made at the Rio Conference in 1992 and at the 1993 Ministerial Conference on the Protection of European Forests in Helsinki (PEC), the government adopted a forestry policy that promoted sustainability (see Appendix 3-6). Council Regulation 2080/92 instituted a Community aid scheme for forestry measures in agriculture and this provided part funding for eligible forestry activities.

Forestry and woodland policy was subjected to review in 1994 (Scottish Office Environment Department, 1994). The Forestry Review identified the challenges for forestry as continued further expansion Britain’s productive forest area, improving the quality of timber’ preventing loss of woodlands and especially native woodlands, and protecting and enhancing recreation benefits offered by forestry. The WGS had already been modified in 1992 to include the introduction of management grants, the Community Woodland Supplement and payments for open space within new planting. Additional changes to the WGS that followed the review are outlined in Section 2.2. The FWPS was evaluated in 1996 (Crabtree, 1996) and re-launched in 1997 (see 2.3 for details)

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[1] We include natural regeneration within the term ‘new planting’.

[2] Unless it is made clear from the context ‘broadleaves’ includes native Caledonian pine because this is paid the same rate of planting grant as broadleaves.

In 1998, as a response to the theme of sustainable forest management, the UK Forestry Standard (UKFS) (Forestry Authority, 1998) set out the criteria and standards for the sustainable management of all forests and woodlands in the UK. It is compatible with the Helsinki Guidelines and the PEC and described how international commitments will be delivered in the UK (Scottish Executive, 2000b).

1.2.2 Current policy context

Important policy developments have occurred since 1999. These developments post-date much of the period to which this evaluation refers.

The **Rural Development Regulation** (1257/99) (RDR) sets out Community support policy for forestry. Article 29 indicates that support shall contribute to the maintenance and development of the economic, ecological and social functions of forests in rural areas by promoting one or more of the following objectives:

- Sustainable forest management and development of forestry
- Maintenance and improvement of forest resources
- Extension of woodland areas.

Articles 30 and 31 deal with the afforestation of non-agricultural and agricultural, and investment in existing forests.

The **Rural Development Plan for Scotland** (RDPS) is being implemented under the RDR. The RDPS has two priorities:

- Priority 1: to assist the future viability and sustainability of Scottish farming
- Priority 2: to encourage farming practices which contribute to the economic, social and environmental sustainability of Scotland's rural areas.

Forestry is the second of two measures under Priority 1, and the implementation mechanisms are the WGS and FWPS. Grant aid is provided under Article 31 for agricultural land and Article 30 for non-agricultural land (outside Objective 1 areas).

In 2000 the Scottish Executive (2000) published the **Scottish Forestry Strategy** (SFS) which lists five strategic directions for forestry in Scotland. These are:

- To maximise the value to the Scottish economy of the wood resource becoming available over the next 20 years;
- To create a diverse forest resource of high quality that will contribute to the economic needs of Scotland throughout the twenty-first century and beyond;
- To ensure that forestry in Scotland makes a positive contribution to the environment;
- To create opportunities for more people to enjoy trees, woods and forests in Scotland; and
- To help communities benefit from woods and forests.

Twenty-two priorities are listed in the plan. Table 1-1- lists the priorities for which the WGS and FWPS are likely to be major delivery mechanisms.

Table 1-1 Selected priorities under the Scottish Forestry strategy

Strategic Direction	Priority
2	Expand the area of well designed productive forest Improve timber quality by following good forest practice Develop more mixed forests
3	Improve management of semi-natural woodlands Extend and enhance native woodlands by developing Forest Habitat Networks Increase diversity of the farmed landscape Contribute to a radical improvement in the quality and setting of urban areas
4	Provide woodland recreation areas near towns
5	Create wider employment opportunities

The Forward Strategy for Scottish Agriculture (Scottish Executive, 2001) refers to forestry only in the context of the RDR, indicating that forestry schemes are one of the elements of the RDPS that will underpin economic, social and environmental objectives in agricultural policy.

1.3 Approach and methods

We obtained information about the impacts of the grants schemes from three sources:

- Published and unpublished studies including previous evaluations of the FWPS and WGS, Forestry Commission reports and the academic literature;
- Analysis of the WGS and FWPS databases; and
- Additional surveys of entrants, agents, stakeholders, technical experts, and non-entrants (those applying for grants aid but not ultimately receiving payment).

1.3.1 Analysis of the WGS and FWPS databases

Details of all WGS applications (plans) made between January 1992 and August 2001 were downloaded from the Forestry Commission's database. These were used for two purposes. The first was to define the population structure and sampling frames for the entrant and other surveys. The second was to give basic statistics on the impacts of the schemes.

The SEERAD FWPS database was also analysed for details of the types of land planted and expenditures under the scheme.

1.3.2 Survey of entrants into WGS and FWPS

Sample frame

It was agreed that we should investigate scheme impacts for two periods. These were

- 1992-1993: a period that included the oldest FWPS schemes and would contribute information on the longer term impacts of the schemes
- 1999-2001: the most recent period which would be informative about the current operation and uptake of the schemes.

The unit of analysis was the WGS plan, and for the entrant survey we selected those plans that had an application date of either 1992-93 or 1999-2001, where new planting[3] formed

[3] We include natural regeneration within the term ' new planting'.

part of the plan, and where planting grant had been paid. There were 2,512 plans that satisfied these criteria. We investigated the structure of this population and set up a stratified sample frame based on the year of application (1992-93, 1999-2001), area planted (<10 ha, >10 ha), scheme (with an FWPS application on part/all of the plan, without any FWPS element), better land supplement status (better land, not better land) and species mix (>50% conifers, > 50% broadleaves or native Scots pine[4]). The population structure is given in Table 1-2. There are 32 individual cells and the intention was to sample 960 of the 2,512 plans.

Table 1-2 Number of WGS/FWPS plans involving new planting on which grant has been paid (1992-93 and 1999-01)

			92-93		99-01		grand total
			<= 10 ha	>10 ha	<= 10 ha	>10 ha	
			no. of plans	No. of plans	no. of plans	no. of plans	no. of plans
No FWPS element in plan	> 50% conifer	No BLS	68	26	11	4	109
		BLS	44	18	11	1	74
	>=50% BL or SPC	No BLS	387	105	147	42	681
		BLS	314	28	91	9	442
FWPS element in plan	> 50% conifer	No BLS	26	18	1	3	48
		BLS	89	66	27	63	245
	>=50% BL or SPC	No BLS	62	82	45	83	272
		BLS	364	92	146	39	641
All			1,354	435	479	244	2,512

There is a preponderance of plans that involve >50% broadleaves (81% of the total), planted areas under 10 ha (73% of the total) and 1992-93 plans (71% of the total). The structure was well balanced for the proportion of plans with FWPS (48% of the total) and for plans receiving better land supplement (56% of the total). Since we wished to explore as wide a range of planting as possible, we selected all plans in cells where there were 35 or less and randomly above that figure, to give a total number of 960.

Questionnaire and procedures

A postal questionnaire was used (Appendix 4). Forty-four per cent of the 960 questionnaires were returned, of which 40.8% were usable (392). When presenting the results, responses are weighted to account for the sampling intensity and the proportion returned.

1.3.3 Survey of advisers, agents and managers

Interview structure

Telephone interviews were arranged with a sample of 16 advisers, agents and managers (hereafter called agents) involved in the woodland sector. The sample was designed to ensure a geographical coverage of Scotland as far as possible, and to include at least one agent, adviser or manager who was, or is, involved in the Grampian Forest Challenge Fund, the Central Scotland Forest Challenge Fund and the Native Pinewood Scheme in North Scotland. The sample was selected to include agricultural advisers who had experience with FWPS and WGS applications as well as specialist forestry advisers.

The telephone interviews were structured and covered client motivation, changes in the client mix over time, reasons for clients not joining WGS or FWPS, maintenance and

[4] Unless it is made clear from the context, ‘broadleaves’ includes native Caledonian pine because this is paid the same rate of planting grant as broadleaves.

management of woodlands, administration of the grant schemes, changes to the schemes that may encourage uptake, impact of the schemes on species planted and the local economy, and suggestions for improvements to the schemes.

Activities of agents interviewed

The agents interviewed were involved with an average of 2,730 ha of grant-aided planting over the last five years. This represented about 40% of all new FWPS supported planting and 12% of all WGS-only planting. The reason for the lower percentage of WGS-only planting may be because a significant area of new planting is handled by the larger estates and organisations who have their own professional foresters.

1.3.4 Survey of stakeholders and technical experts

The Scottish Executive has undertaken a comprehensive consultation in relation to the WGS/FWPS Review. In order to avoid duplication we selected a subset of consultees (18) that we considered might best be able to inform the evaluation through their experience with the policy. We wrote to them asking if they had any additional views that they wished to draw to our attention that related specifically to the grant schemes. Only eight replied and in most cases they provided us with no more than the text of their response to the wider consultation exercise. Where consultees provided additional information we have included this in the analysis of economic, social and environmental impacts.

In order to respond to some specific environmental questions in the remit, we undertook telephone interviews with a number of organisations and technical experts that had particular responsibilities or knowledge in the areas of biodiversity protected sites, archaeology and landscape (See Appendix 4). The intention was not to engage in a consultation with environmental stakeholders since this was already being undertaken within the national consultation. Rather it was to seek information that would assist the team in responding to specific points in the remit (for example, impacts of the grant schemes on designated sites). Telephone interviews were undertaken in each case.

1.3.5 Survey of non participants in WGS/FWPS

Surveys were set up to investigate applications for WGS/FWPS that had either not been approved in a reasonable length of time or had been approved but for which grant had not been paid. No new surveys were undertaken to explore the reason for non-participation in WGS/FWPS but a comprehensive literature review was undertaken and this was amplified by questions in the survey of agents.

Survey of 'Applied-not-approved' WGS/FWPS plans

The WGS database contained 147 applications for WGS (of which 53 for FWPS) made before April 2000 which involved establishment, (new planting, natural regeneration or restocking), or management for which approval had not yet been granted. Of the 147, 77 plans included new planting or natural regeneration (of which 48 were plans that involved FWPS). We undertook telephone interviews with a small random sample (10 with FWPS, 10 non-FWPS) of the 77 plans that involved new establishment.

Survey of expired WGS/FWPS plans

The database also contained a number of approved plans involving establishment where no grant had been paid after 6 years ('expired plans'). In order to investigate why this occurred we undertook a small telephone survey of 20 plans. These were randomly selected from the 297 plans (of which 85 had an FWPS element) involving establishment, where the contract end date was before 1/4/2000.

2 WGS and FWPS: policy rationale and mechanisms

2.1 Woodland Grant Scheme (WGS)

The WGS commenced in 1988 and was modified in 1994 after the publication of the Forestry Review (Scottish Office Environment Department, 1994). The review retained the basic structure of WGS incentives but sought to improve the WGS in order to:

- Increase the productivity and area of forests where this is economically justified so as to raise the country's wood production potential;
- Increase the amenity and environmental benefits from forests, and
- Increase the value for money from WGS expenditure.

After the review, the WGS incentive structure was simplified, the better land supplement increased, the re-stocking grant reduced, changes made in grant aid for natural regeneration, and new initiatives introduced for woodland management, woodland improvement and the procurement of recreational and environmental benefits.

- The current aims of the scheme as stated in the October 2000 Guide to the Woodland Grant Scheme (Forestry Commission, 2001a) are to:
- Encourage people to create new woodlands and forest to:
    - Increase the production of wood,
    - Improve the landscape,
    - Provide new habitats for wildlife,
    - Offer opportunities for recreation and sport;
- Encourage good management of forests and woodlands, including their well-timed regeneration, particularly looking after the needs of ancient and semi-natural woodlands;
- Provide jobs and improve the economy of rural areas and other areas with few sources of economic activity; and
- Provide a use for land instead of agriculture.

The standards for 'good management of forests and woodlands' are those enshrined in the UKFS section 7.46 (Forestry Authority, 1998). The scheme is open to any type of applicant and uses grant aid as its main instrument. Table 2.1 summarises the main types of grant aid currently available (Forestry Commission, 2001a). Applications must satisfy certain silvicultural and environmental standards in order for plans to be approved.

The range of grant aid available has increased over time as new priorities have been established for woodland management (e.g. the woodlands improvement grant) and the procurement of targeted benefits (such as community woodlands that provide recreational access).

Table 2-1 Principal types of grant aid available under the WGS (£ per ha)

Type of grant aid	Rate
NEW WOODLANDS	
Planting grant (new planting)	£700-1350
Natural regeneration	A discretionary payment at 50% of costs plus £325-£525
Better land contribution	£600
Community Woodland contribution	£950
Community Forest premium	£600
Challenge funding	Targeted – competitive bids
EXISTING WOODLANDS	
Re-stocking grant	£325-£525
Annual management grant	£175 over 5 years – discretionary
Woodland improvement grant	50% - discretionary
Challenge funding	Targeted – competitive bids

In addition to the grant aid listed in Table 2-1, a bidding system was introduced in 1995 for special targeted projects. Since 1996 seven challenges have been established (Table 2-2).

Table 2-2 Challenge funded projects

Challenge	Title	Date
Expansion Challenges	Grampian	1997-2002
	Forest of Spey/Deeside Forest	1997-2000 (now closed)
	Central Scotland	1999-2002
Management (WIG) Challenges	Central Scotland Forest	1996-1999 (now closed)
	Argyll and Bute Oakwoods	1996-2001 (now closed)
	Cairngorms	1996-2001 (now closed)
	Capercaillie	2001-2002 (now closed)

2.2 Farm Woodland Premium Scheme (FWPS)

The FWPS provides additional payments to farmers over and above those available under the WGS. It was introduced in April 1992 as a successor to the Farm Woodland Scheme and has become progressively more closely linked to the WGS. It was evaluated in Scotland in 1996 (Crabtree, 1996).

In 1997, after a policy review, adjustments were made to the objectives, administration and payment rates for the scheme. The objectives of the scheme are now re-stated in the RDPS as:

- to enhance the environment through the planting of farm woodlands by improving the landscape;
- providing new habitats and increasing biodiversity; and to
- provide farmers with ongoing income through annual payments to compensate for agricultural income foregone.

Farmers wishing to plant under the scheme must first apply for, and be accepted under, the WGS. The FWPS provides payments to compensate for the loss of agricultural income as indicated in Table 2-3.

Table 2-3 Rates of payment under the FWPS (£ per ha)

	Outside the LFA	LFA (DA)	LFA (SDA)
Arable land	300	230	160
Other improved land	260	200	140
Unimproved land	Ineligible	60	60

2.3 Economic basis for forestry-related payments

New planting

The starting point for specifying policy intervention is usually that of market failure. Intervention is used to correct a situation that is distorted by other policies or one that fails to deliver the socially optimal level of public goods. In the case of forestry, the assessment has to be done on a net basis since existing land use is displaced. The following are thought to be the main sources of market failure:

- Distortions in the land market which would result in reduced forestry investment. The most obvious source is agricultural support under the Common Agricultural Policy (CAP) which increases the returns from land and raises the price of land for forestry. The most recent analysis of this distortion suggested that compensation should reduce the price of land to 54% of that for agricultural use (Harvey, 1994). However, Pearce (1994) argues that this fails to account for the positive environmental and social externalities from agriculture (see 2 below). He suggests that the social value of farmland may be 80% of the free market price.
- ‘Public good’ outputs from forestry. These include the protection and enhancement of landscape, amenity, biodiversity, wildlife habitats and soils. In addition there are recreational benefits including knock-on effects on health. The benefits would have to be adjusted for any public good benefits or disbenefits from the displaced land use (e.g. biodiversity benefits from agricultural use).
- Rural development benefits that derive from reversing the trend towards economic and social decline and depopulation of the countryside (Council Regulation 1257/99). These can also be considered as public good effects and would include any impacts on local community welfare (CJC Consulting, 2000). Again, it is the net impact that is important, taking account of the losses in rural development from any displaced activity on the planted land.

2.4 Cost-benefit of woodland policy

A number of studies have been undertaken to establish the public cost-benefit from intervention in forestry. Pearce (1994) demonstrated the highest returns on capital of 6.0% for upland spruce with a high recreational value and low shadow price for land. Semi-natural broadleaves produced a near zero return. Macmillan (1993) found that 12-48% of existing Scottish forests failed to produce a 6% social return, which at the time was the government’s target return[5]. However, the inability to include many of the environmental benefits from forestry, due to a lack of reliable valuations, limits the use of such results for policy. What they do make very clear is the variability in woodland benefits that occurs depending on the

[5] Timber prices have fallen dramatically from the prices use in these studies and this would substantially reduce the actual returns achieved.

characteristics of the woodland, its location, accessibility by the public, and the previous land use.

2.5 Incentive mechanisms

The WGS and FWPS incentive payments exist primarily to secure public benefits from new planting and from changes to the management of existing woodlands. The amounts paid to support new planting vary enormously with the context and any additional benefits procured. Table 2-4 demonstrates the range that occurs in practice. One extreme example is for small-scale broadleaved planting on arable land that receives planting grant, BLS and FWPS payments. The total incentive is £6,450 per ha distributed over a 15-year period. The second column (£700 per ha) is for coniferous planting on land that does not quality for FWPS or BLS. In practice a proportion of broadleaves would be required and the incentive paid would depend on the proportion planted. The final column gives an example of the cost of the Grampian challenge for planting largely conifers on arable land. Here, both FWPS and a challenge supplement would usually have been paid. The total cost is around £5,600 per ha. In each case, an additional £950 per ha could be paid for access provision under the Community Woodland Supplement.

Table 2-4 Total incentive payments under WGS/FWPS for different types of planting (£ per ha)

Incentive type	Arable land (< 10 ha) (broadleaves)	Unimproved land, non-FWPS (conifers)	Arable land, mainly conifer planting (Grampian Challenge)
Planting grant	1,350	700	860
Better Land Supplement	600		600
Community Woodland Contribution	950		
FWPS (total payment)	4,500		3,000[1]
Challenge supplement			1,200[2]
Total	6,450	700	5,660

Notes 1 For arable land. £2,600 per ha is payable over 10 years on improved grassland.
2 The supplement varies between applicants depending on the bid received.

[9] For example, where payments vary by land quality (reflecting opportunity cost) or species planted (reflecting differences in planting costs and public benefits).

3 Planting, management and improvement under the schemes

3.1 Introduction

This chapter uses the WGS and FWPS databases to identify the expenditures on the schemes and their impacts on woodland creation and management. There were 6058 plans approved between Jan 1992 and August 2001 which involved woodland creation where WGS grant had been paid.

3.2 Expenditure on grant aid

Table 3.1 indicates the expenditure within WGS over the period April 1992 to December 2001. The data relates to new planting and management and excludes FWPS and re-stocking. Expenditure was highest at around £13-16 m per year in the 1997-2000 period when there were large areas of new planting.

Table 3.2 summaries these expenditures according to the different types of grant. Over the 10-year period 1992-2001 72% of the expenditures listed was on planting and Better Land Supplement (BLS). Management and improvement grants took a further 18.6%. Community woodland and forest supplements took 2.1% of the total. The more recent years (2000-2002) show little overall change in the balance of expenditure. Management and improvement grants now take just over 20% of the total

Table 3-2 WGS expenditure by incentive type (£ '000)

	1992/93-2001/02		2000/01-2001/02	
Grant Description	**Expenditure**	**Percentage**	**Expenditure**	**Percentage**
Planting	70,221	61.2	15,711	58.0
Better land supplement	12,833	11.2	2,558	9.4
Community woodland/forests	2,418	2.1	272	1.0
Management	18,068	15.7	4,153	15.3
Improvement	3,290	2.9	1,375	5.1
Challenge supplement	5,274	4.6	1,577	5.8
Other	2,716	2.4	1,442	5.3
Total	114,822	100.0	27,088	100.0

Allocated FWPS expenditure on approved planting to end 1999 (including future payments) was £61.9 m. This can very be approximately compared with the £83m expended on new planting under WGS (Table 3-2) although the time periods are different and the WGS payment data does not include future instalments of planting grant.

Table 3-1 WGS expenditure (excluding FWPS and re-stocking, approved for payment, financial years until 31/12/01, £ '000)

GRANT_DESCRIPTION	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	Total	Percent
0-0.99 HA (Grant Band 1) WGS MK II	223	48	388	123	48	64	86	81	48	13	1120	1.0
1-2.99 HA (Grant Band 2) WGS MK II	306	133	737	220	69	77	171	166	85	36	2000	1.7
3-9.99 HA (Grant Band 3) WGS MK II	322	217	934	349	83	80	257	230	113	44	2629	2.3
>= 10 HA (Grant Band 4) WGS MK II	1995	1531	6883	3858	1937	1513	1726	1622	1198	582	22844	19.9
< 10 HA (Grant Band 5) WGS MK III	0	0	84	908	1090	933	1087	852	1023	774	6750	5.9
>= 10 HA (Grant Band 6) WGS MK III	0	0	275	2475	4889	5470	4863	5102	7117	4674	34865	30.4
SHT RTN COPPICE WGS MK III	0	0	0	0	1	0	2	3	2	2	11	0.0
SHT RTN COPPICE SET ASIDE WGS MK III	0	0	0	0	0	0	0	2	0	0	2	0.0
BETTER LAND SUPPLEMENT	431	1598	2063	1365	1139	1030	1615	1034	1466	1092	12833	11.2
COMMUNITY WOODLAND SUPPLEMENT	67	282	444	211	262	151	142	48	163	75	1846	1.6
COMMUNITY FOREST PREMIUM	0	0	0	68	79	110	199	83	33	0	572	0.5
DISCRETIONARY PAYMENT	0	0	0	161	299	500	586	462	751	484	3244	2.8
FIXED PAYMENT NATURAL REGEN	0	0	0	60	16	30	112	56	164	222	660	0.6
LIVESTOCK EXCLN ANNUAL PREMIUM	0	0	0	7	79	202	279	433	581	475	2056	1.8
WOODLAND IMPROVEMENT GRANT	0	0	0	0	214	474	618	609	855	520	3290	2.9
MANAGEMENT GRANT WGS MK II	0	62	286	431	490	515	453	179	47	20	2484	2.2
MG WITH SMALL WOOD SUPP WGS MK II	0	5	14	23	23	22	19	12	1	2	121	0.1
SPEC MANAGEMENT GRANT WGS MK II	0	106	585	1132	1278	1288	1208	647	256	51	6550	5.7
SMG WITH SMALL WOOD SUPP WGS MK II	0	9	40	65	71	69	54	36	7	3	353	0.3
AMG WGS MK III	0	0	0	23	253	534	775	1120	1441	1040	5186	4.5
AMG LUMP SUM WGS MK III	0	0	0	0	3	24	25	28	28	23	130	0.1
CHALLENGE FUND SUPPLEMENT	0	0	0	0	0	862	1910	923	916	662	5274	4.6
TOTAL	3343	3990	12733	11478	12324	13950	16187	13726	16295	10793	114820	100.0

3.3 Challenge funding and supplements

3.3.1 The Scottish challenges

Allocated expenditure on the seven Scottish challenges has so far amounted to £16.2 million[10] (Table 3-1). On a per hectare basis, Grampian has been the most costly, averaging £2,467 per ha. This reflects the level of incentive necessary to induce planting on better land where the alternative agricultural income is relatively high. The Grampian challenge has timber production as a principal aim and at least two-thirds of the area must be planted with high-yielding conifer species (Garforth, 2001). The Deeside challenge where land is of lower agricultural quality and natural regeneration would be possible in some cases, produced bids of only half the Grampian level.

Table 3-1 Details of schemes approved for Challenge funding (data to end Dec 2001)

Challenge	Bids received	Bids awarded	Payment (£ '000)	Area funded (ha)	Cost per ha (£)
Expansion Challenges					
Grampian	234	120	8,060	3,267	2,467
Forest of Spey/Deeside Forest	45	33	1,934	1,469	1,316
Central Scotland	93	50	4,389	1,973	2,224
Total	372	203	14,383	6,709	2,143
Management Challenges					
Central Scotland Forest	47	34	131	Na	Na
Argyll and Bute Oakwoods	64	42	687	Na	Na
Cairngorms	92	59	649	Na	Na
Capercaillie	19	14	362	Na	Na
Total	222	149	1,829	Na	Na

The four management challenges have cost £1.83 million and funded 149 schemes in various parts of the country. We did not set out to evaluate the impacts of Challenge funding in detail because the Commission had already funded a study on the subject (Garforth, 2001). He assessed the overall perceived success of each challenge and assessed whether fixed incentives set at a rate higher than the WGS rates have been more efficient (lower cost) than challenge funding. His conclusions present a mixed picture. As would be expected, the challenge funding provides an incentive to participate. However, in some cases schemes failed to meet objectives and in others a flat rate incentive would have been a lower cost option.

Such *ex-post* analysis is not very helpful in comparing fixed versus bidding approaches. It assumes that the Commission have perfect *ex-ante* information about the bid response curve, whereas in fact they do not. In theory, a challenge approach can be shown to be potentially more efficient than fixed level incentives (Latacz-Lohmann and Van der Hamsvoort, 1997). However, there may be higher administrative costs and applicants may well not bid the lowest price at which they are prepared to participate. In broad terms, the challenge approach will be particularly effective where:

- The public benefits are expected to be greater than those achieved under WGS/FWPS funding.

[10] This includes all WGS payments plus the challenge supplement but excludes any FWPS payments.

- The Commission has limited information on what level of incentive to offer. Challenge funding then operates as a price discovery mechanism.
- Considerable diversity is expected in the costs of participation and/or the public benefits achieved from individual proposals. This will lead to problems in price setting for fixed rate incentives (see 2).
- High participation is required over a short period of time. Challenge funding provides a platform for promoting schemes and this can increased the rate of participation.

3.3.2 Agents' experience with challenge funded schemes

A number of interviewees had experience with challenge funds and they were asked what, if any, difficulties they had experienced and how they could be overcome. A variety of comments were received of which the most significant were:

- The uncertainty associated with decisions on whether an applicant was successful was a deterrent. Private sector landowners usually wanted to plan their business a year ahead, but it took almost 6 months from the time an application was submitted until a decision was made. If an applicant was unsuccessful, there was little an applicant could do with the land until the following year. Many interviewees felt that a flat rate scheme would be more effective in the long run.
- Many agents and managers were concerned that payment was typically delayed until the owner knew whether the application was successful. This may mean a 6-month delay, and some had has difficulties in obtaining payment on unsuccessful bids.
- The schemes appear financially attractive and build up expectations. Unsuccessful applicants feel somewhat resentful and this discourages re-application.

3.3.3 Conclusions

Challenge funding will be the most efficient and effective incentive mechanism in situations that satisfy the conditions listed in Section 3.3.1. Where the Commission is able to accurately judge the entry prices of participants, flat rate incentives set at higher than WGS levels are to be preferred. It is also likely that stronger targeting towards projects where the public benefits are demonstrably high will be a more effective use of expenditure than untargeted grant aid (which typifies much of WGS and FWPS expenditure). The much better focus implicit in challenge funding presents a strong case for maintaining or increasing the proportion of expenditure devoted to challenges.

The expansion challenges were certainly successful in planting up a sizeable additional area and contributing to the SFS priority to 'expand the area of well-designed productive forest'. It is clear that additional planting can be achieved if incentives are pitched at a sufficiently high level. There may be some concerns about the cost of planting commercial plantations on better farmland with challenge funding. In the Grampian challenge, the cost on arable land was up to £5,600 per ha (Table 2-4). The non-timber benefits will probably be greater on the other expansion challenge areas where planting was achieved at lower cost[11].

[11] These comparisons are made on gross cost and do not account for the different cost savings from reduced agricultural support in different areas. However, if it is assumed that the agricultural support is itself delivering rural development and environmental benefits then account should also be taken of the losses in non-market benefit when agricultural activity is reduced.

3.4 Area planted and type of planting

3.4.1 Areas planted under the schemes

The WGS and FWPS have paid grant on 105,307 ha of new planting during the last 10 years (Table 3-2). Thirty-nine per cent of the area received FWPS payments. The total planting reached a maximum of just under 16,000 ha in 1994/95 and is now around 10,000 ha per year (1999 to 2001). The share of planting associated with WGS and FWPS has changed over time as FWPS has increased in relative importance. Non-FWPS planting has fallen from 10,100 ha in 1994/95 to just under 5,000 ha in 2000/01.

The area of broadleaved planting had been increasing under FWPS land, whereas the overall area of conifer planting has been tending to fall. The indication is that new 'commercial' conifer planting has largely shifted to farmland and receives FWPS payments.

Table 3-2 Areas planted (approved for payment) under the WGS and FWPS (ha) (FC WGS database to 31/12/01)

	Broad-leaves	Conifers	Native pine	Open ground	Total area
FWPS					
1992/93	371	169	11	63	615
1993/94	1656	1113	103	544	3417
1994/95	2263	2463	218	888	5832
1995/96	1600	1639	238	584	4061
1996/97	1530	1752	420	727	4429
1997/98	1517	1355	367	424	3662
1998/99	2095	2485	263	698	5540
1999/00	2042	1140	428	486	4096
2000/01	3384	1808	272	681	6146
2001/02	1530	1325	194	485	3533
Total	17988	15251	2514	5579	41332
NON-FWPS					
1992/93	1716	1810	193	528	4247
1993/94	3605	1933	378	927	6843
1994/95	5203	2052	1435	1469	10158
1995/96	4585	1758	1572	1274	9189
1996/97	3660	1733	1733	1260	8386
1997/98	3358	1314	2190	1006	7869
1998/99	1890	917	1239	951	4997
1999/00	2018	526	1792	743	5080
2000/01	2765	380	795	919	4860
2001/02	1376	87	407	477	2346
Total	30175	12511	11734	9554	63975

The average area of new planting under plans which included an FWPS element was 23.9 ha compared with 17.4 ha under non-FWPS plans. These figures include open ground included in the plans and refers to plan area not block area. One plan may contain several blocks or be modified over time to extend previous planting. The average block size under early FWPS plantings was 5 ha (Crabtree, 1996).

Most of the area planted (and corresponding expenditure) is associated with plans in excess of 80 ha for both schemes (Table 3-6). Non-FWPS planting has a higher a proportion of the area in small plans (< 5 ha) and in very large plans (>80 ha). This reflects the more extreme types of planting that fall under WGS–including small areas of local authority, non-farmer occupier and NGO planting. The larger areas of non-FWPS planting reflect the large blocks planted on estates.

The FWPS database gives approved areas rather than grant-paid areas (Table 3-3) and this explains why the areas are higher than in Table 3-4. Most FWPS planting (82.6%) has been on LFA land (mainly severely disadvantaged). Forty-four per cent of the total planting was on unimproved land and 56% on improved or arable land.

Table 3-3 Areas approved for planting under FWPS (ha) (FWPS database)

Category	Land Type	1992	1993	1994	1995	1996	1997	1998	1999	Total
Arable	LFA-D	6	12	10	9	3	311	199	553	1,102
Arable	LFA-SD	86	714	96	61	42	219	277	265	1,760
Arable	Non-LFA	105	516	292	150	109	757	2,463	1,757	6,149
Improved	LFA-D	35	112	39	28	22	145	78	2,042	2,501
Improved	LFA-SD	438	1,290	1,679	1,598	1,470	943	2,490	2,669	12,576
Improved	Non-LFA	154	378	262	258	163	186	442	186	2,030
Unimproved	LFA-D	1	43	50	53	22	41	29	59	298
Unimproved	LFA-SD	568	1,698	2,280	2,231	2,033	2,596	3,591	5,497	20,493
Total		1,393	4,762	4,708	4,389	3,863	5,199	9,569	13,028	46,910

Note: LFA-D is Disadvantaged

LFA-SD is Severely Disadvantaged

Table 3-4 Proportion of total area planted in different size categories

Area (ha)	Plans with an FWPS element (%)	Plans with no FWPS element (%)
0<5	4.5	5.7
5<10	4.9	3.8
10<20	7.4	5.0
20<40	11.7	7.8
40<80	20.2	13.4
>80	51.3	64.3
	100.0	100.0

3.4.2 Species planted under the schemes

Table 3-2 also indicates the areas of broadleaves, conifers, native pine and open ground associated with planting. Overall, discounting the open ground, broadleaves accounted for 53% of new establishment and native pine a further 16%. Conifers accounted for the remaining 31%. Over the decade there has been a shift in policy to support broadleaves and native pine planting and this is reflected in the areas planted. During the years 2000-2002 the proportion of the total area planted in broadleaves was 63%, with a further 12% in native pine and only 25% in conifers. Interestingly, it is the WGS now plants the highest proportion of broadleaves. In the years 2000-2002 only 8% of non-FWPS planting was in conifers compared with 37% under FWPS supported planting.

3.5 Location of planting

Planting that involved an FWPS element was fairly widely spread throughout Scotland although planting in Highland predominated, with 37% of the total area (Table 3-5). Non-FWPS planting was also concentrated in Highland, accounting for over half (53.7%) of all planting. The limited proportion of non-FWPS planting located in Strathclyde and South West Scotland is notable. There has been a clear shift in planting to the Highlands and Grampian in recent years stimulated in part by grant aid for native pine and challenge funding.

Table 3-5 Location of new planting by local authority (1991-2001)

	Plans with FWPS element			Plans with no FWPS element		
Conservancy	**New planting (ha)**	**mean area (ha)**	**%**	**New planting (ha)**	**mean area (ha)**	**%**
Grampian	6,698	13.3	9.7	5,717	9.5	10.1
Highland	25,677	39.1	37.2	30,557	41.7	53.7
Lothian and Borders	4,498	9.7	6.5	2,242	4.2	3.9
Perth	11,285	18.5	16.3	7,583	13.5	13.3
South West Scotland	7,673	22.3	11.1	5,953	17.0	10.5
Strathclyde	13,203	42.3	19.1	4,802	10.6	8.4
			100.0			100.0

3.6 Additionality of the schemes

An important element of the effectiveness of incentive payments is the extent to which they induce woodland planting or management that would not otherwise have taken place. In order to estimate additionalities for the complete WGS and FWPS participation in our sample, entrants were asked in the survey about the effect of the incentives on their planting decisions. The results have to be interpreted with some care because the questions necessarily involve a degree of abstraction and may have been difficult for some participants to understand. They show that 89.5% of the area would not have planted without grant aid. Additionality was higher for FWPS applicants (92.9% of the area) than for non-FWPS applicants (84.1%).

In order to estimate the additionality of FWPS we asked FWPS applicants if they would have planted had only the WGS payments been available. As would be expected the additionality of FWPS was slightly lower in the presence of WGS, at 76.1% of the area. The additionality of challenge funding was calculated at 59.0% of the area planted. This means that 41% of the challenge area would have been planted without the challenge supplement, and 59% would not.

These additionality estimates are slightly higher than estimates made previously for FWPS entrants (Crabtree *et al*., 2001a). They indicate that there is a very high impact of the grant aid (WGS and FWPS) on the area planted. The additionality of FWPS is also high. Deadweight appears to be much higher with the challenge supplement.

3.6.1 Payment of FWPS incentives to non-farmers

We asked those entrants receiving FWPS payments if they 'would have created the woodland if the full annual payments were only payable to farming owners (e.g. if the FWPS rates were to be reduced by 50% if the owner ceased to farm or sold the land to a non-farmer). 30.8% said that they would not have planted had the rates been cut to non-farmers. This is perhaps surprisingly high and may reflect some difficulty in understanding the question. However, taken at face value, it appears that reducing payments to non-farmers would reduce total planting under FWPS.

3.7 Maintenance and management of woods

3.7.1 Maintenance of woods – agents' survey

Agents were asked to assess how well they thought woods would be maintained and managed once they had been planted. Almost all interviewees felt that up until owners received the second instalment of the planting grant, the woods would generally be well maintained and managed, but there may be about 10% where the standard might be better described as adequate or poor. Those who fell into this category were mostly farmers who may have entered the scheme solely for financial reasons.

After the second instalment of the planting grant there was a widespread perception that the quality of the maintenance and management of woods would fall but remain generally adequate. This was also the case for FWPS planting. Most interviewees went on to point out that by that stage the trees should be well established and there was less need for maintenance and management.

3.7.2 Annual Management and Woodland Improvement Grants

A relatively small proportion of WGS is use to support the management and improvement of existing woodlands. The WGS gives discretionary grants of £35 per ha per year for Annual Management Grants (AMGs) and up to 50% of cost for Woodland Improvement Grants (WIGs). We were not able to undertake field visits to check on the benefits delivered by the AMGs and WIGs.

Agents' views

The agents were generally unenthusiastic about AMGs and WIGs. Some of the key points made about AMGs were:

- They involve a great deal of time negotiating with the FC for relatively small amounts of money. There are too many restrictions.
- They are perceived as largely a PR exercise for the FC as the amounts of money available are limited and the FC adjusts the amount depending on their financial position. The money available was considered to be unrealistic.

In the case of WIGs, they were generally perceived as being better than AMGs particularly in relation to access creation and biodiversity development, but the following points were made by some of the interviewees.

- WIGs only cover 50% of agreed costs and it is not a sufficient contribution to costs to encourage owners to do things they don't want to do such as creating public access to woods. The grant would need to be at least 100% and there should be some incentive above that for delivering public benefits such as access.

- A one-off WIG payment may in some circumstances not achieve best value for money where follow up expenditure is needed in subsequent years. For example, in the case of rhododendron control, the WIG may help to meet the initial costs but there is no support for treatment of the stumps to prevent re-growth.
- The standardised costs used by the FC are useful in developing WIG applications and knowing what the FC will support.

Overall, interviewees felt that the AMGs and WIGs did little to encourage positive forest management but WIGs did help to support the provision of public access.

Conclusion on AMGs and WIGs

The difficulty in establishing an effective, simple incentive system for woodland management and improvement is that proposals are likely to vary considerably in cost, and the private benefit element could vary from zero to almost 100%. The current arrangements are not well refined to cope with this diversity and need greater flexibility and higher ceilings. There is a strong case for paying more than 50% on WIGs where a higher proportion of public benefits is delivered (e.g. with public access) and for moving away from the system of one-off capital payments. At present, it is likely that desirable woodland management and improvement is not going ahead because of limits on incentives. We understand that the Commission also considers that a re-design of AMGs and WIGs is required.

4 Participation in the schemes

4.1 Introduction

Adequate participation in a voluntary incentive scheme is essential if objectives are to be met. However, none of the policy frames (WGS, FWPS, RDPS or SFS) give planting targets or quantitative targets for policy outcomes or benefits. It is not therefore possible to assess in any direct way whether participation can be judged as satisfactory.

This section investigates both the type of applicants applying for grant aid, their planting objectives and the advice received. It also assesses the barriers that prevent expansion of the woodland area in Scotland.

4.2 Type of applicant

The WGS database classifies applicants into six types (Table 4-1). Personal occupiers and business occupiers dominate the planting (at 60.8% and 31.6% respectively). Other categories are much less important although voluntary organisations account for nearly 4% of planting. These proportions have not changed to any appreciable degree over the decade.

Table 4-1 Proportion of planting by applicant type (WGS database,1992-2001)

Type of occupier	Proportion of area planted (%)
Business occupier	31.6
Crofting tenant	0.3
Other	1.8
Personal occupier	60.8
Public ownership	1.6
Voluntary organisation	3.9

The entrant survey gives a more detailed breakdown by type of occupier (**Error! Reference source not found.**). The number of plans is dominated by estate owners (31%) and farmers (40%, of which 16% were part-time). There were smaller numbers from local authorities, trusts and businesses. Estate and farmers tended to plant a higher proportion of conifers whereas other groups were more broadleaf dominated. The proportion of plans accounted for by local authorities and trusts has increased over time from 3% in 1992-93 to 17% in 1999-2001. Local authorities' use of the schemes has increased substantially in recent years. Farmer and estate planting has declined in proportionate terms. As would be expected, farmers dominated the planting on better land and under the FWPS.

4.3 Objectives in planting

We asked entrants about their objectives in planting. Respondents were asked to list the five main reasons. Amenity, landscape and ecological motives were by far the most important (Table 4.3). Making use of poor quality or difficult land was also important in almost two-thirds of cases. Community benefits were mentioned by 10.6% of respondents. Recreation benefits (3.8%) were mainly in the context of planting on golf courses. Less common reasons included increasing capital value, sport, grant income and benefits to livestock primarily from shelter. Timber was only important in a minority of cases. Small numbers of respondents (<1%) mentioned research, environmental reasons, to provide fuel supplies from coppice, riparian management and public access as objectives.

Table 4-2 Proportion of respondents stating a specified objective in creating the woodland

Objective	(%) responding
To enhance amenity for the owner or the public (amenity)	83.6
To encourage wildlife or improve habitats (ecological)	80.0
To improve the landscape (landscape enhancement)	77.8
To make better use of poor quality or difficult land (improved land use)	65.5
To increase the capital value of the land/farm	42.8
To provide opportunities for sport shooting (game)	30.2
To provide a source of income (grant income)	28.5
To provide benefits to livestock including shelter (stock)	27.7
To provide a commercial timber crop (timber)	24.7
To benefit the community (community)	10.6
To provide/improve recreation (e.g. on golf courses) (recreation)	3.8
To provide shelter other than for livestock (shelter)	3.3
Other (other)	2.4

4.3.1 Motivations for tree planting – agents' survey

Interviewees identified a wide range of motivations for their clients wishing to plant trees. The significance and success of the native pinewood scheme and the Grampian and Central Scotland Challenge Funds are clearly shown by the areas that have been planted under these grant support arrangements. This indicates that money is a major motivating factor as there is significantly higher grant support available for them. For farmers, FWPS can be attractive for some of these, but interviewees generally felt that farmers were turning to forestry because of the low levels of farming profitability rather than any positive interest in growing trees.

Estates in North Scotland were reported to be interested in planting native pinewoods since it provided a use for land for which little else could be done, but this was only done to the extent that it did not impinge on the sporting value of the estate. In some cases the planting was being done to provide better habitat. Elsewhere estates were felt to be doing very little new planting other than extremely small areas for reasons of landscaping or for developing a shoot. External non-resident investors are still planting but these were often based overseas and were often advised by the larger specialist forestry management companies. There are also a number of people who were moving into the country from urban areas who are planting on a small scale to improve or reflect their lifestyle and to increase the overall value of their property.

4.4 Advice

Of those entrants who responded to the survey, 90% said that they used a source of advice for planning or creating the woodland, or dealing with particular issues relating to planting. Ten per cent said that they did not. On larger (> 10 ha) woodlands almost all (98%) of respondents used a source of external advice.

The main sources of advice are detailed in Table 4-3. By far the largest sources were private agents/contractors and the Forestry Commission. SAC was used by 12.1 % of respondents (13.6% of FWPS respondents). SEERAD is not a very significant source of advice nor is FWAG. Less than 1% of respondents used the RSPB, Central Scotland

Countryside Trust, The Game Conservancy, Highland Birchwoods, SEPA or local councils. These are aggregated with 'other' in the table.

Satisfaction levels were generally high at over 80% especially for the main sources of advice. The responses appear to indicate that SAC, the Deer Commission, FWAG and SEERAD may have given advice perceived as less satisfactory than advice from other sources. However, we doubt if the evidence can be interpreted so simply. It is more likely that specialist sources were used for problems that were more difficult to solve. Further investigation would be needed before any clear conclusion could be drawn about the relative effectiveness of different sources of advice.

Table 4-3 Advice - use and satisfaction level

Source of advice	Proportion using (%)	Proportion satisfied (%)
Private forestry or woodland manager, agent contractor or consultant	61.1	86
Forestry Commission	32.6	89
SAC	12.1	78
SNH	8.4	86
FWAG	4.4	79
Deer Commission	3.3	74
SEERAD	3.4	69
Other	6.4	79

4.5 Non applicants

4.5.1 Estate and commercial occupiers

Voluntary incentive schemes can only be successful if there is the required degree of participation. The potential land area for new planting is huge if agricultural land is included. In the estate sector, it is well established that planting is determined by the availability of suitable land, the incentives offered, and the extent of restrictions on planting type and location because of environmental and other impacts. Firn Crichton Roberts (1990) did a study of landowner attitudes for the Forestry Commission. At that time, the larger long-established estates had reached a situation where the proportion of forestry in the total landholding was seen as optimal. There was a perception that forestry gave comparatively poor financial returns and the planning environment coupled with SSSI designation was seen as important constraints.

If this was the situation in 1990, all these limiting factors would have become more constraining over time. The indication from calculations of the financial return from commercial woodlands (see Chapter 6) and comments from applicants, stakeholders and agents is that both low economic returns, restrictions on planting and the high cost imposed on some applicants by the consultation procedures are important factors explaining the fall off in estate planting. Lack of suitable land may also be a factor although this was unconfirmed. Farming estates may also be keeping their options open given other developments in the CAP including the Rural Stewardship Scheme.

4.5.2 Farm occupiers

Several researchers in the UK have surveyed farmers to assess their attitudes to tree planting and forestry incentive schemes. The general conclusion is that farmers have little interest in planting, that the incentives on offer are inadequate, and that tenure conditions pose insuperable difficulties for most tenants. For example, Watkins *et al*. (1996) found that an inadequate level of financial incentive was the commonest reason for non-entry into forestry schemes. Many respondents treated woodlands as a peripheral interest, often had no experience of planting and in some cases had a quasi-moral objection to planting on farmland (Bishop, 1990; Clark and Johnson, 1993). Gasson and Hill (1990) examined entry into the UK Farm Woodland Scheme FWS) in Southern England. They emphasised the importance of private benefits, with landscape and amenity most important, and financial considerations less relevant. Property rights were again shown to be important since tenant farmers were less likely to enter.

In Scotland, the 1995 FWPS evaluation (Crabtree, 1996) included a postal survey of 1,500 farmers who had not planted under FWPS. The most commonly quoted reasons for not planting were the loss of farm income, high planting costs, lack of experience or interest, tenancy agreements, and an adequate existing woodland area.

Modelling the probability of farms entering the FWPS

We used June Census data for FWPS entrants and non-entrants in the 1995 FWPS evaluation to develop a predictive model of entry into the scheme (Crabtree *et al*., 2001a). The probability of a farm entering the FWPS increased with farm area and the proportion of existing woodland. It declined as the proportion of rented land increased and as the proportion of non-woodland (crops, grass and rough grazing) increased. Dairy farms and pig and poultry farms were less likely to enter than the other types.

4.5.3 Reasons for not joining FWPS & WGS – agents' survey

Agents were asked why the two grant schemes were not being taken up more widely. The responses covered the following points:

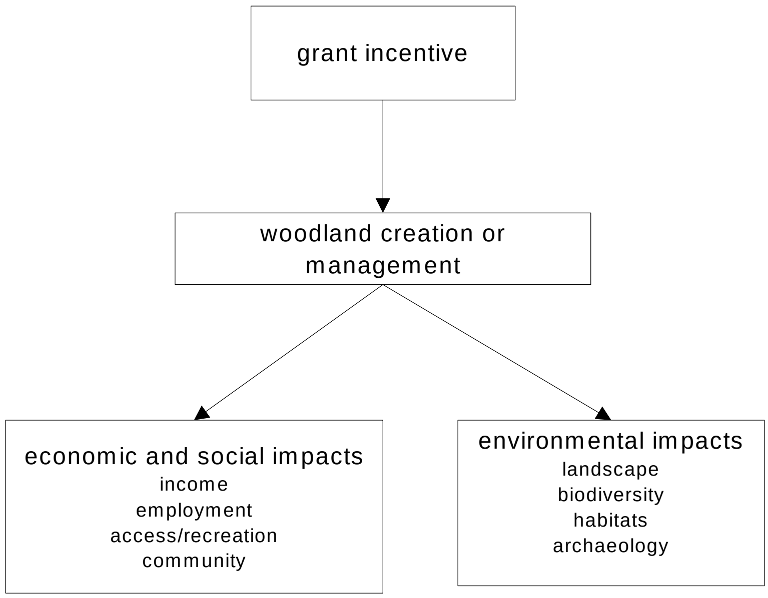
- Landowners were happy with their current balance of land use and saw no reason to make any significant changes at the present time.
- The levels of grant were not high enough to make tree planting sufficiently attractive compared with alternative uses for the land.
- Landowners were reluctant to plant trees on any scale because of the resulting fall in the capital value of the land once planted.
- The planting reduced land use opportunities once the land was planted and new agricultural or environmental support schemes may be introduced at some stage in the future which may provide a better financial return.
- In some cases, too much consultation is required to make it worthwhile.
- The schemes were not attractive to tenants.
- In South Scotland support was only provided if a scheme made a contribution to the landscape.
- In the case of FWPS, there is uncertainty over future annual income payment levels.

5 Economic and social impacts

5.1 Introduction

The incentive schemes encourage the creation of new woodlands and the management of existing ones. These activities have economic, social and environmental impacts (Figure 5-1). There are economic effects through the changes in expenditure and income in local economies which then have knock- effects more widely throughout the economy. When assessing the impacts of the grant schemes it is important to identify the *net* economic impacts of woodland creation, taking account of any losses to the economy from any activities displaced by planting.

Figure 5-1 Economic, social and environmental impacts of incentive payments



5.2 Profitability of planting

In order to assess the private profitability of planting we developed a number of woodland investment models. These take account of forestry costs, grant aid and timber value but not the intangible benefits from sport and amenity. Three cash flow models were created for upland conifers, new native woodland and natural regeneration of native woodland. Cost and yield assumptions are given in Appendix 1. Standing timber was priced at £12 per tonne, native pine at £10 per tonne and natural regeneration timber at £5 per tonne. The models were selected to cover the a range of WGS and FWPS planting, and to link with the types of forestry used in the Forestry Commission input-output study of Scottish forestry (Roberts *et al*., 1999).

Table 5-1 indicates the types of forestry investigated and the calculated internal rates of return. These are based on land being available on the property. Returns for upland conifers at YC 14 were the highest of the non-FWPS plantations. However, the return was still low at 1.64%. Returns would be lower if land was purchased for planting or had an alternative use value. Returns were not very sensitive to moderate changes in the planting grant: for example a 20% increase in the planting grant in Model 1 only increased the return to 2.0%, and in Model 2 to 0.99%. As might be expected, future timber prices have an important effect on returns. Using the current standing conifer price of £8 per tonne gives a return of only 0.35% from upland conifers.

Table 5-1 Investment returns for three types of forestry

Model number	Type	Area (ha)	Species mix	Grant aid (£ per ha over total area)[i]	Internal rate of return (%) (pre tax)
1	Upland conifers	40	80% conifers YC 14 20% broadleaves	WGS: £770	1.64
2	New planting of native woodland	200	50% birch YC 6 50% native pine YC 6	WGS: £945	-0.04
3	Natural regeneration of native woodland	10	50% birch 50% native pine	WGS: £446	0.84

Note: The rates of return exclude any opportunity cost for the land

New planting of native woodlands has a similarly low return despite a higher WGS incentive. This reflects the lower timber income. The ability to plant cheaply, keep costs near to the WGS incentive and derive some non-timber benefits would be important in this context. Natural regeneration (Model 3) has the benefit of lower cost but returns are still not very attractive.

Internal rate of returns were not calculated for farm woodlands (receiving FWPS) because timber revenue is often a major interest and the returns are highly dependent on the opportunity coat of land (see below).

5.2.1 Income foregone on planted land

In the participants' survey we asked entrants to indicate the amount of annual income (net of costs) that had been lost through creating the woodland – the opportunity cost of planting. Seventy-nine percent of FWPS and 45% of non-FWPS respondents said that the planted land would have produced income had it not been planted. As expected, a higher proportion of woodlands planted on better land suffered income foregone than those not on better land (77% as compared with 41% on non-BLS land).

The average income foregone was £180.0 per ha (Table 5-2). Differences are generally in line with expectations. FWPS and better land planting have higher opportunity costs. Income foregone was also markedly higher on larger areas (> 10 ha). Small areas are often planted because they have little alternative use value.

Table 5-2 Mean annual income foregone for different types of planting (£/ha)

Stratum	Mean income foregone (£/ha)
Non-FWPS	149.7
FWPS	195.5
No BLS	40.9
BLS	222.4
< 10 ha	143.0
>10 ha	268.5

5.2.2 Incentive payments in relation to costs

We asked respondents about the extent to which grant aid covered costs. The responses are not easy to interpret because some planting is done with own labour and this may be priced in a variety of ways. Nevertheless, half of the FWPS respondents said that grant aid had covered planting costs and income foregone; an equal number said that it had not. More non-FWPS respondents (66%) considered that grant aid failed to cover planting costs. These differences did not appear to have changed over time. Where planting was coniferous or on small areas (<10 ha), a higher proportion of respondents thought that the incentives did not cover costs.

We asked those respondents who said that grant aid did not fully cover costs to indicate what proportion of costs were covered. The mean response was that 60% of costs were covered by grant aid and this proportion varied very little with the type of planting. These responses

5.2.3 Implications for incentive rates

The evidence from applicants indicates that cost compensation provided for non-FWPS coniferous woodlands, and small area planting is low relative to that for FWPS, broadleaved and larger scale planting. However, this does not imply that efficiency would be improved by corresponding changes to the grant schemes. Account must be taken of the value of the public benefits that the incentives procure. A lower level of cost compensation for coniferous planting would be expected because of the greater perceived commercial benefits and more limited environmental gains they produce.

FWPS planting may contribute greater rural development benefits through its contribution to farm diversification and adjustment. That apart, the results suggest that incentives may be too low for non-FWPS planting in cases where there are clear public benefits produced.

The case for increased grant aid for small area planting needs further analysis. Small, isolated woodlands typically have lower additionality, and may provide limited biodiversity benefits, although much depends on the particular situation and the degree of connectivity to existing woods. (see 6.2.1) They can contribute considerable amenity and landscape benefits in areas with limited tree cover and where they are sited near people. In the CWS evaluation, (Crabtree *et al*., 2001b) the public were more concerned to have a woodland nearby than to have a woodland of any particular size.

5.3 Impacts on land values

The entrant survey indicated no clear-cut effect of planting on the capital value of the land. Most respondents (77%) did not know whether there had been an effect. Overall, a higher proportion (16%) said that the capital value of the land had increased than said it had decreased (7.0%). Much depends on the size of the planting in relation to the overall size of the unit.

Where land values had increased this was most commonly due to increased landscape or amenity value. Shelter, timber value and using unproductive land were also mentioned by respondents. Where land values had decreased the reasons were almost entirely agricultural. The commonest reasons were that woodland was less valuable than agricultural land or that it had reduced the farm's arable or grassland area.

5.4 Employment impacts of forestry

5.4.1 Employment in Scottish forestry

The Forestry Commission's *Forest Employment Survey 1998-9* estimates that employment in forestry and primary wood processing in Scotland was approximately 10,700 full-time equivalents (FTEs) for the study period (Forestry Commission, 2001c) (Table 5-3). Approximately 644 FTEs are estimated to have been created by farm woodland establishment and maintenance (Forestry Commission, 2001d).

5.4.2 Employment generated by different forestry types

Input-output modelling was used to assess the affect on employment of a 100ha increase in the area of different types of woodland: existing native woodland, new native woodland (post 1990), commercial conifers, and farm woodlands. Input-output techniques take into account not only the direct effects, but also the multiplier effects on employment throughout the economy. The analysis is developed from Roberts *et al*. (1999) and methodological details are given in Appendix 2.

Table 5-3 Forestry employment by activity in Scotland, 1998-99

	FTEs	% Total Forestry FTEs
Forest nurseries	201	1.88
Establishment	1,189	11.11
Maintenance	1,304	12.19
Harvesting	1,947	18.20
Road construction	179	1.67
Other forest	372	3.35
Total forest	5,192	48.55
Haulage	593	5.56
Processing	3,083	28.83
Other non-forest	1,826	17.07
Total non-forest	5,502	51.45
Total	10,694	100.00

Table 5-4 presents the employment effects. The *injection* refers to the increased employment within each forest sector following the 100ha increase in its area. *Direct* and *indirect* effects refer to the increases in employment in sectors that supply inputs to the forest sector. *Induced* effects refer to the increase in employment across the entire economy as a result of the increase in income within the aforementioned sectors. For new native woodlands and farm woodlands, employment effects for harvesting have not been calculated because these woodland types have not reached harvesting age.

Table 5-4 Gross employment effects per 100ha (FTEs)

Sector	Injection	Direct and indirect effects	Induced effect	Total effect
Existing native maintenance	0.014	0.010	0.005	0.029
New native planting/ maintenance	0.472	0.504	0.227	1.204
Commercial coniferous planting/ maintenance	0.194	0.049	0.058	0.301
Farm woodland planting/ maintenance	0.644	0.722	0.297	1.663
Existing native harvesting	1.694	0.310	0.230	2.234
Commercial coniferous harvesting	1.904	1.178	0.458	3.540
Agriculture	0.063	0.406	0.160	0.629

Table 5-4 shows that farm woodland planting and maintenance will generate 1.663 FTEs per 100ha across the entire economy. Of this, 0.644 FTEs will be created by the injection (i.e. the value of input to the farm woodland sector itself). The direct and indirect effects (those resulting from sectors upstream from the farm woodland sector increasing their output) will account for 0.722 FTEs; and the induced effects (those resulting from increased wages to workers) will lead to a further 0.297 increase in FTEs.

New native planting and farm woodlands contribute most to employment (per ha) in the establishment phase. Since these woods have yet to be harvested their contribution to harvest-related employment is unknown. Harvesting of naturally regenerating and commercial coniferous woodlands produces relatively high employment effects across the whole economy, and markedly higher than planting and maintenance.

5.4.3 Net employment

To obtain the overall impact of forestry incentives on employment, it is important to take account of any employment displaced when land is planted. Results from the input-output model indicate that agriculture on average generate 0.629 FTEs per ha (Table 5-4). Hence, planting and maintenance of 100ha of new native woodland or farm woodland generates greater employment across the entire economy than an equivalent area of agricultural production. When the harvest element of native and commercial coniferous woodlands is included they generate considerably more employment per hectare than agriculture.

The implication of this is that, if a 100ha of, for example, farm woodland, was at the expense of 100ha of "average" agricultural land, there would be a net increase in employment across the economy. This is supported by the fact that 66% of applicants quote "to make better use of poor or difficult land" as a reason for planting (Table 4-3).

5.4.4 Impacts of WGS and FWPS new planting on employment

Nearly half (49%) of respondents considered that their woodland would contribute indirectly to local employment (e.g. through shooting lets or improving the attraction of the area for visitors). The remainder thought that it would not. The effects were slightly larger with larger woodlands, FWPS planting and mainly broadleaved planting. While this is what might be anticipated, it suggests that the commonest impacts were through landscape and amenity improvement. Respondents considered that there would produce some local employment spin-off.

The impact of grant scheme planting on employment was estimated by combining the planting data from 1992-2002 (Table 3-4) with the additionality estimates (see 3.6) and the employment coefficients (Table 5-4). For example with farm woodlands, the additional area planted over the ten years is estimated as 41,132 ha. The employment coefficient, taking into account the full impacts throughout the economy, is 1.663 FTEs per 100ha *for the planting and maintenance phase*. This gives 639 FTEs (Table 5-5). The total employment generation is 1,177 FTEs.

Table 5-5 Gross and net employment impacts of WGS and FWPS

Type of planting	Area of new woodland created (Table 3.4) (ha)	Additionality (see 3.6) (%)	Gross employment, (planting, maintenance) (FTEs)	Gross employment, (planting, maintenance, harvest) (FTEs)	Net employment impact (FTEs)
Non-FWPS Broadleaves/native pine	49,596	84.1	502	781	519

Non-FWPS Conifers	14,379	84.1	36	464	388
FWPS farm woodlands	41,332	92.9	639	895	654
Total	105, 307		1,177	2,142	1,562

Note: additionalities based on the combined WGS/FWPS effect on planting. Employment coefficients: see Table 5-4. 30% of broadleaves and farm woodland area are assumed to be harvested in column 5

Additional employment will be generated through harvesting and processing, where this occurs. This will not take place for at least 25-50 years and, in the case of recent broadleaved, native pine and farm woodland planting, no-one knows how much of will be harvested. It is also usually argued that future employment should be discounted because it is less valued than current employment. We have not discounted the impacts and as such they represent upper bound impacts. Column 5 gives these undiscounted employment effects assuming that 30% of the broadleaves, native pine and farm woodland area is commercially harvested. The upper bound total is 2,142 FTE jobs. However, these are gross figures. If we assume that displaced jobs are in agriculture where the employment effect averages 0.629 FTEs per 100 ha (Table 5-4), then the net total is between 597 and 1,562. The upper figure includes harvesting. Since the harvesting jobs will not materialise for another 25 to 50 years they should not be given the same weight as current jobs. The harvesting estimates are also subject to considerable uncertainty because they are derived on the basis of current technology. Technical progress may well reduce the extent to which current planting generates future employment benefits.

These figures can only be indicative but they do point to the importance of broadleaves and farm woodlands in job creation under WGS/FWPS. Job creation through WGS (non-FWPS) conifer planting is more limited because of the small area planted. Around 600-1,180 jobs have been created in planting/establishment depending on the extent of job displacement from the planted land. The total FTEs created since 1992 might be 1,560-2,140 FTEs, depending on displacement, but this include harvesting jobs which will not materialise for 25 years+.

5.4.5 Regional and rural impacts

The Forestry Commission's estimates of the regional breakdown of employment are given in Appendix 2. They indicate that almost 70% of forestry employment is located in Highland, Grampian, Strathclyde and Dumfries and Galloway. Employment multipliers are higher in Highland than elsewhere and this is thought to reflect local sourcing of inputs (Robert *et al*., 1999) (see also Appendix 2).

The analysis presented above does not reveal whether the benefits from increased forestry activity would accrue primarily to rural or urban areas. We estimated the percentage of input and contract transactions that take place with firms based in either rural or urban areas of Scotland (see Appendix 2 for details). Firms and businesses based in rural Scotland receive 66% of all direct input transactions and 89% of all contract-related flows. Flows related to the use of contractors in the sector are those most likely to be retained within rural Scotland both in terms of number of transactions taking place and their value. Whilst the majority of the flows associated with forestry accrue to rural areas, there is some leakage - for example, 35% of the value of input purchases flows to urban Scotland.

5.4.6 Use of contractors

In the entrant survey, 78% of respondents said that they had contracted out work associated with the planting or management of the woodland. There were no differences between FWPS and non-FWPS plantings, but 84% of larger plantings used a contractor compared with 76% for smaller ones. There was some evidence that use of contractors is getting more widespread over time.

5.5 Benefits from public access, recreation and amenity

Entrants were asked if their woodland would provide additional access or recreational opportunities for the public. Twenty-eight per cent said that it would, and the effects were greater with broadleaved plantings on non-BLS land with larger and more recent plantings. Since only a minority of plantings would be accessible to the public through an agreement under WGS (see below), it appears that most of those answering 'yes' considered that an improved landscape would produce enhanced recreational experiences for the public. There may also be benefits to tourism and these would have positive employment impacts.

The size of these benefits to local people was not measured but the evaluation of the WGS Community Woodland Supplement (CWS) did quantify the public benefits from woodland access and associated recreation (see below). Interestingly in that study, local communities did in many cases derive considerable benefit from the existence of new community woodland even if they did not 'use' it directly through walking or cycling.

Most respondents (54%) considered that the local community had benefited or would benefit from recreation; amenity or employment associated with their woodland creation. Forty-six per cent said there would be no benefit to the local community. The benefits were greater with broadleaved woodlands, more recent plantings and larger woodlands. There was no difference between FWPS and non-FWPS respondents.

5.5.1 Community Woodland Supplement

The CWS payment of £950 per ha is an incentive within the WGS for the provision of public access on new woodlands. Eligibility for the supplement is restricted to new woodlands sited within 5 miles of the edge of a village, town on city where there are few other woodlands available for recreation. The CWS has recently been subject to an evaluation for the Forestry Commission (Crabtree *et al*., 2001b).

In Scotland, according to the evaluation report, 19% of eligible woodlands (300) were approved for the CWS up to October 2000. Access on 3,455 ha was procured by the supplement. As might be expected, a large number of the woodlands were located in the central belt but there was a wide geographical distribution throughout the country with woodlands in Shetland, the Western Isles, Caithness, Sutherland Dumfries and Galloway. Of the total area receiving supplement, 83% was categorised as being located in rural areas. The public sector (local authorities, schools etc.) and voluntary organisations were significant applicants for CWC and accounted for just over half of the approved plans. There were also a substantial number of plans for access on previously derelict or industrial sites.

There were many examples of high-quality access created under the CWS and very high public benefits from the supplement. Value for money was on average good. However, a there was a proportion of sites where due to poor publicity, location or recreational quality the public benefits were very limited. Twenty to thirty per cent of woodlands did not produce value for money. A major limitation of the supplement was the 10-year contract life which meant that access was not secured when the woodland was beyond the establishment phase. Securing access to established woodland appeared a much more direct route for securing social benefits from forestry. Payments to support access area available under WIGs but no evaluation has been undertaken of their effectiveness and value for money.

5.5.2 WGS procured access and the Land Reform Bill

The proposed Land Reform Bill has a general right of access to land in Scotland. Under s.7(7)a of the bill, the right of access does not apply to growing crops and these include 'a plantation of trees which is at such an early stage of growth that they are likely to be damaged by the exercise of access rights'. The right does apply to woods, forests, orchards and other places where trees are planted.

The WGS incentives for access, which operate through the mechanisms of the CWS and WIGs, will need to be re-formulated. Incentives would only be appropriate for access and access facilities over and above that available under the bill.

5.6 Conclusions

Forestry generates significant direct and knock-on employment. Different woodland types have different employment generating capacity. In particular, planting and maintenance of both new native woodlands and farm woodlands generates significantly greater employment benefits relative to existing native and coniferous woodlands. Forest harvesting (where it occurs) produces greater employment effects than forest planting and maintenance.

We estimate that *since 1992* the WGS/FWPS will have created an additional 600-1,180 FTE jobs throughout the economy from planting and establishment. Estimates depend very much on the extent of job displacement on the planted land. If employment from future harvesting is included and not discounted, job creation might rise to 1,560-2,140 jobs. There may be additional employment impacts resulting from beneficial effects of woodland grant expenditures on tourism. These estimates are indicative only because of uncertainty about the future harvested area and the employment it will generate at the time. The additional jobs arise from a WGS expenditure on planting grants of around £70 m.

Additional economic and social benefits arise through the provision of access to woodlands. The WGS concept of procuring public access to woodlands near where people live is well supported by local communities. Much of the new woodland is highly valued by the public although this is as much for landscape reasons as for access. Whilst the CWS payments deliver good value for money in the majority of cases, in a significant minority they fail to procure access that is valued by local people.

It is likely that providing incentives to enhance access on established woodlands will provide greater value for money. The WIGs do procure such access but we are not aware that the Commission has undertaken any evaluation of WIG expenditure to indicate the benefits procured.

6 Environmental impacts

6.1 Introduction

It was not possible within the time-scale of the evaluation to undertake field-based assessments of the environmental impacts of the schemes. Instead the evaluation was based on literature review, questions to WGS/FWPS participants within the entrant questionnaire, and technical interviews with relevant experts (see Appendix 4).

6.2 Impacts on biodiversity

Since the UN Conference on Environment and Development, biodiversity and sustainable management have become key issues in forestry. Diversity in forests is based on the composition, structure and function of woodlands (Ferris & Humphrey, 1999). The aim is to produce an attractive, productive landscape, rich in wildlife and efficient to manage. However, this is an extremely complex challenge often with contradictory practices that have to be undertaken in order to balance economic development and biodiversity (Ferris-Kaan, 1995).

Maximum biodiversity is usually recorded in old growth forests that are beyond normal felling age. These forests contain a high structural diversity, including a number of layers and features such as dead wood (Ratcliffe, 1995). It is estimated that 40-60% of birds and 65-75% of terrestrial mammals that breed in Europe and North America breed in forests. Forests are also important reservoirs of mycorrhizal fungi, bacteria and associated invertebrates. However, the issue is more complicated than simply species number. Some priority species for example Red Squirrel (*Sciurus vulgaris*) and Goshawk (*Accipiter gentilis*), inhabit relatively low diversity systems and these habitats must also be protected (Ratcliffe, 1995). Scottish woodlands provide habitat for over 70 priority species (Appendix 3: Table A3-1).

Biodiversity policy drivers

- WGS aims to encourage people to create new woodlands and forests to provide new habitats for wildlife and to encourage good management of forests and woodlands including their well timed regeneration, particularly looking after the needs of ancient and semi-natural woodlands (FC, 2000e).
- FWPS objectives include "to enhance the environment through the planting of farm woodlands, in particular to … increase biodiversity" (MAFF, 2000a).
- There are also policy drivers associated with the RDPS, UK BAP, UKFS and the SFS. These are detailed in Appendix 3-1.

6.2.1 Factors affecting woodland biodiversity

Biodiversity scoring method

In order to assess the sites and management techniques used by entrants that would promote biodiversity a scoring method was used based on questions in the entrant questionnaire (Tucker & Hack, 1998). The scores give an objective measure of potential biodiversity in woodlands (see Appendix 3: Table 3-3).

Results summary (expanded in Appendix 3-3)

- Scores could range from -11 to 23. Large, broadleaf (including native pine) dominated plantings rated consistently highest. The lowest score was –4 for a small, coniferous, older, FWPS woodland that received BLS. The highest score was 19 for a large, broadleaf, older, FWPS woodland that also had BLS. There were no significant differences between WGS and FWPS schemes. The schemes receiving a BLS usually had a lower biodiversity score than those that did not. The results suggest this may be a result of the domination of unfavourable species and these plantings are less likely to be situated adjacent to existing woodlands (Figure 6-1).

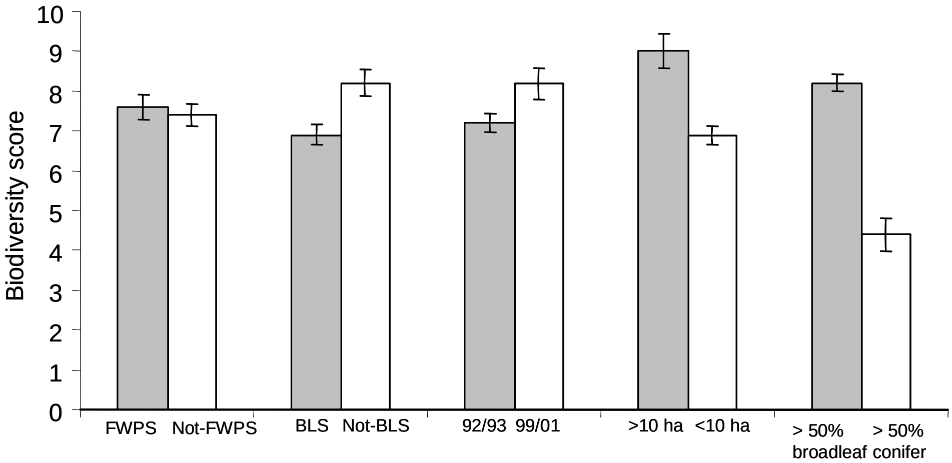


Figure 6-1 The average biodiversity score (mean and standard error) comparing the participants by the sample frame. All the samples were significantly different when compared using an independent t-test (P<0.01) except those based on FWPS entry.

- The results suggest that later plantings have a greater potential biodiversity, suggesting management techniques and/or site selection have improved over the decade or that the criteria for selection are more rigorous and prescriptive.
- Larger plantings (> 10 ha) in size also had a greater potential diversity than smaller woodlands. They were more likely to have larger individual woodland tracts (>5 ha), dead wood, evidence of regeneration, seasonally wet areas and open areas within the planting.
- Broadleaf plantings showed the highest levels of potential diversity. They were more likely to have an open canopy, dead wood retention, higher levels of regeneration and were more likely to include nest boxes and bat boxes (Figure 6-1).

Individual site characteristics have an impact on biodiversity (see Appendix 3). Specific results of the participant questionnaire are discussed below.

Woodland size (Appendix 3: 3-1): In the FWPS sample, 41% had planted individual tracts of woodland of five hectares or more, whereas this only applied to 27% of those surveyed under the WGS. However this does not account for the 50% of new plantings that were adjacent to woodlands.

Woodland structure (Appendix 3: 3-2): Although only low numbers of participants had a grass layer in the 1992/3 sample, this figure had almost doubled by 1999/2001. The proportion of participants planting shrubs remained unchanged at approximately 40%. The proportion of participants retaining dead wood in woodland increased over the 10-year period to almost 25% by 1999/2001. However, 81% of owners had included open spaces, of which only a minority had included the space purely for access. This inclusion of open space undoubtedly reflected the 1992 changes to WGS so as to support incorporation of open space in mew woodlands. These results demonstrate a trend towards practices that can enhance biodiversity (Figure 6-2). The survey of participants showed that only 6% of woodlands had Rhododendron (*Rhododendron ponticum*) present. However, half of this group intentionally planted the shrub, which is likely to create major difficulties later on.

Figure 6-2 The proportion of participants that had planted a field or shrub layer, retained dead wood or included open spaces into their woodland design.

Species selection (Appendix 3: 3-3): The species composition of a woodland will have a pronounced influence on the biodiversity and impact delivery of the UK BAP (Appendix 3: Table A3-1). Planting under the WGS has been dominated by broadleaf/native pine plantings and regeneration (Figure 6-3). Planting levels have decreased, but proportionally, there is significantly more woodland planted with broadleaf and native pine species. A mixed woodland was classified as one that contained a split of 20% or more broadleaf in an otherwise coniferous forest or vice versa.

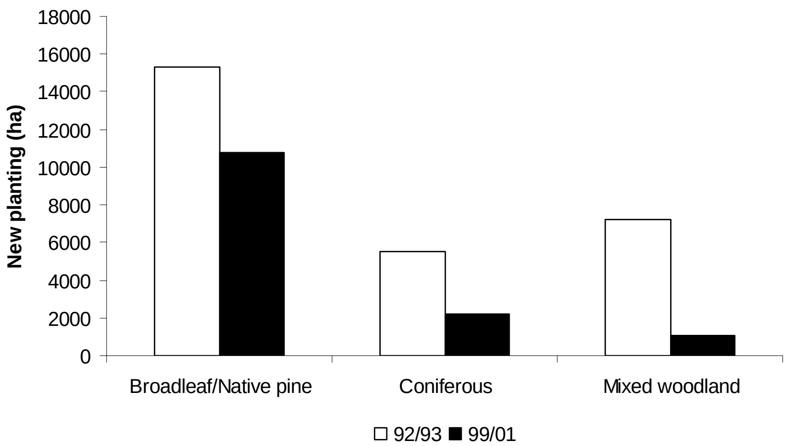


Figure 6-3 The new planting levels derived from the WGS full database for 1992/1993 and 1999/2001.

Use of locally native species: Anecdotal evidence and the technical interviews suggested that participants in the scheme were provided with little information on the issue of provenance and locally native stock was not being sufficiently promoted. Over two-thirds of participants in the technical interviews felt that locally native stock was not being promoted by the FC literature or by Woodland Officers (WO).

Harvey & White (1995) reported that of the 80 million broadleaves planted annually in the British Isles, two-thirds are from Continental traders. Robinson & Ryder (1989) reported in a study of Scottish nurseries that under 10% of stock was from Scottish seed, this was supported by Ennos *et al*. (1998). Mackenzie (2001) reported that the native broadleaf component of Scottish woodlands was often unclear and there should be stricter controls on the seed origin of native broadleaves. The lack of promotion may have resulted in a lack of demand and therefore a low availability of native stock from nurseries.

6.2.2 The effects of new planting on biodiversity

This section is expanded in Appendix 3: 2. A summary is given below.

- New woodland plantings of five hectares are generally accepted as bringing biodiversity benefits (Cranfield University, 1999; Usher, 1995), but it may take several decades for the benefits of newly created woodlands to reach their environmental potential for woodland specialists.
- New woodlands provide valuable habitats for non-woodland species, particularly birds and invertebrates including several Priority Species (Cranfield University, 1999; Ecoscope, 1998; Sutherland & Hill, 1995).
- The under-sowing of trees with grass or with a species-rich mix can have a profound impact on the ground flora community in the short term.
- Anecdotal evidence suggests that Scottish new plantings often show rapid increases in species; those listed by participants include small songbirds, tawny owls, raptors, pheasant, grey partridge and wild cats.
- Collection of data on long-established secondary woodland is required to identify the principal factors that are responsible for the variation in communities of birds, invertebrates and the ground flora. This information is required to determine the role of new woodlands in the long-term enhancement of biodiversity within farmland landscapes.

6.2.3 Conclusions

- Over three-quarters of those involved in the technical interviews felt that new woodland planting would not have occurred without the support of the WGS/FWPS grants.
  - Woodland Grant Schemes have fulfilled the aim in the WGS to create new woodland to provide new habitat.
  - WGS have also fulfilled the priority for action under the SFS to extend native woodlands, particularly native pinewood (Mackenzie, 2001).
- It was not possible to evaluate whether the objective under FWPS to actually increase biodiversity has been met due to lack of field-based monitoring. There has been an increase in biodiversity enhancing practices. Only 8 of 49 Scottish WGS woodlands examined in the Mackenzie (2001) report referred to FC Bulletin 112 or Forestry Practice Guidelines.
- The UKFS (Forestry Authority, 1998) criterion for conservation and enhancement of biodiversity and UK BAP in and around woods and forests and the SFS also require an increasing contribution to BAP targets. Without field-based monitoring it is not clear whether the WGS/FWPS is achieving this objective of the UKFS.
- The UK BAP is increasingly important in FC strategy but the woodland grant schemes are not considered effective at delivering UK BAP to date. The schemes are currently not achieving HAP targets for expansion. It was felt that the FC should

be more consistent and targeted delivery on the HAP on which they are lead partners (Mackenzie, 2001).

- An SFS aim is also to increase the environmental value of forests and trees, habitat and landscape by means of including increasing open space and structurally diverse forests. The results demonstrate that open space is now commonly used by the majority of participants but techniques to increase structural diversity, for example, by planting of field and shrub layers are more limited in their application.
- Technical experts suggested that the rigorous application of the stocking density in order to fulfil the requirements to receive the grant payment may result in a failure to achieve grant objectives.
- Despite adequate policy drivers addressing biodiversity, there has been some difficulty in delivering woodlands characterised by high environmental quality on the ground. This is illustrated by a recent assessment of the Scottish contribution to Woodland HAP (Mackenzie, 2001) and further supported by an assessment of Native Woodlands the in National Parks Challenge in England (Currie, 2001). Both these studies raised compliance with the UKFS and FC Bulletin 112 (Rodwell & Patterson, 1994). They raised issues over the design of woodlands and site selection. Finally, both reports discussed that lack of verification of origin of native stock.

6.3 Impacts on habitats

We were asked to evaluate impacts on habitat. The WGS aims to encourage people to create new woodlands to provide new habitats for wildlife and the FWPS objectives include enhancing the environment through the planting of farm woodlands, in particular to … provide new habitats (FC, 2000e; MAFF, 2000a).

The SFS states that Caledonian Pinewood, Atlantic Oakwood, some bog, flood plain and gorge woodlands are listed as Annex 1 habitats within the EU Habitats Directive. This requires the prevention of deterioration and maintenance or restoration to favourable conservation status. An SFS priority for action (PCE2/FFR3) is the extension and enhancement of native woodlands and mixed forest by developing the Forest Habitat Networks (FHN), to prevent fragmentation and improve biodiversity. The SFS states that the FC should publish guidance on FHN, increase area of native woodlands in accordance with the FHN and contribute to the UK BAP (FC, 2000a).

6.3.1 Habitats converted to woodland

The Macaulay Institute (MLURI) land cover maps from the 1988 Land Cover Survey were used to define the types of habitat that have been converted to woodland. Grid references for new woodlands were derived from the FC database which details the point at which the most activity in the application with take place (FC, 2000b). All new WGS/FWPS woodlands created in 1992/1993 and 1999/2001 were used to assess the changes in habitat type (Table 6-4).

The breakdown of land classes for broadleaf plantings in Scotland suggests that less arable land was put into the scheme in the later sample, although the levels of improved pasture have maintained the same levels. Coniferous and mixed woodland were planted mainly on improved pasture and arable land, and there were some coniferous urban plantings that were not seen in the earlier years.

Relatively large areas of new plantings occurred on the moorland and bog land classes. These habitats may be associated with Priority Habitats (UK Biodiversity Steering Group, 1995). The coniferous planting on bog and moorland habitats fell from 16% in 19992/3 to

1% in 1999/2001. This change is ecologically beneficial as the afforestation of moorland with conifer plantations is regarded as ecologically damaging (Peterken, 2001). The proportion of planting in broadleaf/native species on moorland and bog land classes rose from 34% to 44% in 1999/2001. Although this is not necessarily ecologically damaging, planting on or adjacent to Priority Habitats as defined by the UK BAP, and particularly open habitats, needs to be carefully monitored. Technical interviewees raised the issue that in some cases smaller schemes that do not require Environmental Impact Assessments can progress to quite a late stage before concerns about the ecological impacts are considered fully.

Table 6-4 The land class categories that have been converted into new woodland as defined by the MLURI 1988 Land Cover Survey

Land class	Broadleaf (ha)		Conifer (ha)		Mixed (ha)	
	1992/3	1999/01	1992/3	1999/01	1992/3	1999/01
Arable	1156	397	302	586	1258	239
Blanket bog*	324	559	475	3	284	118
Bracken	53	3	4	47		16
Native/broadleaf woodland*	1562	1253	2	51	295	
Buildings/urban	177			121	49	
Coarse grassland* (*Nardus/Molonia*)	111	357	421		30	37
Coniferous plantation	687	291	389		161	37
Dry heather moorland*	431	203	71		309	4
Recreation areas[1]	17	27			19	2
Improved pasture	2606	2015	1544	1183	3395	406
Mixed woodland	809	76	9		186	82
Montane*	5					
No land cover class (outside land area)	160	77	92	144	125	
Other moorland	3605	2555	318	17	490	
Preparation for woodland planting	24	7	49		148	
Recently felled woodland	99		46		5	
Refuse tips	2	3				
Saltmarsh*	4					
Scrub	8	20	1			
Semi-natural coniferous*	57	42				
Smooth grassland*	692	739	1441	87	315	60
Smooth grassland with low scrub	139	334	12		29	7
Smooth grassland with rushes*	1178	154	143		78	29
Unimproved land	9	4	57		25	
Wet heather moorland*	908	1486	7	10	4	
Wetland*	4		129			
Young plantation	497	68	5	39	54	

[1] Golf course/airfield/cemetery/caravan park, ski areas

* Land classes that may contain UK BAP Priority Habitats within them

6.3.2 Locally distinct habitats

The technical interviews suggested there were some concerns about the maintenance of local distinctiveness. There was confidence that funds targeted through challenge funds, woodland initiatives and forest planning are leading to locally appropriate planting. However concerns were raised about the standard grant procedures, which it was felt tended to produce a more uniform woodland and did not reflect the local Scottish region. There were also concerns about the restoration of inappropriate plantings in Scotland and the requirement to replant regions where felling has been undertaken. It was felt that where plantings were inappropriate there should not be an inflexible attitude towards replanting, and it should not be a requirement of a felling license under these conditions.

6.3.3 Conclusions

- The WGS and FWPS objectives to create new woodlands and provide new habitats have been fulfilled. In terms of the UK BAP, the contribution of new woodlands has mainly been to the native pinewoods HAP (FC, 2000a; MacKenzie, 2001).
- Over two-thirds of the participants involved in the technical interviews felt that the wood-pasture and parkland should be included under the WGS/FWPS. At present the schemes do not contribute towards this HAP.
- A SFS priority for action (PCE2/FFR3) is the extension and enhancement of native woodlands and mixed forest by developing the Forest Habitat Network (FHN). The FC has yet to publish guidelines on FHN, although they are anticipated within the next few months. Therefore the contribution of the schemes cannot be evaluated at this stage.

6.4 Landscape enhancement

6.4.1 Introduction

The landscape provides a cultural record of our history, recreational and amenity value, a source of enjoyment, identity, habitats for wildlife and money through tourism (Anon, 2000a). The WGS aims to encourage people to create new woodlands to improve the landscape and the FWPS objectives include enhancing the environment through the planting of farm woodlands and in particular to improve the landscape (FC, 2000e; MAFF, 2000a).

The SFS states that landscapes will be protected by adoption of best landscape practice set out in the UKFS and associated Forest Landscape Design Guidelines. The priority for action (PCE 3) to increase the diversity of the farmed landscape, states that priority areas should be identified, developing the work in the SNH landscape character assessment (LCA) and targeting incentives accordingly. There should be a positive impact shown in the monitoring of woodland development against the LCA.

The UKFS states one criterion for sustainable forest management as the conservation and enhancement of heritage features and landscape quality. There should be evidence that the landscape principles of forest design are used and the cultural and historical character of countryside is taken into account when creating new woodlands.

6.4.2 Impacts on the landscape

Crabtree (1996) assessed the landscape character at over 160 FWPS sites through field visits and expert assessment. With respect to landscape character, 94% of woodlands had a positive impact; and natural regeneration was considered most beneficial to landscape character. On an aesthetic level the woodlands were considered as being in scale with the surrounding environment. The woodlands were assessed as having a positive shape with either graded or intermediate edge, although a sizeable minority (17%) of woodlands still had a sharply defined, intrusive edge. A small percentage were not in keeping with the character of the local environment.

It must be remembered that the above study only dealt with FWPS schemes. Improvement of the landscape was stated by 78% of respondents to our entrant questionnaire as one of the reasons for planting the woodland (Table 4-3). The technical interviews suggested there were variable impacts on the landscape, with the achievement of landscape enhancement, sensitivity of forest expansion and maintenance of local character depending on the FC personnel in each region (Figure 6-4). However it was felt that the FC usually acted on the best information available.

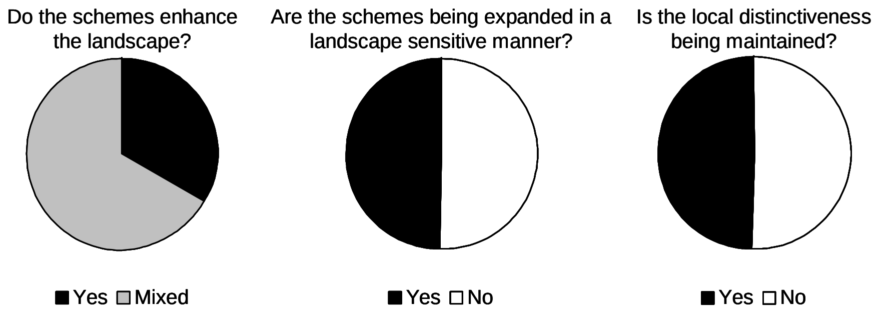


Figure 6-4 A summary of the response from the technical interviews on the impacts on the landscape (n=8).

Further information on landscape impacts may soon become available. A report on upland conifer forests and their design in terms of the UKFS was completed in 2000 and is still to be released by the FC. The design of new woodlands in culturally sensitive areas must incorporate the character of important landscapes. The Royal Commission on the Ancient and Historic Monuments of Scotland (RCAHMS) and Historic Scotland are also developing a process of Historic Land Use Assessment to increase the awareness of practitioners with respect to archaeological and cultural sensitivities.

6.4.3 Conclusions

- The main difficulty in assessing the impacts on the landscape is the lack of a landscape strategy upon which to base such an evaluation. There are no clear guidelines on what landscapes should be conserved or restored and in the case of restoration of the historic environment, targets do not appear to have been defined. However, SNH has produced 29 individual LCA which identify more than 360 distinct types of landscape (FC, 2000a). These are currently available as reference to Commission staff, monitoring guidelines will be available from April 2002 and work is currently being undertaken to present them in a GIS format.
- The Association of Regional and Island Archaeologists (ARIA) (2001) reported that forestry can adversely impact historic environments and stated that systems of delivery of the conservation of these assets through forestry planning and grants should be reviewed as there were significant shortcomings. These views were supported by the Council for Scottish Architecture (CSA, 2001) and those involved in the technical interviews.
- Crabtree (1996) demonstrated that most the woodlands created under FWPS made a positive contribution to the landscape. Assuming similar results are applicable to the WGS, this would imply landscape improvement, therefore fulfilling the FWPS and WGS objectives to improve the landscape (FC, 2000e; MAFF, 2000a).
- The SFS states that woodlands should be monitored against the SNH assessments but no monitoring information is available. There appears to have been no assessment of whether the landscape principles of forest design are being used or whether the cultural and historical character of countryside is taken into account when creating new woodlands. Not all Commission information on landscape

impacts has been made available to us. It is not therefore possible to assess whether the schemes are conforming to the UKFS.

6.5 Pollution reduction

6.5.1 The impacts of forestry on pollution

Well-designed and sited afforestation delivers major environmental benefits. But, poor management, particularly of upland, commercial, coniferous plantations can also contribute to soil acidification, leaching of nutrients to watercourses, erosion and physical damage to the soil (Nisbet *et al*. in press; Scottish Executive, 2000). The main overview of the technical interviews was that the FC 'Forest and Water Guidelines' tackle all the pollution issues that are faced by foresters and forestry practices and if entrants into the schemes abide by these best practice guidelines, concerns should be alleviated.

Forestry can have a variety of impacts on pollution. The areas where there are particular effects are listed below, however the subject is given a detailed treatment in the Forests and Water Guidelines (FC, 2000f):

- Water quality & quantity
- Acidification
- Nutrient enrichment
- Grazing and agriculture
- Riparian & floodplain woodland
- Carbon sequestration

These aspects are discussed in greater depth in Appendix 3-5.

6.5.2 Conclusions

- It was unclear whether the FC undertook regular monitoring of forestry practices and their impacts on water systems. The SFS states that on the FC's own estates they should monitor acidification and ensure they are compliant with the 'Forest & Water Guidelines' (PCE 4). Although there are no results to report through the results of this literature review, the participants in the technical interviews were confident that FC estates achieved compliance in their technical operations.
- The UKFS states as criteria of sustainable forest management that there should be monitoring of afforested catchments, and the water quality should be protected or improved, yields maintained above any critical level and discharge patterns disturbed only when unavoidable. Again, it is unclear whether it is the FC or SEPA that were responsible for monitoring the impacts of forestry on water supply.
- The UKFS states as criteria for sustainable forest management that forest soil condition should be stable or improving and that there should be net carbon sequestration. There should be measurement of national forest increment, studies of forestry carbon balance, the net carbon sequestration should increase by forest planting and pollution should be avoided. The grant schemes are likely to contribute to carbon sequestration.
- The WGS/FWPS plantings are likely to be contribute to pollution reduction. There will be reductions in soil methane emissions and the soils and trees will gradually

lock up carbon over long periods. The broadleaf-native dominated plantings will have lesser impacts on water yields than coniferous planting.

- Compliance with the Forest & Water Guidelines should achieve best practice methods of forestry processes resulting in the least damaging consequences of forestry operations, although levels of compliance are currently unknown.

6.6 Sustainable use of land and resources

The definition of sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own (Forestry Authority, 1998). The policy drivers behind sustainable land use are discussed in Appendix 3-6.

6.6.1 Motivation to enter the scheme

A main determinant of forest sustainability is the objectives of the participants in planting the woodland. In the entrant survey amenity value, ecological objectives and landscape enhancement rating as the top three with approximately 80% of entrants selecting each of these objectives as one of their main motivations (Table 4-3). Our findings are broadly similar to those found in a previous evaluation of the FWPS (Crabtree, 1996), although the ecological motive is stronger in the WGS/FWPS respondents and shelter and game are less important. When entrants were questioned on their harvesting intentions approximately a third of respondents did not know how they would harvest the woodland, another third stated that harvesting was not applicable to them, 16% stated they would selectively harvest and only 4% stated they would clearfell the woodland, although the clear-felling figure was higher for participants with greater than 50% conifers (14%) (Figure 6-6).

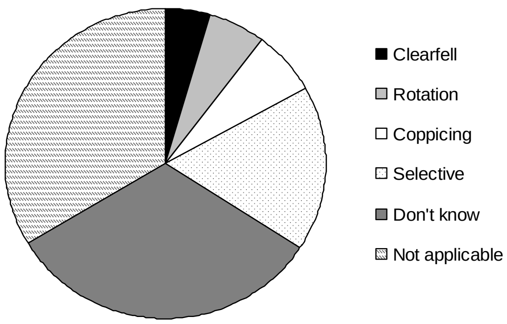


Figure 6-6 The harvesting intentions of the entrants surveyed in the participant questionnaire (n = 394).

If the land is to be managed for ecological objectives and landscape enhancement, this might imply that the woodlands will be maintained in the long term, and are therefore largely sustainable. However, there is no guarantee that this will happen if woodland owners are unable to generate an adequate cash flow from their commercial activities to cover the costs of maintenance their ecological woodlands.

6.6.2 Conclusions

- Over half of new woodlands planted by those surveyed in the participant questionnaire are extensions to existing woodland. This provides increased sustainability and conservation value and supports the formation of Forest Habitat Networks.

- Sustainability indicators have been developed for agriculture but no primary indicator for sustainable agriculture relates specifically to forests (Scottish executive, 2001).
- Sustainability indicators and targets are currently being developed as part of the SFS. However, these are not yet available or defined. It is therefore not possible to assess the WGS/FWPS contribution to the SFS (Woodland Trust Scotland, 2001).

6.7 Impacts on designated areas (SSSI, NSA), waterways and archaeological sites

A UKFS criterion is the conservation of heritage features. Important heritage features are to be protected and due account taken of cultural, historic or designated landscapes. There should be evidence that important sites are clearly recorded, there should be sound principles for integrating archaeological sites into woodland design, sites must be protected and damage avoided.

6.7.1 Impacts of the WGS/FWPS on important sites

The entrant survey indicated that over a third of WGS/FWPS plantings were alongside a watercourse or water body. Over 15% of plantings were either on, or adjacent to archaeological sites or ESAs, closely followed by those near SSSIs (Figure 6.7). These figures incorporate WGS and FWPS, but the proportions are higher than those found by Crabtree (1996) where only 4% of FWPS plantings were on SSSI, 11% in ESA and 6% on Scheduled Ancient Monuments.

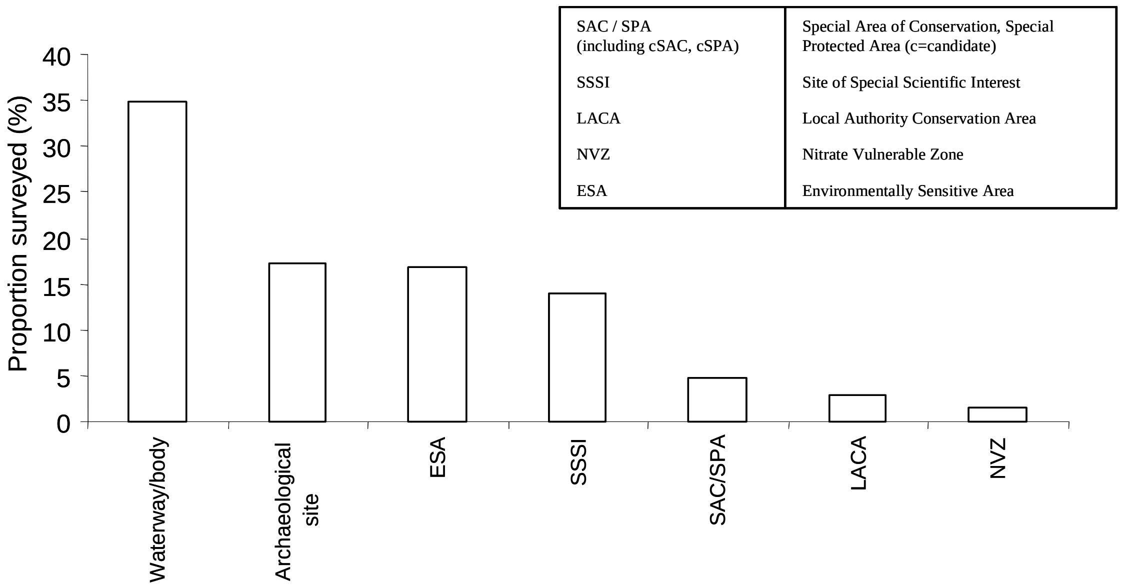


Figure 6-7 The proportion of plans surveyed that were on or adjacent to ESA, SSSI, archaeological sites, waterways/bodies, SAC/SPA, LACA or NVZ.

6.7.2 The impacts on conservation sites

The technical interviews suggested there had been varied experiences in the treatment of designated sites and there was mixed opinion as to whether sufficient attention is paid to sites adjacent to new woodland plantings. Unfortunately there was no literature available for Scotland. SNH stated that they were not aware of any specific monitoring of WGS schemes for impacts on designated sites and biodiversity (Helen Gray & Jenny Bryce, personal communication). Therefore, it has been necessary to draw on the results of studies undertaken elsewhere. A study of the impacts of WGS on 64 ancient and semi-natural ancient woodland SSSIs in England was undertaken before the UKFS guidelines were developed. The results indicated that at least 11% were being damaged as a direct result of the WGS (Kirby *et al*, 1998). The combination of the English study and the technical interviews suggest there may be legitimate concerns for impacts on Scottish sites.

The technical interviews highlighted concerns about the management of sites adjacent to important conservation sites. An example of felling mature native pinewood plantations that support Capercaillie, adjacent to Natura 2000 sites illustrated a lack of foresight. Examples of this kind show there are currently insufficient safeguards to ensure environmental interests are protected. The RSPB stated that their objection rate to schemes is usually very low, at around 5%. But these objections are often lodged at the latter stages of the grant process, when environmental safeguards should have already prevented the scheme reaching such a late stage.

As over 15% of sites are on or adjacent to SSSI, SAC or SPA, it is inevitable that the schemes are having an impact on these sites. This is also supported by the land class data described in Section 6.2. Monitoring is required to demonstrate that UK BAP habitats and species are being protected and enhanced so as to determine whether the WGS/FWPS are achieving the indicators detailed in the UKFS.

6.7.3 Impacts on archaeological sites

The forest planting guidelines state that field and woodland boundaries, remains of settlements, buildings, tracks, quarries, earthworks, ruined structures and crop marks are all of interest (FC 2000c). In general, those involved in the technical interviews felt that there was protection of the archaeological resource under WGS/FWPS. There was also confidence that important sites were brought to the attention of the appropriate authority by the Commission. It was thought that local expert knowledge was used by the FC and there was general approval for the Forest & Archaeology guidelines (1995).

Problems

- Archaeologists suggested there were insufficient funds for the local authorities to fully advise the FC. This resulted in an inconsistent quality of archaeological advice.
- Advice is sometimes based on too little archaeological survey data. If there has been no survey there are no records and the FC officers have to spot any potentially important sites, or the onus lies with the participant to undertake the necessary surveys.
- There is very little feedback after the initial agreement. Therefore it was not known whether sites are managed sympathetically nor whether participants comply with agreements.
- It is perceived that the FC do not monitor registered archaeological sites to ensure they are not being damaged. If the FC does undertake monitoring, local archaeologists are not aware of it.

The WGS/FWPS implementation mechanism fulfils the first indicator of the UKFS as known important archaeological sites are recorded. However, it is not possible to evaluate whether archaeological sites are protected and damage is avoided as the relevant monitoring information is not available.

6.8 The level and quality of management of woodlands

The management of woodlands is critical to the success of woodland establishment and the creation of an environmentally valuable woodland. The WGS aims to encourage good management of forests and woodlands and a SFS priority for action is to improve the management of semi-natural woodlands (PCE 1) as it is believed that their long-term survival is threatened through neglect. The strategy also states that FC is to develop better techniques and clarify priorities for ancient woodland restoration (Forestry Commission, 2000a).

6.8.1 Woodland management and establishment success

There are a number of management practices that enhance establishment success and diversity, this are briefly discussed in Appendix 3-7[14]. When establishing a new woodland there are a number of standard clauses that can be used as required in the WGS contract. These include protection from livestock, pests and weeding.

The entrants into the WGS/FWPS showed a wide variation in the planting success rates over the initial five years of the scheme. In each of the five years the percentage of trees requiring replacement varied from none to between 80-100%. Although in the first two years an average of 5% of trees required replacement, dropping to lower levels in the later years (Figure 6-8).

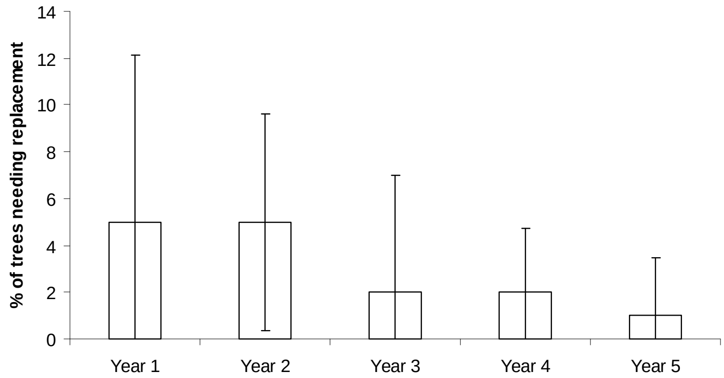


Figure 6-8 The percentage of trees needing replacement in years one to five (median and inter-quartile range).

[14] The Forestry Commission would like to add that they run a series of annual technical seminars for agents and woodland owners on woodland establishment techniques.

The participants in the questionnaire were asked to provide details of the major causes of tree loss, and the associated levels of planting failure. The highest losses were due to hares, vandals and adverse climatic conditions. These high losses only occurred in a small proportion of plantings (Figure 6-9). The three commonest causes of damage were deer and rabbit damage and weed growth. These factors resulted in widespread, though low levels of damage.

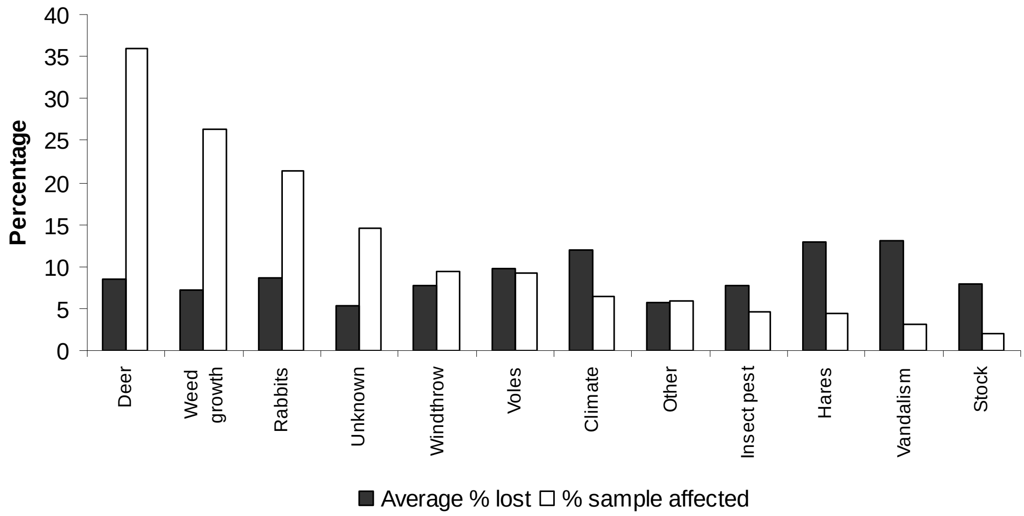


Figure 6-9 The average percentage loss due to each factor and the % of the sampled entrants affected (n=392).

In order to investigate the main causes of major crop failure, entrants were asked to specify when they had lost more than 25% of their crop in any one year and to state the cause. 20.4% of respondents lost more than 25% of their trees and their responses fell into one of four main categories: climate, vegetation, animal and other (Table 6-5). Climate resulted in a loss of almost a fifth of all plantings that had heavy losses. Although adverse weather conditions cannot be avoided, factors such as exposure and salt spray are considerations that could have been taken into account when planning the new woodland, these losses may therefore have been avoidable with better advice. There is also the consideration of local provenance. Locally grown trees may well be better suited to the local weather patterns, and therefore more resilient to adverse conditions when they arise. The quality of the advice provided is also called into question when examining the 'Other' category, as location and inappropriate soils are both problems that could also have been avoided.

Twelve percent of the high losses were due to competition with weeds. Deer caused 20% of heavy losses, the other main culprits were rabbits, hares and voles. Animal damage resulted in almost half of the heavy losses suffered by the participants sampled. It is possible the FC may need to refocus efforts to inform participants about the losses that can be incurred by pests, and the provision of more detailed information on pest control. Britt (1996) found that some of the greatest problems encountered during woodland establishment were usually mammalian pests and weeds.

Additional management

Just under 40% of participants surveyed undertook more management than they felt was required by their WGS/FWPS agreement. The main management practices included maintaining fencing, access, mowing, pruning and weeding (See Appendix 3).

Table 6-5 The main causes of heavy losses (> 25%) in new woodland plantings. The table shows the proportion of those affected (n=392) and the proportion of heavy losses that were attributed to the stated cause.

Cause of losses	% of scheme entrants	% of causes of >25% damage
Weather conditions		
Adverse weather conditions	4.2	10.5
Exposure	1.5	3.75
Salt spray	0.8	2.0
Strong winds	1.6	4.0
Impacts of vegetation		
Bracken	0.4	1.0
Weeds	4.9	12.3
Poor quality stock	2.3	5.8
Animal damage		
Deer	7.9	19.8
Hares	2.4	6.0
Insects	0.2	0.5
Rabbits	2.9	7.3
Stock	2.5	6.3
Vermin	0.6	1.5
Voles	2.6	6.5
Other		
Inappropriate soils	0.5	1.3
Location	1.8	4.5
Poor management	0.8	2.0
Vandalism	2.1	5.3

6.8.2 Conclusions

It was not within the scope of this research to investigate the compliance of participants with their management agreements. The Commission check a percentage of schemes before making the final grant payments.

Those involved in the technical interviews were confident that new research was incorporated into management. However, they were not confident that there was sufficient research into the effectiveness of management in producing woodland biodiversity. Previous studies have highlighted that a significant minority do not comply with management agreements (e.g. Pryor and Martin, 1998). Continued and enhanced monitoring is therefore necessary.

The planting failures might imply a lack of guidance in the initial planning stages. The introduction of management agreements could be far-reaching, with more specific requirements as to woodland management and establishment, as shown in other agri-environment schemes. However the inclusion of more exacting management prescriptions would also entail a higher degree of monitoring and assessment of compliance.

6.9 Natural regeneration within the WGS/FWPS

A detailed discussion of factors effecting natural regeneration is given in Appendix 3-8.

6.9.1 Conclusions

Regeneration is supposed to be supported by grants everywhere it is practical and appropriate. There is, however, very limited use of this option and it could possibly be used more widely. In England, Kirby *et al.* (1998) found that planting was still undertaken even where natural regeneration was best, and Currie (2001) found that, although regeneration was included in woodland design, it was often placed in inappropriate locations. The strong opinion of those consulted in the technical interviews was that regeneration was a highly appropriate means of afforesting land and the WGS arrangements may need to be adjusted to encourage this. However, from an owner perspective regeneration is technically difficult with an uncertain outcome. The grant structure may need to be changed so that the Commission take on a greater share of the risks involved.

The time frame may need to be extended beyond the current ten years, as the requirement for 1100 trees per hectare within this time may be unrealistic. Therefore, the timeframe may need to be extended. Discretionary payments or management grants should be available to support on-going management, particularly where good examples of regeneration have developed. It could also be possible to withhold a portion of the grant until regeneration occurs in order to maintain the participant's commitment (RSPB, 2001; SNH, 2001).

6.10 Impacts of deer

The increase in woodland area has extended deer habitat and is associated with an increase in deer numbers and reported damage to horticulture and forestry. The SFS states that tackling deer problems is a priority for action (SFS FFR5) in order to increase success of natural regeneration, restocking, enhancement of woodland structure. It would also have an impact on biodiversity, prevention of damage to timber and avoiding the need for deer fencing. The SFS also states that the FC is to carry out effective deer management on its land and improve links between deer management plans and grant support. The indicators include reduced deer numbers, increased numbers of deer management plans and reduced levels of economic and environmental damage (FC, 2000a).

6.10.1 The impacts of deer on WGS/FWPS entrants

The impacts of deer and their management are discussed in Appendix 3-9 Over 35% of sampled participants suffered an average of 8% tree mortality due to deer damage (See Section 6.7). Eight percent of participants lost over 25% of their planting in one year due to deer damage.

Sixty-nine percent of participants recorded deer as being present on the new woodland sites, with higher levels being seen on FWPS, coniferous plantations, BLS, older plantings and larger sites. Only 6% of participants considered the deer an asset, with a further 37% having a mixed attitude towards their presence (Figure 6-10).

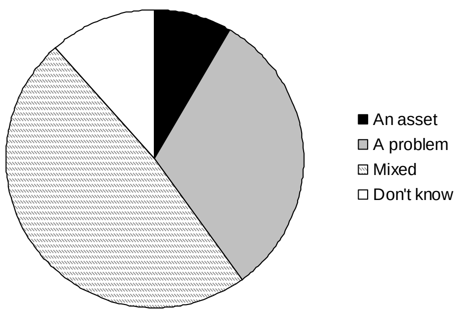


Figure 6-10 The proportion of sampled participants and their attitude towards deer presence on new woodlands.

Almost 50% of respondents undertake deer management of some description, and this proportion is higher with plantations of over 10 ha (74%) and on mainly coniferous plantations (67%). As a result of this management, only 50% said their deer management led to tolerable levels of damage. When asked if deer were constraining their objectives participants either stated the damage was at levels that prevented them meeting their objectives, or they stated the deer did not constrain their objectives at all. There were very few intermediate responses (Figure 6-11).

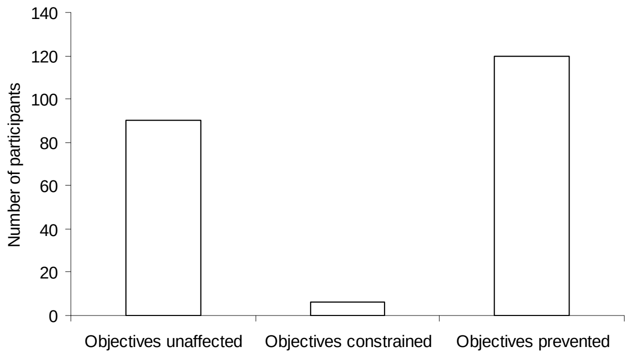


Figure 6-11 The impacts of deer on scheme entrants' objectives.

6.10.2 Future direction and current issues

The increase in forested land and deer levels are a highly important issue. Deer were stated to be the greatest disincentive to planting new woodlands by one technical interviewee. The appropriateness of using deer fencing has been called into question in certain regions and this means that greater attention needs to be devoted to the development of strategic guidance for woodland establishment.

The control of deer needs a constant effort, as is stated in the SFS (FC, 2000a). This could be achieved by the incorporation of deer management plans (DMP) into the management agreements. However, if DMP are to be incorporated into the WGS/FWPS then financial support will be necessary as the costs can be considerable. Those needing to undertake deer management may require training, equipment, vehicles and neighbour liaison in order to provide collaborative deer management. Deer occur at a landscape level, so there is also the issue of accountability and monitoring. There is a need for greater clarity over which organisations are responsible for the monitoring and control of deer and a more coordinated approach between the various interests (SNH, 2001; WTS, 2001). Not only is the control of deer an issue in the SFS, but the wider implications for biodiversity and protection of priority habitats and species are all impacted by deer numbers. Therefore this issue spans a number of the priorities and objectives detailed in the SFS, UKFS and those of the WGS and FWPS.

7 Administration of the schemes

7.1 Introduction

We examined the efficiency of the administration of the schemes through the surveys of entrants and agents. We also explored a number of cases from the database where applications to the scheme may have been affected by poor administration or difficulties in meeting the schemes' conditions.

7.2 Entrants' views on the administration of the schemes

7.2.1 Application pack and scheme administration

Ninety percent of entrants said that the applicant pack and scheme administration were satisfactory. There was no difference in response between FWPS and non-FWPS respondents, indicating a wide measure of satisfaction with the administration of both schemes. Ninety-three percent said that the conditions that applied to the grant schemes were clear in the documentation and contract. Overall, 7% found the conditions not clear and 10% found the administration unsatisfactory in some way.

The most important reasons (quoted by at least 2% of respondents), which explained unsatisfactory administration, were:

- Complicated and confusing application procedures
- Slow administration and/or time consuming bureaucracy
- Involvement of two agencies (SEERAD and FC) caused confusion and delays.

Problems tend to be more common amongst non-professionals and in particular first time applicants. For them the application forms do not make sufficiently explicit what are and are not acceptable proposals. For farmers, a smoother integration of FWPS with WGS would be advantageous. This would avoid additional administration when applying of grant aid and when plans are modified or afforested land is split up or sold. Professional agents on the other hand understand the system and find few problems. For them the gains from a more integrated approach would be small.

7.2.2 Conditions and consultation procedures

Ninety-three percent of entrants found the conditions clear. The most common reason for finding the conditions unclear was that they were too complicated or confusing for the applicant to understand.

Where consultation was perceived to be a relevant issue, 92% of respondents found the consultation procedures acceptable. Eight percent did not. The main problem (3.3% of respondents) was the fact that consultation was time consuming and caused delays Nevertheless, these figures should not be interpreted as indicating that the consultation process does not result in severe problems and expenditure for some applicants (see below). These tend to be larger scale plantings of non-native species in environmentally more sensitive locations. The evidence on non-approved and expired plans, and from the TGA indicates that the current consultation process may be reducing applications for grant aid and planting rates, by imposing higher costs, delays and rejections on applicants. There is a case for reviewing these procedures to assess whether they could be made faster and less costly to applicants.

7.3 Applied-not-approved WGS/FWPS plans

We investigated a sample of plans that had not been approved for 18 months after application. There were 77 plans with application dates prior to April 2000 which had not yet been approved or rejected. Seventy of these were in the 1996-2001 period and represented 2.8% of all plans.

Unapproved plans were on average substantially larger than approved plans. For example, in the 1996-98 period there were 11 unapproved non-FWPS plans and these had an average area of proposed new planting of 528 ha compared with 17.6 ha for approved plans. Unapproved FWPS plans also involved larger areas of planting. This suggests strongly that the main factor explaining very slow approval was the more extensive consultation required by larger plans.

Of the 77 database entries, 20 were randomly selected and interviewees contacted by telephone.

7.3.1 FWPS applicants

Application outcome

The interviews revealed that four of these planting plans are going ahead. They have been recently approved and are about to be planted. The application that had taken longest time was 3.5 years and the shortest delay was 13 months. In general applicants or their agents did not seem overly concerned by the delay.

Of the other six respondents, half of the plans were not going ahead due to factors generally outside the influence of the Forestry Commission. Reason included objections from local residents, recent designation as an SPA and sale of the land, and inadequate grant aid.

7.3.2 Non-FWPS applicants

Application outcome

This group compromised farmers (4), estate owners (3), private landowners (1), NGOs (1) and businesses (1). All applicants had applied through an agent.

Of all the 10 applications three were extremely big schemes (> 400 ha), one in excess of 1,000 ha. In all of these cases the delay has been due to the fact that the schemes required environmental assessments or more detailed negotiations, and these plans are now going ahead. Of the seven smaller projects in the sample, two were going to be, or had already been, planted. This indicates that 50% of applications in this group have resulted in projects being implemented.

There were a variety of reasons for the other 10 schemes not going ahead. These included sale of the farm, lack of funding, lack of attractiveness of WGS grant aid, and more attractive land uses (Countryside Premium Scheme and residential building)

The delay in the administrative process in these 10 cases seems to have been generally due to necessary procedures. Fifty percent of applications will result in planting while the other 50% have been withdrawn.

7.3.3 Summary

Overall half of these applications that were denoted in the database as having been received but not approved are indeed going, or have gone, ahead with planting. Comments from individuals and agents did not indicate serious frustration or criticism at the pace of administrative procedures. However, some agents did make a general comment that the Forestry Commission's administrative process could be slow, depending at times on the conservancy carrying out the administration.

7.4 Expired plans

This part of the survey concerned those applicants who had applied, been approved and had a contract set up with the Forestry Commission but, after a 6 year period, grants had still not been claimed. There were 297 expired plans with application dates in the 1988-1995 period that involved new woodland. This compares with 3,732 on which grant had been paid (7.4% of expired plans in the total). Expired plans had a higher mean percent of conifers in the new woodland (55.6% compared with 35.8%) and were smaller (10.1 ha compared with 18.1 ha). The proportion of expired plans was slightly higher with those not involving FWPS.

Again, 20 random interviewees were contacted, 10 who had entered the FWPS and 10 who had not.

7.4.1 FWPS applicants

The reasons for expiry within this group were varied, although 40% had simply not gone through with the planting because other uses for the land seemed more profitable or practical. Their agents indicated that three of these farmers found forestry to be more difficult than they had anticipated having had problems or failures with previous planting schemes.

In four out of the six other cases the reason for the application having expired did not seem to be related to administrative procedures. There was more evidence of discontent about the WGS policy and Forestry Commission administration in the remaining two cases, where an estate owner had decided to go ahead with planting most of the proposed area on his own because he was very unhappy with the level of 'interference' and inflexibility of Forestry Commission staff. In another case, the current landowners had inherited the scheme from previous owner and had then been held responsible for success of scheme. They felt that Forestry Commission staff had not been helpful. In common with the former case they would not be interested in applying for such schemes in the future.

7.4.2 Non-FWPS applicants

This last group consists of people who had not applied for FWPS and whose contracts have expired. Again a significant proportion (50%) decided that there were better alternative land use options by stating clearly that the scheme as not economically attractive enough or that planting would devalue the land. Other problems encountered by applicants were difficulty in obtaining labour to plant trees, and that the individual areas applied for were too small to qualify, although the overall area was big enough.

7.4.3 Summary

It is evident that in the case of expired contracts very few schemes are planted up anyway (10%) and this is clearly at the personal expense of the landowner as grants have not been claimed. This group therefore demonstrates a higher degree of policy failure, in this respect, than the 'applied-not-approved' group. Overall 50% of those surveyed had not carried out planting because they felt it was not economically viable. A further 30% of the non-FWPS group had not gone through with the plan because of financial costs of the scheme.

7.5 Conclusions on scheme administration

- The great majority of scheme participants found the administration of the scheme satisfactory.
- Ten per cent found it unsatisfactory and the issues raised related to the complexity of the application procedures, slow speed of administration in some cases and lack of integration of FWPS and WGS. In general, the criticisms seem fairly minor although a limited number had more major problems with the cost and time scale of consultation.
- The total numbers of slow approvals and expired plans was not unreasonably large. As a general point, and taking account of comments made to us by owners and stakeholders, the Commission may need to reflect on whether approval is being unreasonably delayed by the consultation process and whether large scale planting opportunities are being lost.

8 Conclusions

8.1 Introduction

In this chapter we draw together conclusions on the economic, social and environmental outputs delivered by the incentives schemes over the last decade. It is important to appreciate that the policy context has evolved over the decade and the schemes were not designed within the context hat now prevails. We conclude by examining how the scheme delivers in relation to requirements of the current policy drivers.

8.2 Establishment of new woodlands

The area of new WGS planting now seems reasonably stable and FWPS planting has become a relatively stronger element within WGS. New ‘commercial’ conifer planting has largely shifted to farmland and receives FWPS payments. The proportion of broadleaf planting has been increasing and it now represents 63% of the total, with 12% in native pine and 25% in conifers.

The FWPS element is now a major source of cash flow for planting and during the last four years larger areas have been planted with FWPS funding than without it.

It is clear from the expansion challenges that new planting can be induced if incentives are sufficiently large. In the future, planting on farmland may increasingly have to compete with the Rural Stewardship Scheme and initiatives to encourage organic farming if agri-environment funding is increased.

8.3 Management and improvement of woodlands

Whilst most of the WGS/FWPS expenditure has been directed towards forestry and woodland expansion it is the existing resource that provides the bulk of the benefits to society. Yet less than 20% of grant aid is directed at existing woodland management (3.2). There is a case for some shift in the balance of expenditure towards procuring more public benefits from the existing estate, in terms of biodiversity, landscape and access. If the environmental priorities of the SFS are to be delivered, more emphasis needs to be placed on management and monitoring to ensure that the current schemes are producing environmental benefits. Neither the effectiveness of the schemes nor their contribution to the obligations under the SFS and UKFS can be assessed unless there is adequate monitoring.

We were unable to investigate the AMGs and WIGs in detail because this would have required extensive fieldwork. We understand that the Commission has not evaluated these elements of WGS but what evidence we have indicates that their effectiveness could be improved. It would be helpful if these incentives were first subjected to a more rigorous evaluation to assess their additionality and performance. Mechanisms for encouraging the sustainable management of native and semi-natural woodlands are not well defined within the current incentive schemes although considerable knowledge exists on the subject.

8.4 Economic and social outputs

Rural employment

The grant schemes generate significant employment from planting and timber harvesting and their knock-on effects throughout the Scottish economy. We estimate that, from

105,000 ha of new planting over the last decade, around 600-1,180 additional jobs will have been created in the planting/establishment phase. The range takes into account some uncertainty about the extent of job displacement from the planted land. If harvesting is included, we estimate the total FTEs created as between 1,560-2,140 FTEs, depending on displacement, and assuming 30% of the broadleaved and farm woodland area is harvested. The harvesting jobs will not materialise for another 25 to 50 years and therefore cannot be given the same weight as current jobs. The estimates are also subject to considerable uncertainty. At least two-thirds of these jobs will be located in rural parts of Scotland.

Commercial conifer planting generates by far the largest source of employment from the current forestry stock. This is not the case for new non-FWPS planting because the areas planted are small and the employment generation per hectare low. Over 90% of employment in the planting phase induced by WGS/FWPS derives from broadleaved and FWPS planting. In the longer term, the relative contribution of coniferous planting will be higher but much will depend on how much of the farm and broadleaved woodlands are harvested.

There will be some jobs created from grant expenditures on forest management and indirect benefits to tourism through landscape and recreational impacts on tourist spending. We were unable to estimate the magnitude of these but the tourism effects could be considerable.

Access and recreation

The main social impacts of the schemes are through access creation and enhancement using the Community Woodland Supplement (CWS), AMGs and WIGs. The CWS had successfully created over 300 new accessible woodlands near centres of population in Scotland. The majority of the woodlands were highly valued by the public but a significant proportion did not represent good value for money because of their poor quality and low rates of use. We were not able to evaluate the recreational benefits procured under the AMGs and WIGs but the CWS evaluation suggests that problems of additionality, information to the public and integration within wider access networks need to be addressed.

The Land Reform Bill will change the policy framework for access. It will provide the context for a re-examination of the role of incentives in creating and extending recreational benefits for the public. There is scope for an incentive based policy to build enhanced public opportunities and benefits onto the expanded rights of public access.

8.5 Environmental outputs and sustainability

Biodiversity

Overall, the evidence suggests that the grant scheme generate substantial positive impacts on biodiversity. However, woodland biodiversity is unlikely to be realised at the 2-10 year timescale investigated and it is not known if the management required by the WGS/FWPS rules is producing diverse woodlands. However valuable scrub habitats and enhanced biodiversity for non-woodland species will occur rapidly. The successful management of biodiversity will require more scientific experimentation and substantial monitoring. For example, there is limited information available on biodiversity in coniferous plantations and the extent to which conifers are reservoirs of native biodiversity. Traditionally, the management of short-term wood production is akin to engineering, whereas preserving biodiversity requires an ecological community approach where structural and process diversity are the key components (Simberloff, 1999).

Creating environmentally valuable woodlands

In terms of management, there needs to be a greater shift in priorities towards creating environmentally valuable woodlands. It cannot be assumed that simply establishing trees will automatically bring environmental benefits, as was illustrated by MacKenzie (2001), Currie (2001) and Cranfield (1999). The achievement of environmental gains entails woodland management beyond the establishment phase. In many situations the benefits of woodland management to the public far outweigh those to the landowner and cost sharing arrangements need to reflect this. There are also objectives in the WGS, FWPS and SFS to expand native woodlands. This has also been achieved, although there is some concern about the impact of new woodlands adjacent to designated areas.

Landscape scale and impacts

The evaluation has illustrated a need for greater collaboration between organisations and a more holistic approach at the landscape scale. There would be benefits from a joined up approach between agriculture and environment as reiterated in the SFS. This is particularly necessary with respect to the impacts of deer and landscape enhancement and protection of the historic environment. The lack of monitoring and research means in certain cases it has not been possible to evaluate whether the schemes are fulfilling their own objectives nor those of the UKFS and SFS. This is particularly the case with archaeology where there is a need for transparency and accountability in the monitoring of impacts on the archaeological resource. There is a need for very clear advice on site selection, preplanning and management.

Pollution and carbon sequestration

The schemes appear successful in reducing pollution and storing carbon. The removal of land from agricultural production automatically reduces polluting inputs into the ecosystem. The planting of trees, if best practise guidelines are followed, will result in additional uptake of carbon, reduction of pollutants, and an increased carbon holding capacity in the soil. Most new plantings will contribute to these objectives, therefore fulfilling objectives in the UKFS.

8.6 Performance and policy drivers

We note that none of the policy drivers, which provide the strategic framework for the WGS and FWPS, give quantitative measures against which performance can be assessed. The Scottish Forestry Strategy (SFS) sets out the indicators by which performance is to be measured but these are not generally quantified and monitoring baselines are not given.

This limits the extent to which the effectiveness of the grant schemes in delivering on the SFS and RDPS can be assessed.

We examine the main policy drivers in turn.

Scottish Forestry Strategy

Table 8.1 summarises the performance of incentives in delivering on selected SFS priorities. In nearly all cases the grant schemes make a positive contribution but without quantitative measure of SFS policy aims it is not possible to assess the efficiency or effectiveness of these schemes in fulfilling the strategy.

Forward Strategy for Scottish Agriculture (FSSA)

The FSSA indicates no specific role for forestry or farm woodlands and gives no objectives or targets against which performance can be measured.

Table 8.1 Incentive performance in relation to the Scottish Forestry Strategy

Priority	Indicators	Incentive performance
Expand the area of well designed productive forest	Increase forest area	Forest area is increasing but the rate of expansion has been declining. Lack of evidence on design attributes means that compliance of established woods with UKFS is not known although this is a now a condition of all new contracts.
	Increased potential timber production	New planting will contribute to the timber production potential. However, the coniferous area is now under 10% of grant-aided new planting.
Improve timber quality by following good forest practice	Increased proportion of planted ground that achieves satisfactory establishment	Not directly assessed. High levels of losses after planting remain a cause for concern.
	Increased percentage of volume suitable for sawmilling	Not assessed.
	Increase area of forest subject to appropriate silvicultural management	Not assessed. WGS/FWPS do not address quality issues in broadleaves
Develop more mixed forests	Increased overall diversity of species and age	Within-forest diversity not assessed. Some evidence for species uniformity in earlier FWPS planting. Overall species diversity increased by greater emphasis on broadleaves and native pine.
	Contribution to BAP targets	Contribution to the targets for area of new woodland planted.
Improve management of semi-natural woodlands	Prevention of loss of semi-natural woodland	Mechanisms for preventing loss of semi-natural woodlands not explicit within WGS. Both Wales and England have native woodland planting and management schemes within WGS at the pilot stage or beyond.
	Contribution to BAP targets	Contribution to the targets for area of new woodland planted.
Extend and enhance native woodlands by developing Forest Habitat Networks (FHNs)	Publication of guidance on FHNs	Not assessed
	Increased areas of native woodlands established in accordance with FHN	FHN as yet unpublished, therefore not possible to assess this indicator
	Contribution to BAP targets	Contribution to the targets for area of new woodland planted
Increase diversity of the farmed landscape	Positive impacts shown in monitoring	No monitoring data as yet available. Majority of FWPS schemes (>90%) enhance the landscape but concerns over maintenance of local diversity due to uniformity in planting.
Contribute to a radical improvement it the quality and setting of urban areas	Improvement in quality of priority areas shown in local authority assessments	Not assessed.
	Development and implementation of plans for green networks	Not assessed
Provide woodland recreation areas near	Increased accessibility of woodland recreation for all social	Opportunities created by CWS and WIGs but access incentives will need to be reviewed in the context of the

towns	groups	Land Reform Bill.
	Identification of priority areas	Not clear whether priority areas have been defined although some have (e.g. Central Scotland Forest Challenge). Forest access policy would benefit from greater integration into wider access policy
Create wider employment opportunities	Increased rural employment from forestry, wood processing and related activities in sensitive areas	The evidence indicates that new woodlands contribute to net employment. The number of additional jobs created by the grant schemes depends critically on the extent of any displacement of labour associated with the previous land use and on the extent to which timber is harvested.

Rural Development Plan for Scotland

The objectives of forestry in the RDPS are defined in terms of the objectives of the WGS and FWPS. As noted above, the objectives of these schemes are not stated in terms of quantitative targets or indicators. Measures of success are thus not built into policy. Within the limited scope of this study, our conclusion is that all the stated objectives of the schemes are being met.

Whilst it is extremely difficult to assess whether the expenditure represents good value for money in an absolute sense, it is possible to indicate where effectiveness and value for money might be increased.

Woodland Grant Scheme

The WGS incentives have delivered on all the scheme's objectives. The additionality of the fixed incentives is high which means that little planting will take place without them. The additionality of challenge funding is lower and one must conclude that challenges have to be used selectively if they are to deliver good value for money.

The administration of the WGS and the advice offered by Commission staff appears good with a low level of dissatisfaction. But the application process is complex and farmers applying to FWPS face dual administrative hurdles. Greater unification of WGS and FWPS would simplify matters. There seem to be no problems in obtaining good quality advice and the use of contractors and agents is widespread. New entrants should have no difficulty in obtaining services from the market.

Effectiveness in achieving the aims of SFS can be increased through:

- Discretionary selection for planting based on scoring of expected benefits. This will prioritise expenditure on planting. An even more effective measure would be to link benefit to cost and select on a value for money basis.
- More targeted initiatives with challenge funding or special supplements. Challenge funding has proved a very valuable route for the more effective targeting of incentives. Special supplements may be more efficient but challenges are useful in the first instance in order to discover at what price supplements should be set. There is also a danger that challenges lead to much increased levels of incentive (and expenditure) which may not result in good value for money.
- The performance of AMGs and WIGs could be improved. The evidence supports the case for a greater concentration of expenditure on the enhancement of existing woodlands particularly in relation to achieving environmental objectives. Many woodlands planted over the past three decades could be substantially improved for biodiversity by relatively moderate investment in management schemes.
- The introduction of 'regional' priorities into the WGS through differential scoring of applications and incentive rates. This is a longer term aim because the required detailed understanding of regional priorities and contexts would take some time to develop.

Farm Woodland Premium Scheme

The FWPS is now central to woodland expansion. Its key objectives are to improve the landscape, provide new habitats and increase biodiversity. In reality, it derives its mechanisms for achieving this from standards set by the WGS, and becomes a financial mechanism that compensates farmers for income foregone. It has on occasion been used to finance large areas of planting (e.g. in the Grampian challenge) where greater contributions to landscape and habitats (the FWPS objectives) could have been achieved through use of more different species and designs. The case for integrating the objectives and payments of FWPS in WGS is strong - it would reduce problems for applicants and lead to greater policy coherence.

FWPS has to be progressively evaluated as an RDR mechanism alongside other RDR mechanisms. The Rural Stewardship Scheme (RSS) is the obvious comparator. It is designed to encourage farmers to maintain and enhance habitats and landscape features. The RSS is strongly targeted with well-specified environmental objectives, is linked well to the BAP and has competitive participation to enhance value for money.

The aims of FWPS are admittedly not the same as those for the RSS. But there is a case for the FWPS to move in the same direction (if it remains a distinct scheme). Objectives better linked to BAP and more clearly defined in terms of landscape contributions would enhance its environmental performance. Selective entry would improve value for money.

Since FWPS is co-financed under a specific measure related to compensation for farm income foregone, it may not be possible to integrate the objectives with WGS under this specific measure. The same principle may be true of any proposal for linkages with RSS.

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Appendix 1:Planting models

Appendix 1: Planting models for internal rate of return calculation

MODEL 1: UPLAND CONIFER PLANTATIONS – NEW PLANTING

SCHEME OUTLINE

Total area	40 ha
Unplanted area (20%)	8 ha
Planted area:	32 ha

SPECIES AND STOCKING

Conifers	SS 65% =	20.8 ha	YC 14	80% =	25.6 ha
	DF 15% =	4.8 ha			
Broadleaves	AH 10% =	3.2 ha		20% =	6.4 ha
	BI 10% =	3.2 ha			
Stocking:			2,250 plants/ha		

EXPENDITURE – 2001 COSTS

Operation	**Year**	**Unit Cost**	**Assumption**	**Total Cost (ex VAT)**
Acquisition costs	-1	£1,500	£750 Adviser £750 Lawyer	£1,500
WGS application	-1		3 days	£900
Site survey	-1	£10/ha		£400
Initial access roads + bell mouth	0	£15/m	3m/ha Pre-planting roads, bell mouth	£1,800
Fencing (deer)	0	£5.50/m	2,850m	£15,675
Mounding	0	£220/ha		£7,040
Drains	0	£50/ha	Includes unplanted area	£2,000
Plants - conifers - broadleaves	0 0	£150/1,000 £250/1,000	2,250 plants/ha 2,250 plants/ha and stakes	£8,640 £3,600
Planting	0	£200/ha	2,250 plants/ha	£6,400
Fertilising - initial - aerial	0 0	£150/ha £90/ha	50% of planted area 50% of planted area	£2,400 £1,440
Beating up	1 2		20% of cost (£18,640) 5% of cost (£18,640)	£3,728 £932

MODEL 1. (Cont).

EXPENDITURE (continued)

Operation	Year	Unit Cost £	Assumption	Total Cost (ex VAT)
Weeding (chemical)	1-3	£100/ha	30% of stocked area. Unit price per ha weeded.	£960
Fire protection	0-35	£1/ha/ann	Beaters etc	£40
Vermin control	0-15		£500	£500
Insurance	0-10	£2/ha	0.14% of £1,400/ha on 32ha	£62
Management fee	0-25	£12/ha		£480
Maintenance contingency	0-10	£200/year		£200
Harvesting roads	17	£15/metre	3 metres/ha upgrade	£1,800

INCOME

Grants - Woodland Grant Scheme Mk III

Conifers 80% of 40ha @ £700/ha = £22,400

Broadleaves 20% of 40ha @ £1,050/ha =£8,400

1st Instalment (70%) = £21,560 Year 1

2nd Instalment (30%) = £9,240 Year 6

Timber Income - 2001

Conifers

Crop Age	Type of Operation	Estimated Quantity Removed Tonnes/ha	Assumed Standing Value/tonne (return to owner)	Harvesting Costs £/tonne	Transport Costs £/tonne
18	Thinning	40	£0 (-3 to +3)	16 (15-20)	8 (6-12)
35	Clearfell	300	£12 (8-16)	8 (6-10)	8 (6-12)

1. Assumes scheme is the maximum size without triggering an environmental assessment.
2. Assumes all trees are extracted by forwarder rather than skyline or winch.
3. Figures in brackets are ranges.

Broadleaves

It is assumed that no commercial timber will be produced from the broadleaved trees that are planted initially.

MODEL 2: NEW PLANTING OF NATIVE WOODLAND

SCHEME OUTLINE

Total Area:	200ha
Unplanted Area (10%):	20ha
Grant Aided Open Ground (20%):	40ha
Plantable Area:	140ha

SPECIES AND STOCKING

50% Birch YC 6	70ha
50% Native Pine YC 6	70ha
Initial Stocking:	2,250 plants/ha

EXPENDITURE – 2001 COSTS

Operation	**Year**	**Unit Cost £**	**Assumption**	**Total Cost (ex VAT)**
Acquisition costs	-1	£1,500	£750 Adviser £750 Lawyer	£1,500
Environmental Impact Assessment	0	£10,000		£10,000
New deer fence	0	£5.50/m	5,656 m	£31,100
Site preparation	0	£220/ha	Mounding 140ha	£30,800
Cost of plants	0	£0.25/tree	@2,250/ha = £563/ha	£78,820
Planting	0	£40/1,000	£90/ha	£12,600
Beat up (replace)	1		15% of £91,420	£13,710
	2		5% of £91,420	£4,570
Chemical weeding	1	£100/ha	50% of area planted Year 0	£7,000
	2	£100/ha	25% of area planted Year 0	£3,500
Vermin control	0-6	£5/ha	Within deer fence	£1,400
Fence maintenance	0-15	£500/yr	Contingency item	£500
Insurance	0-15		0.14% of £1,400/ha over 140ha	£275
On-going maintenance and management	0-15	£12/ha/an	On 200 ha	£2,400

INCOME

Grants - Woodland Grant Scheme Mk III

Planting grant @ £1,050/ha over 180ha = £189,000

(broadleaved and native pine wood rate)

70% of total in Year 1 = £132,300

30% of total in Year 6 = £56,700

Timber – 2001 prices

The most realistic assumption at the present time is that no commercial timber will be produced from the site. However on the optimistic assumption that some may be, it could be assumed that the area will not be managed for commercial timber production and that only one third of the area will produce any timber. It is further assumed that access to the site for harvesting may be very limited and that higher than average costs may be incurred.

It is assumed that 100 tonnes of native pine roundwood and birch could be produced at year 85 and could provide a return to the grower of £10 per tonne standing.

Crop Age	Quantity Removed t/ha	Estimated 2001 Price (return to owner) £/m^3	Harvesting Cost £/tonne	Haulage Costs £/tonne
85	100	10 (8 - 15)	12 (10 - 15)	8 (8 - 12)

Footnote: It is assumed that the area to be planted is a square for calculating fencing costs.

MODEL 3: EXISTING NATURAL REGENERATION OF NATIVE WOODLANDS

SCHEME OUTLINE

Total Area:	10 ha
Unplanted Areas (15%):	1.5 ha
Stocked Area:	8.5 ha

SPECIES AND STOCKING

Species: Caledonian Pine	YC 6
Birch	YC 6

Restocking all done by natural regeneration.

EXPENDITURE – 2001 COSTS

Operation	Year	Unit Cost	Assumption	Total Cost (ex VAT)
New deer fence	-1	£5.50/m	1,265 m	£6,960
Site preparation	0	£50.00/ha	Prep for regeneration	£425
Insurance	0-85	0.2%	Av. value: £2,500/ha	£45.00
Management	0-85	£15/ha		£50.00
Fence maintenance	0-85		Fence repairs	£50.00

INCOME

Grants - Woodland Grant Scheme Mk III

Natural Regeneration grant, including open ground (stocking of 1,100 stems/ha).

Caledonian pine grant £525/ha at Year 5: £4,460

There may also be a discretionary payment based on 50% of first year costs.

Timber

Crop Age	Quantity Removed t/ha	Estimated 2001 Price (return to owner) £/tonne	Harvesting Cost £/tonne	Haulage Costs £/tonne
40	50	2 (1-5)	17(15-20)	8(6-12)
50	30	4 (3-7)	13(10-15)	8(6-12)
60	30	9 (8-12)	10(8-12)	7(4-10)
70	30	12 (9-15)	10(8-12)	7(4-10)

Footnote: Figures in brackets indicate possible prices ranges.

Regeneration Felling – age 85 years.

Number of stems: 400/ha, average volume 0.6m$^{3.}$

Standing volume: 240m^{3}/ha.

Remove 200 stems/ha. Leave 200 stems/ha for regeneration.

Remove 100 tonnes^{3}/ha. Estimated income £5/tonne$^{3.}$ standing.

TOTAL INCOME £500/ha

Crop Age	**Quantity Removed t/ha**	**Estimated 2001 Price (return to owner) £/t^{3}**	**Harvesting Cost £/tonne**	**Haulage Costs £/tonne**
85	100	5 (3 -15)	12 (7-15)	7 (4-10)

Appendix 2: Employment impacts of forestry

A2-1 Employment generated by different forestry types-methodology

The evaluation concentrated on identifying the employment impacts of four different forest types in Scotland: existing native woodland, new native woodland (post 1990), commercial conifers, and farm woodlands. Full methodological details of the approach used are given on Eiser and Roberts (2002). This required extensive survey work to collect data on the outputs, expenditures and financial flows of each woodland type. To this end, a stratified survey of woodland managers, contractors and processors was conducted. The sample covered activities relating to 78 Scottish woodlands, the total area of which was 350,633 ha, or 28% of the total forested area of Scotland in the base year of the study, 1995[15].

The Scottish input-output table for 1995 was disaggregated using data from the survey, and information on the total area of each of the four forest types in Scotland. The strength of input-output analysis lies in its ability to take into account the interdependencies that exist between sectors in an economy. Input-output techniques can be used to measure the full contribution of a sector to an economy, taking into account not only the direct effects, but also the multiplier effects associated with that sector. The process of integrating the woodland survey data with in the 1995 Scottish Input-output table involved four stages. Figure A-1 provides a schematic layout of these stages, from survey data to final disaggregated, balanced input-output table.

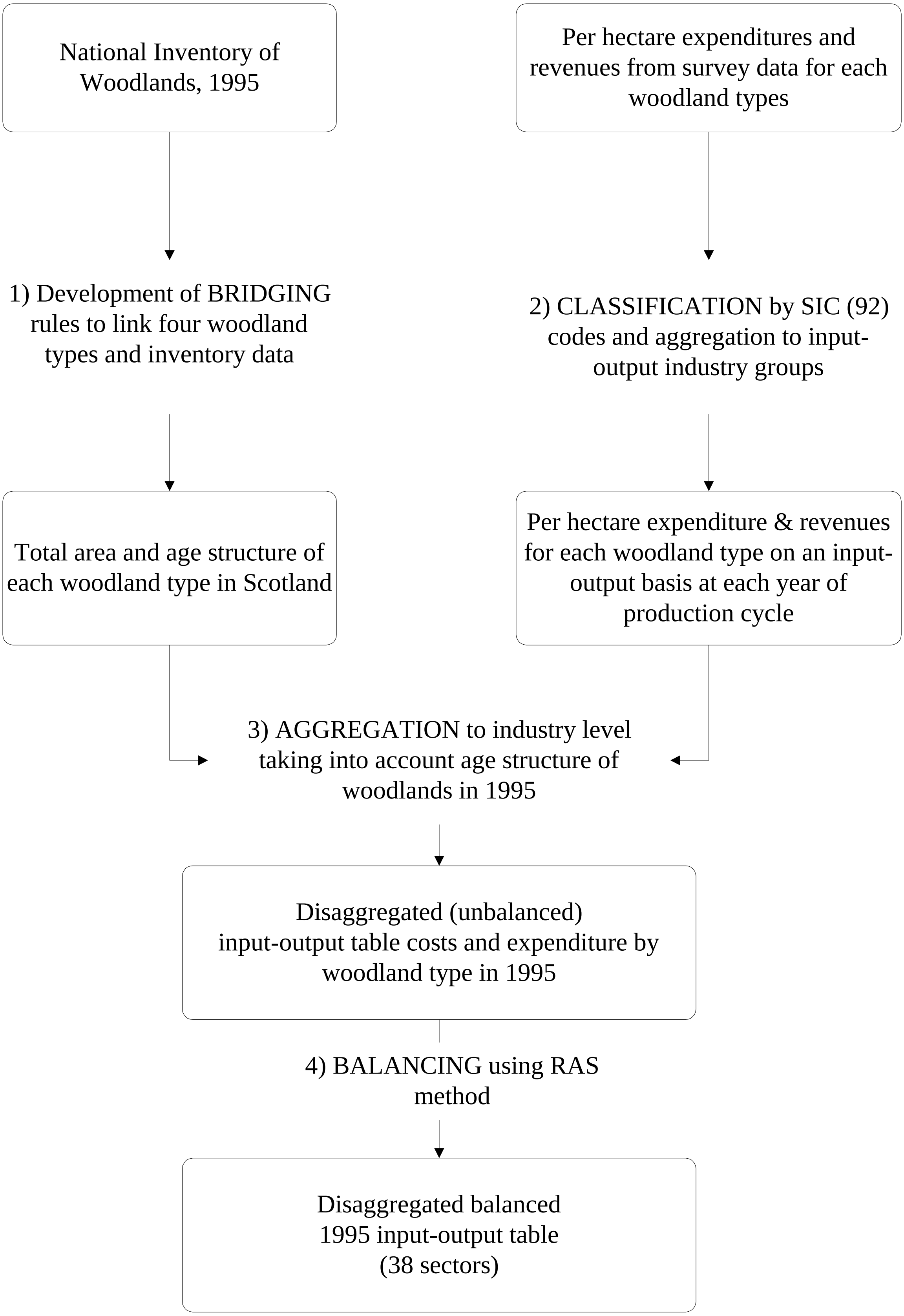
The Scottish input-output tables differ from those for the UK in that, while the UK tables contain just one forestry sector (which covers all forest types and all operations associated with forestry), the Scottish tables distinguish between two broad output and employment generating stages of the forestry production cycle. These are firstly, forest planting and maintenance, which includes all operations associated with forest establishment and care, and secondly, forest harvesting. The costs and returns from woodland thinning are included in the harvesting sector. Unlike previous input-output studies of forestry, this research did not aim to calculate the economy-wide effect of changes in output from each forest type. Instead the focus is on the economy-wide employment effects resulting from changes in the total land area devoted to each of the four forest types. This aspect is more relevant to policy appraisal given that forestry policy acts to influence the land area under each forest type, rather than operating to control the output of forestry sectors.

The calculated multipliers thus indicate the total effect in the economy of a balanced increase in the area of the woodland type in question, including 1) the injection 2) the direct effects; 3) the indirect effects; and 4) the induced effects. The injection represents the effect of increased output from the (exogenous) woodland sector; the direct and indirect effects measure the knock-on effects in other sectors following the increase in demand for inputs; and the induced effects measure the effect of the increased income in the economy leading to increased household consumption demand[16].

[15] 1995 was the most recent year for which input output tables were available for the analysis.

[16] It has been pointed out that the 1995 Scottish input-output tables omit integrated pulp and paper mills. However, given that we are concerned here with demand driven effects (i.e. the effect of forestry on sectors that supply inputs to forestry) rather than supply-driven effects, the omission of integrated pulp and paper mills will have negligible effects on our results.

Figure A2-1 Stages involved in the formation of the disaggregated Scottish Input-output table.



The model does of course suffer from the usual limitations of input-output analysis, namely those of fixed prices, no substitution effects, and no supply constraints[17]. Another difficulty in interpreting the results arises from the fact that forestry is characterised by an extremely long production cycle, ranging from 35 years in the case of coniferous softwood to 100 years in the case of native hardwood. In contrast, input-output analysis is based on a "snapshot" picture of the economy indicating the flows that take place during a period of one year – the base year of the analysis. This may cause problems when analysing the impact of a marginal increase in the area of a particular forest type, in that the marginal impact accruing from harvesting the new woodland area will not be realised for at least 30 years following the planting.

On the other hand, it may be argued that the majority of "knock-on" benefits accruing from planting will be felt in the year that the planting takes place, with rather limited flows of benefits (from maintenance) in subsequent years. This problem is alleviated to some extent by the fact that the Scottish input-output tables distinguish the planting and maintenance side of production from the harvesting side. However, the multipliers derived from an input-output study are critically dependent on the structure of the forestry sector in the base year, including the maturity of woodlands in the presence or absence of domestic processing capacity. In particular, the multipliers should be interpreted as indicating the impact on the economy of a balanced increase in woodland activity *assuming that the levels of plantings, stocks, harvesting and processing are in line with those of the base year*. Indeed, the results below do not include the employment effect of harvesting either farm woodlands or new native woodlands, as these had not reached maturity at the time of the analysis and therefore data was not available.

The disaggregated input-output model emphasising different woodland types was used to generate estimates of the backward (demand-driven) effects on employment in the wider economy of a 100 hectare (1km^2) increase in the land area devoted to each woodland type. The decision to analyse the effects of a 100-hectare "shock" was arbitrary, but legitimate given that the interest is to analyse relative differences employment effects across different woodland types. Thus although from a practical point of view it would be a fallacy to suggest that an area of one of the woodland types, naturally regenerating woodland, can be increased by 100 ha overnight, the analysis seeks to analyse what the output and employment affects would be of "giving over" 100 ha of land on which woodland can regenerate. It should be emphasised that these estimates of the marginal impact of forestry expansion make the standard *ceteris paribus* assumption. In other words, it is assumed that an increase in land area devoted to a given woodland type does not result in a corresponding reduction in the area devoted to any other land use. The feasibility of this assumption, and the implications of relaxing it, are discussed below.

A2-2 Net employment

The agricultural sector in the input-output tables is highly aggregated. The definition of agricultural production includes elements as diverse as extensive grazing and intensive crop production[18]. Therefore it is not possible to distinguish between the types of agricultural land onto which forestry may impinge. Ideally, the agriculture sector in the input-output tables should also have been disaggregated so as to provide more reliable estimates of the employment foregone given an increase in forest area.

[17] Computable General Equilibrium (CGE) models have the potential to address some of these limitations. However, they are more data demanding and the sectoral detail that is possible with CGE analysis is limited due to computational complexities.

[18] Thus our definition of agricultural land area encompasses all forms of agricultural production including crops, fallow, set-aside, grass and rough grazing, as outlined in Scottish Office, 1996).

The exact extent to which any increase in the area of a particular woodland type will have positive or negative net employment effects across the wider economy will of course depend upon the particular type of agricultural land onto which the woodland impinges. As mentioned previously, the aggregated agriculture sector in the input-output table is not able to provide greater detail on this matter. Two points should be borne in mind when considering the economy-wide net employment effects of changes in the area of a given woodland type. First, substantial woodland plantings, particularly of coniferous plantations, have been established on land not used for agriculture, and on wilderness areas (such as the Flow country of Sutherland and Caithness), and here forest expansion will not have resulted in any significant level of foregone agricultural employment effects (although this assumes that the increase in forestry does not impinge onto other employment generating land-uses such as conservation jobs).

Second, and more importantly, different types of agricultural land use will clearly generate a wide range of different employment values. Under the Woodland Grant Scheme, landowners have considerable flexibility to choose the location and extent of new plantings. Given this fact, it is not surprising to learn that the majority of new plantings occur on land of low agricultural value. Mather and Thomson (1995) report that almost all of the increase in forest area in Scotland between 1975 and 1990 occurred on land that had previously been used for sheep grazing, a land use renowned for its low employment intensity per hectare. Despite this reduction in area of hill sheep grazing, sheep numbers actually increased and the area of arable farmland remained constant, despite a 40% increase in forest area over the study period. In addition, land planted under the Farm Woodland Premium Scheme is allowable as a contribution to obligatory set-aside. Clearly, where plantings take place on land that would otherwise have been used as set-aside, then these plantings will not result in any reduction in agricultural employment. But planting on intensive grassland or arable land could have negative employment effects.

A2-3 Regional employment impacts

Estimates of the total employment (FTEs) in Scottish regions are estimated in the Forestry Commission's report *Regional Employment in Forestry and Primary Wood Processing in GB 1998/9* (Forestry Commission 2001b). The results are given in the Table below. Forestry and primary wood processing are defined as in the *Forest Employment Survey 1998/9* described above. There is less than average employment per forest area in the Highland Region, and more than average in Dumfries and Galloway.

Table A2-1 Regional employment in forestry and primary wood processing in Scotland

Region	FTEs	% FTEs in Scotland	National Inventory woodland area (%)
Highland	1,947	18.2	27
Grampian	1,411	13.2	14
Tayside	752	7.0	9
Fife	181	1.7	1
Central	760	7.1	4
Strathclyde	2,238	20.9	23
Lothian	893	8.4	2
Borders	661	6.2	8
Dumfries and Galloway	1851	17.3	12
Total	10,694	100	100

A2-4 The rural-urban spread of forestry-related transactions

This section aims to add to existing knowledge of the role of the sector in rural Scotland by explicitly tracing the extent to which the benefits from forestry accrue to rural as opposed to non rural areas, as reported in Roberts *et al*. (1999). It focuses on the first and second round effects of forestry activity which together account for the lions share of the total multiplier effects (Bulmer-Thomas, 1982). The definition of rural areas of Scotland is based on that proposed by Randall (Scottish Office, 1992).

Table A2-2 Destination of input, output and contract flows from Scottish woodlands

	% of total number of transactions				% of total value of transactions			
	Rural Scotland	Urban Scotland	Rest of UK	Total	Rural Scotland	Urban Scotland	Rest of UK	Total
All inputs	66.46	22.15	11.39	100	60.68	34.63	4.70	100
Contractors	88.74	9.93	1.32	100	98.40	1.42	0.19	100

Firms and businesses based in rural Scotland are shown to receive 66% of all direct input transactions and 89% of all contract-related flows (see Table). In terms of the flows of money associated with these transactions, the percentages are 61% and 98% respectively. Flows related to the use of contractors in the sector are those most likely to be retained within rural Scotland both in terms of number of transactions taking place and their value. Whilst the majority of the flows associated with forestry accrue to rural areas, a relatively high percentage of value “leaks” from the rural economy to urban areas of Scotland. For example, 35% of the value of input purchases flows to urban Scotland.

Appendix 3: Environmental Technical Appendix

Table A3-1 The priority species in Scotland associated with Scottish Woodland Habitat Action Plans (HAP). Adapted from Jones (2001).

Common Name	Species	Native pinewood HAP	Upland oakwood HAP	Upland ashwood HAP	Wet woods HAP	Lowland Wood Pasture Parkland HAP
ANTS						
Scottish wood ant	*Formica aquilonia*	✔	✔			
Narrow-headed ant	*Formica exsecta*	✔				
Hairy wood ant	*Formica lugubris**	✔	✔			
Shining guest ant	*Formicoxensus nitidulus**	✔	✔			✔
BEES						
A mason bee	*Osmia uncinata*	✔				
WASPS						
A cuckoo wasp	*Chrysura hirsuta**	✔				
BUTTERFLIES						
Pearl-bordered fritillary	*Boloria euphrosyne*	✔	✔	✔		
Chequered skipper	*Carterocephalus palaemon*		✔			
MOTHS						
Dark-bordered beauty	*Epione paralleria*				✔	
Cousin German moth	*Paradiarsia sobrina**	✔	✔			
Argent and sable moth	*Rheumaptera hastate*		✔			
Barred tooth-stripe	*Trichopteryx polycommata*			✔		
Square spotted clay moth	*Xestia rhomboidea*		✔			
BEETLES						
A leaf beetle	*Cryptocephalus decemmaculatus**				✔	
A leaf beetle	*Cryptocephalus sexpunctatus*		✔			
A ground beetle	*Dromius quadrisignatus*					✔
A weevil	*Melanapion minimum*				✔	
A weevil	*Procas granucollis*		✔			
A jumping weevil	*Rhynchaenus testaceus*				✔	
SPIDERS						
Caledonian sac spider	*Clubonia subsultans**		✔			
HOVERFLIES						
A hover fly	*Blera fallax*		✔			
Aspen hover fly	*Hammerschmiditia ferrungina*					✔
A crane fly	*Lipsothrix ecucullata*					✔
A crane fly	*Lipsothrix errans**					✔
A crane fly	*Lipsothrix nervosa*					✔
BIRDS						
Wryneck	*Jynk torquilla*		✔			
Scottish crossbill	*Loxia scotica*		✔			
Spotted flycatcher	*Muscicapa striata*		✔	✔	✔	
Black grouse	*Tetrao tetrix*		✔			
Capercaillie	*Tetrao urogallus*		✔			
MAMMALS						
Otter	*Lutra lutra*					✔
Red squirrel	*Sciurus vulgaris*		✔	✔	✔	

FUNGI					
A poroid fungus	*Boletopsis leucomelaena**	✔			
Tooth fungi - northern group	Hydnoid spp. (x 14)	✔	✔		
Bracket/ ascomycete	*Hypocreopsis rhododendri*		✔	✔	
A lichen	*Pseudocyphellaria norvegica*		✔	✔	
A lichen	*Schismatomma graphidiodes*		✔		
MOSSES					
Aspen bristle-moss	*Orthotrichum gymnostomum**				✔
Pale bristle moss	*Orthotrichum pallens*				✔
Spruce's bristle moss	*Orthotrichum sprucei**				✔
LIVERWORTS					
Wilson's pouchwort	*Arcobolbus wilsonii*		✔		
Atlantic Lejeunea	*Lejeunea mandonii*			✔	
VASCULAR PLANTS					
Juniper	*Juniperus communis*	✔			
Twinflower	*Linnaea borealis*	✔			
Small cow-wheat	*Melampyrum sylvaticum*		✔	✔	
Killarney fern	*Trichomanes speciosum*		✔	✔	✔

A3-1 Biodiversity Policy drivers

In the Rural Development Plan for Scotland (RDPS) the Scottish Executive acknowledged the need to comply with the international obligations associated with the Convention on Biological Diversity, which is being implemented by way of the UK Biodiversity Action Plan (UK BAP) and Local Biodiversity Action Plans (LBAP). There was also a commitment to sustainable forest management demonstrated through the adoption of the UK Forestry Standard (UKFS) and through the Scottish Forestry Strategy (SFS). The SFS acknowledges the UK BAP which identified the need to protect, improve and restore ancient semi-natural woodland and encourage the extension of new native woodland. Habitat Action Plans (HAP) are now available for native pinewoods, upland oakwoods, upland mixed ashwoods, wet woodland and lowland wood pastures (Scottish Executive, 2001). These HAPs also have associated targets for restoration and expansion (Table A3-2).

Table A3-2 Targets for restoration and expansion of native woodlands in Scotland (FC, 2000a).

Habitat	Restoration (ha)	Expansion / creation (ha)	Completion date
Upland oak	3,000	3,000	2005
Native pine	5,500	30,500	2005
Upland mixed ash	8,700	2,000	2015
Wet woods	1,600	2,200	2015
Lowland wood pasture and parkland	150	-	2010

SFS priorities for action include (Forestry Commission, 2000a):

- the extension and enhancement of native woodlands by developing Forest Habitat Networks
- to improve the diversity of the farmed landscape and to ensure that forestry in Scotland makes a positive contribution to the environment
- develop more mixed forests (SFS ref: FFR3) with the aim of improving the environmental value of forests
- to increase environmental value of forests and trees, habitat and landscape by increasing open space, reduce risk of catastrophic damage by host-specific pathogens, species mixes, nurse species and structurally diverse forests.

In the UKFS there are various criteria for sustainable forest management. These include :

- nature conservation in and around forests
- conservation and enhancement of biodiversity in and around woods and forests
- UK BAP species and habitats are conserved and enhanced
- important but previously disturbed semi-natural habitats are restored where practical.

A3-2 The influence of site characteristics on biodiversity

A3 2-1 Woodland size

A number of studies suggest that farm woodland should be five hectares or more if they are to contribute to landscape and wildlife conservation (Cranfield University, 1999; Kirby *et al*., 1999; Usher, 1995). Generally, new woodlands adjacent to existing woodlands achieve greater colonisation rates by flora and fauna, and therefore a greater diversity than stand-alone woodlands, regardless of their size (Kirby *et al*., 1999). New woodland that increases the size of an existing woodland may also provide a buffering function, protecting existing woodland from edge effects such as pesticide drift from adjacent agricultural land (Kirby *et al*., 1999).

A3 2-2 Woodland structure

The within-stand diversity including tree density locations, species composition, crown size and shape are all determinants of structural diversity. Field and ground layer vegetation communities are also considered to be key components of biodiversity, providing habitat for dependent fauna and influencing the development of shrub layers and the natural regeneration of canopy trees (Ferris *et al*., 2000; Ratcliffe & Peterken, 1995). Ecologically, a dead tree is as important in a forest ecosystem as a live one: a forest can lose more than a fifth of its whole fauna if dead wood is eliminated. Dead wood includes standing dead trees, fallen logs and large branches. Dead wood is multi-functional, providing excellent sites for natural regeneration and it is often the base of a food-chain including microbes, invertebrates, small mammals and cavity nesting birds (Ratcliffe & Peterken, 1995). Humphrey *et al*. (2001) have demonstrated that stand structure and dead wood are biodiversity indicators in planted forests and foliage height diversity has also been related to invertebrate diversity and richness.

Peterken (2001) states that introduction of conifers into small woodlands does cause an obvious decrease in small-scale diversity and biomass of ground vegetation. However, despite this, mature stands of conifer can support diverse assemblages of lower plants, vertebrates and invertebrates and incorporating the above management and design can increase diversity. The closed canopy spruces usually have poorly developed plant, bryophyte and lichen communities. However, the retention of dead wood will lead to a number of fungal species and this habitat can potentially support a large assemblage of invertebrates including Hymenoptera, Collembola, Psocoptera and Acarina that thrive in dark, damp conditions (Newton & Humphrey, 1997; Peterken, 2001).

The number and variety of species do not reach the same levels as in native tree plantings and introduced trees and large shrubs have been ecologically damaging in the sense that they have either reduced biodiversity or reduced authenticity by disrupting natural features. The most obviously damaging species so far is Rhododendron (*Rhododendron ponticum*), which has spread vigorously into native woods with acid soils and forms an impenetrable shrub layer which completely obliterates the ground flora preventing natural regeneration of trees. Substantial and expensive programmes of eradication have been necessary but when complete clearance has been possible the native woodland vegetation has regenerated well (Peterken, 2001).

A3 2-3 Species selection

The species composition of a woodland will have a pronounced influence on the biodiversity that subsequently develops since tree species differ in terms of the number of species that associate with them (Newton & Humphrey, 1997). The large-scale restoration and expansion of native woodland in Scotland may have major benefits for biodiversity by increasing and improving the habitat for large numbers of forest-dwelling organisms. However, the species impact on biodiversity is difficult to predict.

Establishment of new woodlands is the first step towards an increased resource, and under the UK BAP over 30,000 ha of native pine woodlands are scheduled for establishment or regeneration between 1989 and 2005 under the WGS (Table A3-2). The inclusion of greater percentages of broadleaves alongside spruce has been found to bring significant environmental benefits. The retention of birch within managed spruce enhanced groundcover and species diversity and maintained the regional distinctiveness of natural woodland communities (Wallace, 1998). Watt *et al*. (1998) found 90 recorded plant-feeding insect species on spruce and 334 on birch. It is expected that the incorporation of birch would therefore increase invertebrate numbers and diversity.

Table A3-3 The questions used to objectively score impacts on biodiversity in Scotland. Adapted from Tucker & Hack (1998). The term broad-leaf incorporates native pinewood.

Is this an extension of existing woodland?		
Yes	No	
1	-1	
If yes, is the existing woodland 5 years or older than the new planting?		
Yes	No	
1	0	
What is the species mix?		
> 50 % conifer	≥ 50% broadleaf	
-2	2	
Are any tracts planted?		
< 5 ha	> 5 ha	
0	2	
Is there Rhododendron, and if so what area of the woodland does it cover?		
> 30%	< 30%	N/A
-2	-1	0

How much of the ground is covered by a field layer?			
0-25%	25-50%	50-75%	75-100%
0	1	2	3
Did you plant a field layer?			
Yes	No		
2	0		
Did you plant a shrub layer?			
Yes	No		
2	0		
How much of the ground under the planted trees is shaded?			
0-25%	25-75%	76-89%	90-100%
-1	1	2	-2
Is there dead wood?			
Yes	No		
3	0		
Did you install any of the following?			
Bat boxes	Nest boxes	Neither	
1	1	0	
Are any of the following very common?			
Nettles	Brambles	Rosebay willow	
-1	-1	-1	
Is there evidence of regeneration (scrub)?			
Yes	No		
2	0		
Are there seasonally or permanently wet areas?			
Yes	No		
1	0		
Did you intentionally include open areas?			
Yes	No		
2	0		
Were these purely for access?			
Yes	No		
-1	0		

A3-3 Results of biodiversity scores

The results of the Scottish biodiversity rating demonstrated that large, broadleaf dominated plantings rated consistently highest when the results were broken down fully by the sampling frame (Section 1.3.2). Broadleaf plantings includes native pinewoods. The scores could theoretically range from -11 to 23. However, the lowest score gained was –4 for a small, coniferous, older, FWPS woodland that received Better Land Supplement (BLS). The highest score gained was 19 for a large, broadleaf, older, FWPS woodland that also had BLS. There were no significant differences derived from entering the FWPS scheme; however there were differences between the other categories within the sampling frame (Figure A3-1). The schemes receiving a BLS usually had a lower biodiversity score than those that did not. The results suggest this may be a result of the domination of unfavourable species such as Nettles, Brambles and Rosebay Willow Herb. The results also demonstrate that these plantings are less likely to be situated adjacent to existing woodlands.

It would be anticipated that the older woodlands would show a greater diversity. However the scoring system focussed on site selection, establishment and management techniques that would promote biodiversity (Table A3-3). The results show the later plantings have a greater potential biodiversity, suggesting management techniques and/or site selection have improved over the decade or that the criteria for selection are more rigorous and prescriptive. The results suggest that the planting of field layers, retention of dead wood and incorporating open spaces within the woodland have all become more common practices, although the inclusion of nest and bat boxes has fallen. Older woodlands also tended to be dominated by weed species, which may indicate a lack of management.

Plantings that are greater than 10 ha in size also had a greater potential diversity than smaller woodlands. This is supported by the literature and discussed below. They were more likely to have individual tracts that are greater than five hectares, participants tended to retain dead wood, there was more evidence of regeneration, more seasonally wet areas and a greater proportion of participants included open areas within the planting. Finally, broadleaf plantings showed the highest levels of potential diversity. They were more likely to have an open canopy, dead wood retention, and there were much higher levels of regeneration observed by participants and were more likely to include nest boxes and bat boxes (Figure A3-1).

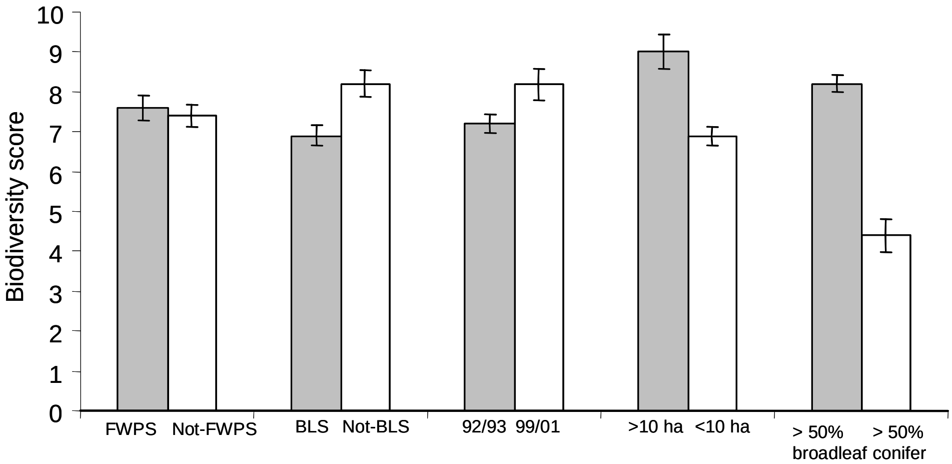


Figure A3-1 The average biodiversity score (mean and standard error) for new planted woodland, comparing the participants by the sample frame. All the samples were significantly different when compared using an independent t-test (P<0.01) with the exception of those broken down by FWPS entry.

A3-3-1 Woodland size

A number of studies suggest that farm woodland should be five hectares or more if they are to contribute to landscape and wildlife conservation (Cranfield University, 1999; Kirby *et al*., 1999; Usher, 1995). Of the participants surveyed in the FWPS scheme, 41% had planted individual tracts of woodland of five hectares or more, whereas this only applied to 27% of those surveyed under the WGS.

However this does not account for small areas of woodland creation that were adjacent to existing woodlands. Fifty percent of all new plantings in the participant survey were adjacent to woodlands. Generally, new woodlands adjacent to existing woodlands achieve greater colonisation rates by flora and fauna, and therefore a greater diversity than stand-alone woodlands, regardless of their size (Kirby *et al*., 1999).

A3-3-2 Woodland structure

The within-stand diversity including tree density locations, species composition, crown size, dead wood retention and shape are all determinants of structural diversity. The survey of participants suggested that although only low numbers of participants had planted a grass layer in the 1992/3 sample, this figure had almost doubled by 1999/2001. The proportion of participants planting shrubs remained unchanged at approximately 40%. The proportion of participants retaining dead wood in woodland increased over the 10-year period to almost a quarter by 1999/2001. However, 81% of owners had included open spaces, of which only a minority had included the space purely for access. Assuming all these practices should relate to biodiversity, these results demonstrate a trend towards practices that can enhance biodiversity (Figure A3-2).

Introduced trees and large shrubs have been ecologically damaging by reducing biodiversity or reduced authenticity by disrupting natural features. The most obviously damaging species so far is Rhododendron (*Rhododendron ponticum*) (Peterken, 2001). The survey of participants showed that only 6% of woodlands had Rhododendron present. However, half of this group intentionally planted the shrub, which is likely to create major difficulties later on.

Figure A3-2 The proportion of participants surveyed by postal questionnaire that had planted a field or shrub layer, retained dead wood or included open spaces into their woodland design.

A3-3-3 Species selection

The species composition of a woodland will have a pronounced influence on the biodiversity (Newton & Humphrey, 1997). Establishment of new woodlands is the first step towards an increased resource, and under the UK BAP over 30,000 ha of native pine woodlands are scheduled for establishment or regeneration between 1989 and 2005 under the WGS (Table A3-2). Planting under the WGS has been largely dominated by broadleaf/native pine plantings and regeneration (Figure A3-3). Planting levels have decreased, but proportionally, there is significantly more woodland planted with broadleaf and native pine species. A mixed woodland was classified as one that contained a split of 20% or more broadleaf in an otherwise coniferous forest or vice versa.

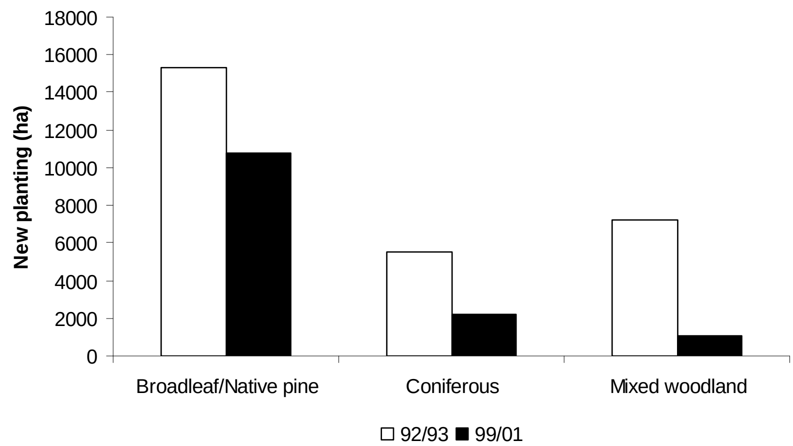


Figure A3-3 The new planting levels derived from the WGS full database for 1992/1993 and 1999/2001.

A3-4 The effects of new planting on biodiversity

New woodland plantings of five hectares are generally accepted as bringing biodiversity benefits (Cranfield University, 1999; Usher, 1995), but it may take several decades for the benefits of newly created woodlands to reach their environmental potential. Despite this, data obtained on bird populations suggests that some environmental benefits follow rapidly from the establishment of new woodlands but that these benefits follow from the removal of the area from cultivation. Even poor quality woodlands attract more birds than intensively farmed arable land (Ecoscope, 1998).

A study of new woodlands of ten years and younger observed that young farm woodlands support a range of bird species, including several Priority Species, for example Song thrush (*Turdus philomelos*) and Linnet (*Carduelis cannabina*), as well as several other species that have suffered population declines in recent years, for example Yellowhammer (*Emberiza citronella*) and Starling (*Sturnus vulgaris*)). However, many of the species making use of these woods are not typically woodland birds. Yellowhammer, Skylark (*Alauda arvensis*) and Linnet are all birds associated with open or scrubby habitats and most of the species found in young farm woods, with the exception of Meadow Pipit (*Anthus pratensis*), are found in higher densities and greater frequency in other non-cropped farm habitats; hedges and other boundaries are usually the preferred areas (Cranfield University, 1999; Sutherland & Hill, 1995).

The flora and invertebrate fauna also take a considerable time to develop woodland characteristics. None of the invertebrate species, recorded in the FWS/FWPS woods during an evaluation of new planted woodland were considered to be woodland specialists. The invertebrate assemblages recorded were characteristic of land taken out of agricultural production, not of woodland, and only a small proportion of recorded species were specific to the planted trees. It was suggested that the woodland would provide benefits to the invertebrate fauna of the farm on which they were planted but that the benefit will be slight, for a period of decades at least. There was also some limited evidence that new woodlands planted where grassland may have developed diminished the value of the habitats for invertebrates (Cranfield University, 1999).

It was found that the under-sowing of trees with grass or with a species-rich mix can also have a profound impact on the ground flora community in the short term and hastened the development of a diverse grassland community. However further research would be necessary in order to assess whether these differences persist beyond the early years of woodland development. In England, DEFRA is currently investigating this through a contract with Ecoscope. Other factors such as the proximity of a woodland propagule source were also important. For example, woodland species were observed to colonise rapidly when a new planting was adjacent to an old hedgerow (Cranfield University, 1999).

Anecdotal evidence suggests that Scottish new plantings often show rapid increases in species; those listed by participants include small songbirds, tawny owls, raptors, pheasant, grey partridge and wild cats. However, collection of data on long-established secondary woodland is required to identify the principal factors that are responsible for the variation in communities of birds, invertebrates and the ground flora. This information is required to determine the role of new woodlands in the long-term enhancement of biodiversity within farmland landscapes. Whilst general advice on farm woodland management is available there have been few empirical studies directly focussed on the management of secondary woodland, and this should form part of future research.

A3-5 Pollution reduction

A3-5-1 Water quantity

Water enters a catchment as precipitation, the amount of water intercepted is influenced by the nature of the vegetation and by land-use practices. Forests are notorious for using more water than other vegetation. The reduction of water yield increases with forest height and canopy development and is greatest in the wetter, upland areas of the UK. Research suggests there is a 1.5-2.0% reduction of potential water yield for every 10% of a catchment under mature forest (Forestry Commission, 2000f; Nisbet, 2001). Recent shortages across much of lowland England lead to concern about the impact of increased planting of broadleaved woodland on water supply. Research in 1989 illustrated that trees evaporate less water than grassland, but more than arable land. Although there was very little information about the water use of arable crops. Therefore if there are water shortages, replacing the existing vegetation with trees may not be advisable (Kerr & Nisbet, 1996). However the amount a forest uses and therefore its impact depends on a variety of factors. These include (Nisbet, 2001):

Forest type: interception by broadleaf woodland is lower than coniferous woodland, usually because the woodland is deciduous. The interception rates of ash and beech have a are half those found from conifers (Harding *et al*. 1992). Flooding usually occurs during the winter when broadleaf are lacking leaves, and therefore not intercepting much precipitation. The rate of interception by conifers is also dependent on rainfall or the time of year, however conifers may have an impact in the prevention of flooding under snow cover as there is often increased evaporation and interception and delayed melting (Nisbet, 2001).

Forest management practice: It takes many years for potential interception rates to be attained from planting, for the first 10 years young trees interception rates does not significantly differ from other vegetation types. Heavy thinning will reduce interception rates and harvesting will return water uptake to base-line levels. The results of clearfelling can result in lower evaporative losses from the land, compared to moorland, for years (Nisbet, 2001).

Forest location: High interception rates result in a drier soil due to plant uptake. This delay in the water running off results in an attenuation of flood flows. However, after dry soils reach saturation point at the start of winter, they have no additional capacity during heavy rainfall later in the season. Dry soils have the additional complication of being prone to drought.

Forest scale: Most flooding problems occur in the lower catchment, where usually there is very little woodland, therefore currently woodlands are likely to be having a relatively neutral effect (Nisbet, 2001).

Changes in land use

The cultivation and harvesting of forests will reduce the evaporative and transpiration losses due to the removal of the trees and other vegetation, resulting in more water draining through the soil (Forestry Commission, 2000f). Therefore forestry can have a range of effects on peak and base water flows depending on the type and scale of forest operation. The low summer base flows in rivers can often be critical for wildlife, water supply and pollution levels. The reduction in water due to upland conifer forests has a limited effect on these flows. However in the lowlands a significant decline in summer base flows can be expected as there is a greater reduction in water yield. High peak flows are often associated with more acid conditions, increased erosion of bankside habitat and spawning gravels, greater siltation, and localised flooding. Altered peak flows may also have an impact on the timing and duration of the refill of reservoirs, which could pose a problem for water supplies (FC, 2000f; Harding *et al*. 1992).

In one study the ploughing and drainage of a complete catchment was shown to result in a significant increase in peak flows (15-20%), decreasing to 5% after 20 years - and a decrease in the time to peak of up to one-third. These effects were greatest for moderate rainfall events and tended to decrease with increasing storm size. However, overall, research suggests that the contrasting effects of the different stages of the forest cycle will even out at a larger catchment scale. Lowland forests can reduce peak flows, with benefits for flood control, and this will be enhanced by the drier, organically richer soils that which can receive and hold more rainwater.

A3-5-2 Acidification

The main cause of acidification is the deposition of acidic sulphur and nitrogen compounds produced by the use of fossil fuels. The soil acts as a natural buffer to these compounds, although at times its capacity is exceeded and this results in the acidification of water entering watercourses. Affected areas are usually found in the UK uplands and although pollution levels are falling, there are still particular problems in central and south-west Scotland (Forestry Commission, 2000a; 2000f).

The deposition of nitrogen and sulphur compounds is strongly influenced by the nature of the vegetation. Forest canopies can significantly increase the capture (scavenging) of some of these pollutants in the atmosphere. Research has illustrated that levels of atmospheric pollution are more concentrated above the canopy than within it, there is also evidence that the forest edge is very effective at scavenging metallic salts (Harding *et al*., 1992). The scavenging action of forests is linked to forest age and type[19]. Forests can reach a nitrogen capacity, therefore if nitrogen deposition is high, after a certain stage it will be leached from older forest stands. This has been identified in some parts of south Scotland, though this topic is not fully understood and research is ongoing (Forestry Commission, 2000f; Nisbet, 2001). In the short and medium term the new plantings resulting from the WGS/FWPS schemes are likely to have a positive effect on pollution, reducing nitrogen and sulphur compounds through scavenging and uptake.

A3-5-3 Nutrient enrichment

There is concern that the aerial application of phosphate fertiliser nutrients may result in elevated chemical levels in the local water supply, although the use of fertilisers is now much reduced. Nitrate leakage also results from harvesting operations resulting in a high pulse of nitrates lasting 2-5 years, depending upon the rate of re-vegetation. These additional nutrients, in normally nutrient poor areas, can lead to excessive algal growths, resulting in fluctuating oxygen concentrations and disruption of the ecosystem through eutrophication (Forestry Commission, 2000f; Nisbet, 2001; SEPA, 2001). Fortunately fertilisation of new plantation woodland is rarely necessary and the Forest & Water Guidelines if applied rigorously should avoid any unnecessary enrichment of the water supply. Riparian woodlands can also assist in pollution reduction – this is discussed below.

A3-5-4 Grazing and agriculture

[19] The Forestry Commission indicated that broadleaves have a lower ability to scavenge pollutants in comparison to conifers. Also coniferous forests with a diverse age structure are more beneficial to uptake of pollutants.

Over-grazing and mechanisation can lead to soil erosion, compaction and organic matter loss. Fertiliser and pesticide application may also lead to soil acidification, eutrophication and the build up of pesticide residues. All these impact soil quality and result in water pollution through the accumulation of nitrates and phosphorous in surface water (Scottish Executive, 2000; SEPA, 2001). Gaseous emissions and uptake from soils are important. The Scottish Climate Change Programme estimated the carbon emissions from agriculture and forestry as 36% (8.5 MtC) of the total carbon emissions in 1995. It is estimated that nitrous oxide and methane from agriculture will account for 63% of non-carbon dioxide emissions by 2010. In general larger amounts of nitrous oxide are measured from managed grasslands than arable soils as they receive higher levels of fertilisation and the higher water content of the soils results in more favourable conditions for nitrous oxide production (MAFF, 2000; Scottish Executive, 2000a; SEPA 2001).

Soil is a source and a sink for methane and under aerobic conditions microbes can take up 15% of global methane. The highest level of methane uptake is under forestry. However soils can take a long time to recover and may take as long as 100 years to reach pre-cultivation levels. Globally, peatlands produce the most methane, but in Scotland the main source is from the livestock. The ammonia produced by livestock can also lead to soil acidification and eutrophication, as discussed above. Agricultural sources results in 90% of ammonia emission in the UK, usually in the form of animal waste and slurries (SEPA, 2001).

A3-5-5 Riparian & Floodplain woodland

It has recently been recognised that the establishment of flood plain woodlands can help in flood control. Floodplain woodlands include alluvial forests, floodplain forests, riparian woodland, river woodland, forested river corridors and riparian corridors. Virtually all natural floodplain woodland in Britain has been cleared and drained for agricultural purposes. Most native woodlands associated with water in Britain now are predominantly alder and willows and are of limited stature and broadleaf woodland associated with watercourses are no longer flooded due to engineered flood control and is not directly associated with existing watercourses. There are still riparian woodlands, this is normally a relatively narrow strip of land along any watercourse which could function as a buffer with the adjacent agricultural land (Kerr & Nisbet, 1996).

Benefits of riparian and floodplain woodland

Pollution control: woodland is likely to reduce diffuse pollutant inputs to the groundwater. A 10-20 m wide strip of riparian woodland filters water from the surrounding land, retaining chemical pollutants and sediments. The pollutant control function of riparian woodland can be expected to be magnified many times by natural floodplain woodland with the greatest effects observed during periods of flood flows when the hydraulic roughness and increased floodwater retention times promote the natural water purification processes of sedimentation and denitirification (Kerr & Nisbet, 1996).

Flood control: The removal of artificial constraints allow floodwaters to spread and attenuate peaks in flow. There is also evidence that the conversion of agricultural land to woodland on floodplains would enhance the flood control function of the land, and when combined with the higher infiltration rates of woodland soils the result is increased water retention. However it has not been possible to quantify the above theory due to a lack of relevant data. Previous research has been based upon upland conifer afforestation and is not directly applicable to natural floodplain woodland with broadleaved species (Kerr & Nisbet, 1996).

Nature conservation: Broadleaved woodland offers significant conservation benefits, particularly when compared to most agricultural land uses. Natural floodplain woodland is rare. Rodwell (1991) did not describe the habitat in the NVC as there was not sufficient habitat left in existence. Therefore the restoration of floodplain woodland would result in the restoration of a lost ecosystem (Kerr & Nisbet, 1996).

Fisheries: The improved bankside stability afforded by floodplain woodland and shelter by tree root systems are beneficial to fisheries. The additional leaf litter and insects are also important food sources. So an increase in these woodland types would result in an increase in the quality and quantity of aquatic habitats (Kerr & Nisbet, 1996).

Problems

The majority of large river floodplains in the Britain have been drained for agricultural use and road and rail networks are often in floodplain regions. The floodplains that remain are now important meadow and marshland habitats. WGS do not allow planting of areas with conservation status, floodplains are an important open habitat for ducks, waders and waterfowl. So the restoration of natural floodplain woodlands are likely to be constrained by the need to protect existing infrastructure and conservation sites. Although suitable sites may exist on a small to medium scale, where there may be scope for helping to alleviate local flooding problems (Kerr & Nisbet, 1996).

Riparian woodlands can offer many of the potential benefits of natural floodplain woodland. They can provide pollution control, timber, wildlife and fisheries enhancement and landscape improvement. On the other hand, many of the potential problems are minimised for example flood risk, water supply and navigation (Kerr & Nisbet, 1996).

A3-5-6 Carbon sequestration

In terms of climate change forests have an important role in storing and recycling carbon and, as mentioned in the previous section, forests are also an option of managing carbon dioxide emissions. Carbon is removed from the atmosphere and is locked into the plant structure, as well as in all other parts of the ecosystem including the soil. Planting on mineral soils will lock up carbon as long as the site remains afforested, or until the wood is burnt or rots. Although this does not apply on all sites, for example on organic soils such as peat, if drying occurs carbon dioxide is released. The most effective means of carbon storage is planning forests that grow high quality timber, on long rotations, in complex forest ecosystems, with soils of low organic content that will eventually be put to a long-lived end use (Forestry Commssion, 2000a; Nisbet, 2001).

Scotland has 50% of the UK carbon sink capacity; Scotland's soils have a high carbon content, and using the soil through cultivation or peat drainage, has the potential for significant emissions of carbon dioxide and the loss of carbon from the soil into the atmosphere. There is currently intensive research into the contribution to climate change of organic soils under different land uses. This will aid consideration of how guidance might be given to reduce emissions. The realisation of the extent of emissions and potential sinks in Scotland has also lead to the realisation that there are significant implications for policy development. If Scottish soils were put into cultivation they may emit double the expected carbon compared to the rest of the UK (Scottish Executive, 2000a). Therefore there is a high environmental gain from preventing deforestation and actively promoting reforestation of Scottish soils where appropriate.

Carbon sequestration is also allowable for the purposes of meeting the UK Kyoto commitment of reducing emissions by 600 ktC per year. This is achievable in the UK by current planting levels. These plantings are supported by the WGS/FWPS, as well as pledges by private sources (Scottish Executive, 2000a). It is estimated that at the current planting levels, forests planted since 1990 will absorb an average of 0.4 MtC per year by 2010. There is also an objective to increase wood production for fuel. This is a good method of reducing carbon emissions, as wood is a renewable energy source, assuming the woodland is sustainably managed and the wood produced forms a substitute for fossil fuels (FC 2000a; Scottish Executive, 2000a).

A3-6 Policy drivers for sustainable use of land and resources

At the 1992 UN conference on Environment and Development (Earth Summit) the UK was a signatory to Agenda 21, a plan for attaining sustainable development in the 21st century, and along with 170 other countries adopted a Statement of Forest Principles. In June 1993, at the Helsinki conference European governments built on the Rio Forest Principles by adopting guidelines for the sustainable management of European forests and for the conservation of their biodiversity proposing the Pan-European Criteria (PEC). The UK responded to this agreement by producing 4 plans: *Sustainable development – the UK strategy*, *Biodiversity – the UK Action Plan, Climate Change – the UK Programme and Sustainable Forestry – the UK programme.* In 1995 the UK government prepared a UK Forestry Standard, published in 1998, which was compatible with the Helsinki Guidelines and the PEC and described how international commitments will be delivered in the UK.

The definition of sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own (Forestry Authority, 1998). The definition of sustainable forest management, as defined by the Ministerial Conference on the Protection of European Forests (Helsinki 1993) (PEC) is the stewardship and use of forests in a way and at a rate that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil now, and in the future, relevant ecological, economic and social functions at local, national and global levels and that does not cause damage to other ecosystems (Forestry Authority, 1998).

The UKFS is compatible with Helsinki guidelines and the PEC. It states there are certain sustainable forest criteria and these include (Forestry Authority, 1998):

- the maintenance and appropriate enhancement of forest resources and contribution to global carbon cycles (Section 7.5)
- maintenance of forest ecosystem health and vitality
- maintenance and encouragement of productive functions of forests (wood and non-wood)
- maintenance, conservation and appropriate enhancement of biological diversity in forest ecosystems (Section 7.1)
- maintenance and appropriate enhancement of protective functions in forest management (notably soil and water) (Section 7.4)
- maintenance of other socio-economic functions and conditions

A3-7 Woodland management

The Forestry Commission planting research shows attention to weed control/vegetation management is the key to successful tree establishment on ex-agricultural sites (Moffat & Williamson, 1991; Williamson, 1992). Weeds compete for resources required by young trees including soil moisture and nutrients. Additionally, climbing weeds can mechanically damage trees and produce toxins. Experimental work has demonstrated clear differences in the first 10 months between treatments with and without weeds (Davies, 1987). The management of inter-row vegetation is also very important. It is possible to sow a field layer in order to suppress weeds. These can include grasses and wildflower mixes, which can produce good habitat for species such as butterflies (Williamson, 1992) and other invertebrates (Ecoscope, 1998).

Colonisation of new farm woods by woodland species is slow. This is because new woodlands are poor habitats, especially if they are isolated from other habitats, on formerly cultivated land and have no internal diversity (Francis *et al*., 1996). In fact, without management they may remain species poor for decades. This can, however, be mitigated for and colonisation can be accelerated by placing the woodland in contact with existing semi-natural habitats and by creating a diverse internal design or transplanting woodland species. Reasonably diverse communities can be created within the first rotation and the environmental benefits of WGS and FWPS can be realised (Ecoscope, 1998).

There are a number of desirable management techniques that, although not specified in the contract, do encourage a diverse flora. These include (Brosofske *et al*., 2001; Christensen & Emborg, 1996; Coulthard, 2001; Ferris *et al*., 2000; Ratcliffe & Peterken, 1995):

- the creation and maintenance of rides, glades, open areas and wetlands
- careful, selective thinning to produce a diverse age structure and greater understorey development
- the retention of dead wood as discussed in Section 6.1
- linking small patches of woodland
- planting of shrubs to attract birds
- low intensity grazing
- inclusion of an irregular mosaic of forested and open vegetation including some native scrub

Table A3-4 The additional management practices undertaken by scheme participants beyond those that were detailed in their management agreement.

Management practice	Number	% of those surveyed
Bracken control	3	0.7
Coppicing	1	0.2
Deer management	10	2.4
Ditch management	1	0.1
Drainage	3	0.7
Fencing	20	5.1
Fertilization	1	0.1
Involving the community	5	1.3
Litter collection	6	1.6
Maintaining access	44	11.2
Maintaining hedgerows	1	0.1
Mowing	44	11.3
Other	1	0.2
Pest control	2	0.4
Planting field layer	5	1.4
Planting shrubs	3	0.8
Pond building	1	0.3
Protection of archaeology	1	0.2
Pruning	30	7.7
Rabbit control	6	1.6
Re-spacing older stems	1	0.2
Rhododendron control	1	0.1
Ride cutting	13	3.2
Road maintenance	1	0.4
Roost posts	1	0.1
Tube removal	1	0.4
Weeding	22	5.7

A3-8 Natural regeneration

Natural regeneration results in a more natural matching of trees and shrubs to the surrounding environment. It conserves the local genetic distinctiveness and diversity and has low establishment costs. The woodland produced is patchy in distribution with an irregular and natural appearance (Good *et al.*, 1997; Harmer, 1999; Rodwell & Patterson, 1994). Regeneration is, however, unpredictable and may take years to establish. The success of woodland establishment through regeneration depends on site conditions, time of initiation, tree seed availability, germination of seeds, survival and growth of seedlings.

Bain (1987) found 900 ha of regeneration had occurred in Scotland between 1957-1987, usually extending from scattered groups of trees, with the best examples occurring in the east. This was probably due to better soil conditions, ring fencing to prevent deer damage or more people using woodlands which resulted in the discouragement of deer. Regeneration was seen in exclosures and not elsewhere and Bain (1987) indicated the need for grant aid for natural regeneration sites.

The WGS is available for the creation of new woodlands by natural regeneration. A discretionary payment (50%) is available for the work needed to encourage regeneration and a fixed payment is made once regeneration occurs. Where natural regeneration is both practical and appropriate, the FC would not normally agree to proposals for planting. However it is risky for owners and the Commission may need to take on a greater share of the risk (through improved grant aid conditions) if more regeneration is to be encouraged.

A3-8-1 Establishment by regeneration

Natural colonisation should only be initiated when a supply of seed is assured, most seed falls close to the tree and it is unrealistic to expect colonisation from any distances greater than those detailed in Table A3-5. Colonising trees are also positively associated with sub-soil, small stony substrates such as gravel and a weak grass sward. Weed control will almost always be necessary, as will protection from browsing animals (Harmer, 1999).

Table A3-5 The maximum distance at which colonisation can reasonably be expected to occur. Adapted from Harmer (1999).

Species	Distance (m)
Oak	20
Ash	50-100
Birch	100-200
Alder	20
Beech	20
Sycamore	50-100
Sweet chestnut	20
Willow	100-200
Field maple	50-100
Hazel	20
Aspen	100-200
Small-leaved lime	50-100
Hornbeam	50-100
Limes	50-100
Crab apple	20
Elms	50-100
Pine	100-200

Some species, for example birch, willow or rowan, colonise more readily and over longer distances than oak and it is not unusual to get a closely spaced forest of these seedlings which might be unsatisfactory if the objective is to produce a semi-natural woodland of high wildlife and conservation value. It must also be assumed that time is of no concern to the landowner. Oak will eventually reach the woodland and replace the early colonists, but if the idea is to produce a semi-natural woodland for multiple uses and eventual harvest, then this is not a realistic objective when using regeneration. The objectives have to be clearly defined when natural regeneration is being decided upon.

Natural colonisation may also have a role to play in urban environments, even when the sites are some distance from existing woodland or plantation and may not have supported woodland themselves since before urbanisation took place. This was investigated in Leeds, where it is estimated that 40% of newly planted urban trees were dead within five years (Millard, 2000). Natural colonisation avoids the costs of ground preparation, plant purchase and planting.

Natural regeneration is not appropriate when a seed source for characteristic trees and shrubs is not present, or when the seed source is further from the regeneration site than the distance detailed in Table A3-5 (Harmer, 1999; Rodwell & Patterson, 1994). Harmer (1999) found that colonisation is negatively associated with loam, sand, a grazed sward and sites with no vegetative cover. Sites that are poor for natural colonisation require intensive management if it is to be achieved.

Natural regeneration is also inappropriate where there is inadequate control of grazing. Hester *et al*. (2000) show regeneration of rowan and birch to be suppressed at stocking densities of above one sheep per hectare. Oak and rowan are suppressed at low cattle densities although other species are less vulnerable.

A3-9 The impacts of deer

Deer are native species and contribute to biodiversity by maintaining important habitat types at the correct grazing density. Dunging and trampling by deer can create gaps within closed swards. The total removal of grazing can lead to the loss of smaller grasses and forbs resulting in a loss of conservation value in open areas within the new native woodland. This also results in a loss of potential colonists for woodland since rough grassland often harbour woodland herbs such as wood anemone, dog violet and primrose. Dung beetles benefit from the presence of deer, as well as external and internal parasites, as well as those species that rely on carrion. There are five red data carrion feeding beetles; all being very dependent on deer (Gill, 2000). In upland situations maintaining low intensity grazing should be considered where practical, unless the afforestation technique being used is natural regeneration (Gill, 2000; Putnam, 1996; Rodwell & Patterson, 1994).

Regeneration of Scots pine can occur at densities up to 4-7 deer/km^2. In the lowlands, deer are usually smaller and the vegetation more vigorous so higher densities of deer can be supported. If alternative land uses are available unpalatable species can regenerate at up to 15 deer per a kilometre. In broadleaved woodlands, seedlings have failed to reach above 2 m due to combined weeds and browsing impacts. Deer accentuate poor seed supply and competition. Regeneration of coppice is also a widespread problem; coppice stools are vulnerable to deer for two years post-cutting, and fences can be uneconomic (Gill, 2000; Hester *et al*., 2000).

Deer can cause serious damage. Heavy grazing can result in suppression of ground flora, prevention of regeneration, or coppice regrowth (Gill, 2000; Hester *et al*., 2000; Putnam, 1996). Browsing changes the height of lower growing shrubs and prevents tall species from reaching their full stature. This results in a simplified structure with the middle layer of the woodland mainly missing. If the richness of the plant community in type and structure has been reduced, then insect diversity will also decline. High deer numbers often lower insect diversity with concomitant effects on insectivorous birds. Deer can also damage the understorey for small mammals including woodmice, bank voles, shrews and yellow-necked mice (Gill, 2000; Petit & Usher, 1998).

Deer damage depends on the species occupying the woodland (DCS, 2000):

- *Roe deer*: tend to be browsers that cause considerable damage to young trees, shrubs and sensitive plants; they seek to occupy any available cover.
- *Red deer*: cause damage by grazing, browsing, fraying, bark stripping, trampling, particularly to trees, shrubs and sensitive plants.
- *Sika deer*: cause damage to trees of all age classes often in large areas of woodland where bark stripping can become a problem.
- *Fallow deer*: cause significant browsing damage and are known to strip trees on occasions.
- *Muntjac*: are selective and can cause considerable damage to woodland.

Certain tree species are more vulnerable to certain deer species than others. Coppice such as hazel is vulnerable to all deer, but small leaved lime, alder and maple unpalatable. Ash tends to be damaged by fallow deer and roe show a preference for birch (Gill, 2000; Putnam, 1996).

A3-9-2 Deer management

Deer management is necessary to protect land, but it is expensive. Deer management needs to have clear objectives, as damage does not increase linearly with density. Research suggests that damage levels are tolerable at four deer per 100 ha, although the suppression of natural regeneration can occur at lower densities. Where deer damage reaches unacceptable levels there is a need for culling, temporary or permanent fencing, protection of individual trees or chemical repellents (DCS, 2000; Putnam, 1996). The cull levels currently available from the Deer Commission for Scotland (DCS) are given below (Table A3-6).

Table A3-6 The estimated numbers and cull levels of deer in Scotland in 2000. Adapted from DCS (2000).

Deer species	Estimated population level	Cull level
Roe	200,000	40,000
Red	350,000	72,000
Sika	?	4,000
Fallow	< 8,000	-
Muntjac	Not confirmed in Scotland	-

The DCS monitors deer levels and advises on cull targets. They estimated that 100,000 deer are culled each year, the largest cull being undertaken by the FC. Most estates are members of voluntary Deer Management Groups (DMGs) who attempt to coordinate management in areas and promote high standards. Unfortunately the figures described in this study show that only a minority of those planting new woodlands are members of DMGs (17%) and it is considered that they are not sufficiently coordinated or effective at managing the deer population at present.

Deer fencing is not always appropriate; it not only affects wildlife but it also makes deer difficult to manage locally in an integrated manner. It may be feasible in certain regions to fence through the woodland establishment phase but this is not appropriate in the long term (SNH, 2001). The FC now have a guidance note on deer fencing (Pepper, 1999). A particular issue is the impact of deer fencing on Capercaillie and Black Grouse. The effects are so profound that the RSPB are requesting enhanced grants for removal of deer fences and a specific Capercaillie Fund to address problems with hazardous deer fencing and to encourage effective deer control by culling (RSPB, 2001).

The deer management undertaken by participants was mainly culling (55%) with a lesser proportion using fencing (27%). Others stated that they let shooting, local stalkers undertook culls, participated in deer drives, used controllers, undertook monitoring and trophy hunting occurred on their land. The majority of those involved in the technical interviews felt that deer management is not adequately developed and coordinated regionally and that the submission of a deer management plan should become a requirement within the management agreement if deer are a problem locally.

Appendix 4: Environmental consultation

Representatives from the following organisations were involved in the environmental consultation and technical interviews:

- Association of Regional and Island Archaeologists (ARIA)
- Butterfly Conservation (Scotland)
- Council for British Archaeology
- Council for Scottish Archaeology
- Deer Commission for Scotland
- Farming & Wildlife Advisory Group (FWAG)
- Forestry Commission
- Highland Council
- Historic Scotland
- National Trust for Scotland
- Reforesting Scotland
- Royal Society for the Protection of Birds (RSPB)
- Scot Link Forestry
- Scottish Environmental Protection Agency (SEPA)
- Scottish Native Woodlands
- Scottish Natural Heritage (SNH)
- Scottish Wildlife Trust
- West of Scotland Water
- Woodland Trust (Scotland)
- WWF Scotland

Appendix 5: Participant questionnaire

To be added in bound version

[10] For example, where payments vary by land quality (reflecting opportunity cost) or species planted (reflecting differences in planting costs and public benefits).