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COUNTRY REPORT TO THE FAO INTERNATIONAL TECHNICAL CONFERENCE ON PLANT GENETIC RESOURCES

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CHAPTER 1
Introduction to UK and its Agricultural Sector

The United Kingdom of Great Britain and Northern Ireland (UK) constitutes the greater part of the British Isles.The largest of the islands is Great Britain which comprises England, Wales and Scotland. With an area of 242,000 km^2, the UK is just under 1,000 km in length from the south coast of England to the extreme north of Scotland and just under 500 km across in the widest part. It has a population of 57.5 million.

England is predominantly a lowland country although there are uplands in the north (the Pennine Chain, the Cumbrian mountains and the Yorkshire moorlands) and in the south west in Cornwall, Devon and Somerset. Central southern England has the downs - low chalk hill ranges. Wales is a country of hills and mountains, the highest of which are in Snowdonia in the north west; the tallest peak is Snowdon (1,085 m). More than half of Scotland consists of the sparsely populated highlands and islands of the north. Scotland contains the majority of the UK's highest mountains - nearly 300 peaks over 913 m. Northern Ireland is at its nearest point 21 km from Scotland. At its centre lies Lough Neagh, the UK's largest freshwater lake (381 km).

The UK's climate is generally mild and temperate. It is subject to frequent changes but to few extremes of temperature. It is rarely above 32° C or below -10° C. The average annual rainfall is more than 1,600 mm in the mountainous areas of the west and north but less than 800 mm over central and eastern parts. Rain is fairly well distributed throughout the year.

Agriculture occupies 77% of the UK land, and forestry about 10%. The rest is mainly urban land, on which around three quarters of the UK population live. A wide variety of agricultural systems has evolved over the centuries to match local environments. An advanced infrastructure to support the resulting production has also developed. The efficiency of UK agriculture has been increasing rapidly over a long period. This has led to greatly increased food production, although in recent years, it has manifested itself as reduced inputs rather than increased output: the 18% increase in efficiency since 1985 comprises a 3% increase in output and a 15% reduction in resources used.

The industry contributes nearly 7 billion to the UK Gross Domestic Product (GDP). Self-sufficiency in those foodstuffs which can be produced in the UK rose from 60% in 1970 to around 75% in the early 1980's, which level has been sustained. The condition of the land remains dependent on the farmers who work it and whose predecessors have shaped it over the centuries. Since the 1950's agricultural productivity has increased markedly - as evidenced by the two thirds reduction in the agricultural labour force. Over 0.5 million people remain directly employed in agriculture today, around 2% of the total work force, although this has much greater importance in some rural areas. Many other jobs in the supply trade and food manufacturing industries are dependent on agriculture. Moreover, agriculture's role in providing an attractive and varied countryside makes a significant contribution not only to quality of life, but also to rural economic activity, particularly tourism.

The trends in recent years which have affected or which will affect agricultural production include; the drive for increased food production during and following the second world war, the level of support under the European Union's common agricultural policy (CAP) which has encouraged a further intensification of production, and the 1992 CAP reform which represented an important change of emphasis away from high levels of support and the resulting pressures on the environment. For the future, the UK government will encourage, and will work for further CAP reform to reduce levels of support and integrate fully environmental considerations.

In 1991 there were some 241,000 farm holdings in the UK (excluding minor holdings), with an average size of 71 ha. About two-thirds of all agricultural land is owner-occupied. Within the relatively small area of the UK there is great diversity of farming types (summarised in Tables 1 and 2 below), reflecting a wide variety of climate, geology, soils and local traditions. Each farming type makes its own contribution to biodiversity, and many habitats and species depend upon traditional agricultural practices for their survival.

Table 1 Total area on agricultural holdings

	Percentage of total	
Land usage	1991	1993
Grassland over 5 years old	30.4 %	30.1 %
Crops	28.8 %	26.1 %
Sole right rough grazing	27.2 %	26.7 %
Grassland under 5 years old	9.1 %	9.0 %
All other land including bare fallow	4.1%	8.1%

Table 2 Percentage of crops grown

	Percentage of total	
Land usage	1991	1993
Wheat	40.0 %	38.9 %
Barley	28.1 %	25.8 %
Oilseed rape	8.9 %	8.3 %
Peas and beans	4.1 %	5.4 %
Sugar beet	3.9 %	4.4 %
Horticulture	4.0 %	4.1 %
Other crops	10.9 %	13.1 %

The policies of successive governments over the past 70 years have increased forest cover from 5% to 10%. The main strands of present policies are aimed at the protection of the very few surviving ancient and semi-natural woodlands, the sustainable management of all existing woodlands and forests, and a steady expansion of tree cover in harmony with the environment.Timber production from existing woodlands and forests will rise to around three times the current level over the next 30 years.

A list of acronyms referred to in this report is included at Abbreviations.

CHAPTER 2
Indigenous PGR

The UK has a wide variety of habitats that sustain a rich diversity of plant genetic resources, as summarised in Table 3 below.

Table 3 List of the major habitats to be found in the United Kingdom

Habitat	Area*	Habitat	Area*
marine	N/A	lowland wet grassland	0.07 Mha
arable	4.5 Mha	shingle	N/A
plantation	2.1 Mha	machair	0.04 Mha
improvecd pastures	1.8 Mha	dunes	0.06 Mha
upland heaths	1.7 Mha	lowland heaths	0.06 Mha
upland mires	1.5 Mha	saltmarsh	0.04 Mha
upland grassland	1.4 Mha	native pinewoods	0.01 Mha
built up areas	1.3 Mha	calcareous downland	0.01 Mha
ancient broadleaved woodland	0.7 Mha	lowland bogs	0.006 Mha
montane	0.6 Mha	coastal lagoons	0.003 Mha
open water	0.3 Mha	swamps/fens/carrs	0.002 Mha
intertidal flats	0.2 Mha	limestone pavement	0.002 Mha

*** Area is expressed in Million Hectares (Mha);**
N/A = information not available

A summary of the UK's forest genetic resources is presented in Annex 1. The majority of UK commercially cultivated plants are derived from non-native species However, a number of endemic wild progenitors, which may not contribute to commercial cultivation can still be found in the wild. A list of some of the more commonly known relatives of current or potentially important commercial or agricultural benefit that may be found in the wild is provided in Table 4.

Table 4 A list of some of the wild relatives of plants grown for agricultural and commercial purposes, that are still found in the UK in the wild

Species	Common name	Species	Common name
Alliuim ampeloprasum babingtonii	Wild Leek	*Rubus caesius*	Dewberry
Berberis vulgaris	Barberry	*Rubus chamaemorus*	Cloudberry
Beta maritima	Sea Beet	*Rubus fruticosus*	Blackberry
Brassica nigra	Black Mustard	*Rubus idaeus*	Raspberry
Brassica oleracea	Wild Cabbage	*Sambucus nigra*	Elder
Brassica rapa	Wild Turnip	*Trifolium arvense*	Haresfoot Clover
Corylus avellana	Hazelnut	*Trifolium bocconei*	Twin-flowered Clover
Crambe maritima	Sea Kale	*Trifolium campestre*	Hop Trefoil
Dactylis glomerata	Orchard Grass	*Trifolium dubium*	LesserYellow Trefoil
Daucus carota	Wild Carrot	*Trifolium fragferum*	Strawberry Clover
Empetrum nigrum	Crowberry	*Trifolium glomeratum*	Clustered Clover
Fragaria vesca	Strawberry	*Trifolium micranthum*	Slender Trefoil
Lactuca saligna	Least lettuce	*Trifolium molinerii*	Crimison Clover
Lactuca serriola	Wild Lettuce	*Trifolium occidentale*	Western Clover
Lactuca virosa	Trifolium repens	*White Clover*	
Lolium perrene	Rye Grass	*Trifolium scabrum*	Rough Clover
Malus sylvestris	Apple (crab)	*Trifolium squamosum*	Sea Clover
Prunus padus	Cherry	*Trifolium striatum*	KnottedClover
Prunus spinosa	Sloe	*Trifolium strictum*	Upright Clover
Pyrus cordata	Plymouth Pear	*Trifolium suffocatum*	Suffocated Clover
Ribes nigrum	Blackcurrant	*Vaccinium myrtillus*	Bilberry
Ribes rubrum	Redcurrant	*Vaccinium oxycoccus*	Cranberry
Ribes uva-crispa	Gooseberry	*Vaccinium vitus-idaea*	Cowberry

These plant species are still found in the wild. As wild plants are subject to natural selection in order to facilitate their survival in localised environments, the plants are adapted to local soil and climate and many possess pest and disease resistance traits which have not been characterised. Whilst not all of these plant species are relatives of economically important crops in the UK, some are of importance in other countries (for instance cranberry in the USA).

2.1 LAND RACES ('FARMERS' VARIETIES) AND OLD CULTIVARS

Land races and old cultivars are still maintained by some growers and amateur gardeners. These plant genetic resources are being actively conserved by some UK based institutions such as the Scottish Agricultural Science Agency (SASA), Horticulture Research International (HRI), the John Innes Centre (JIC) and privately funded organisations such as the National Council for the Conservation of Plants and Gardens (NCCPG) and the Henry Doubleday Research Association (HDRA). Land races are not commonly used by commercial farmers. However, farmers do still occasionally use land races which formed the basis of the earliest breeding pools.

Old cultivars of top fruit such as apples (Old English Apple Varieties) are still grown commercially in the UK. The Government supports conservation of top fruitvia the Countryside Stewardship Traditional Orchard Scheme, and funding for the maintenance of the National Fruit Collection (NFC), Brogdale.

CHAPTER 3
National Conservation Activities

The UK Government is strongly committed to the objectives of the Convention on Biological Diversity (CBD) and to developing existing strategies and programmes to ensure the conservation and, where possible, enhancement of biodiversity within the UK. The UK's Biodiversity Action Plan was published in January 1994. It describes the Govenment's overall goal, underlying principles and objectives for conserving biodiversity and it gives details of UK circumstances and schemes designed to protect and restore biodiversity both *in situ* and *ex situ*. It includes 59 steps which the Government and its agencies aim to take to conserve and enhance biodiversity. Many of these are designed to enhance diversity of plant species. They range from the more general, such as protecting ancient semi-natural woodland, to the specific, such as adding at least five new species each year to the existing Species Recovery Programme. The Government has also set up a Biodiversity Action Plan Steering Group to oversee the development of a range of specific costed targets for key species and habitats for the years 2000 and 2010.

3.1 *IN SITU* CONSERVATION ACTIVITIES

Many plants have widely dispersed populations. They are not generally amenable to site based conservation, but instead require the retention of features traditionally located in the countryside, such as hedges, copses, ponds and flushes. Sympathetic land management is important to the conservation of these widely dispersed species.

Rare and vulnerable species require more specific action. The Wildlife and Countryside Act gives specific protection to 168 species of plants. Action is concentrated when the species is classified threatened i.e. rare, vulnerable or endangered according to the World Conservation Union (IUCN) system.

In 1991 the Government Agency, English Nature launched its Species Recovery Programme with the specific objective of maintaining or enhancing populations of endangered species. Efforts are presently focused on 18 plant species. As part of this initiative, action plans for species in the future will be drawn up by the conservation agencies and the Joint Nature Conservation Committee (which is a Government Advisory Council composed of the Countryside Council for Wales, English Nature and Scottish Natural Heritage) working with the voluntary sector, for species that are globally threatened,

endemic to the UK, of international importance (i.e. listed in annexes to the Bern Convention and the European Union (EU) Habitats Directive), or are rapidly declining. Plantlife (a voluntary body) is running a Back from the Brink' campaign to save threatened plants with assistance from English Nature. There are other projects involving Non-Governmental Organisations (NGOS) aimed at promoting the *in situ* conservation of genetic resources.

3.1.1 Protected Areas

While protected species remain important, there is increasing emphasis towards a strategy designed to ensure that as wide a range of species as possible survives throughout their natural range. The cornerstone of *in situ* conservation in the UK is a system of protection for areas notified as being of special scientific interest because of their biological or geological features.

Particularly vulnerable and precious habitats and species will be further protected through the designation of Special Areas of Conservation (SACS) under the EU Habitats and Species Directive. By the end of March 1993, the UK had a total 6,000 designated Sites of Special Scientific Interest (SSSI) and Areas of Special Scientific Interest (ASSI). These represented nearly 2.0 Mha or 8.5 % of the total land area.

Outside these formally and informally protected areas, environmentally beneficial management of farmland is encouraged through a number of schemes introduced under the EU Council Regulation 2078/92, for example Environmentally Sensitive Areas (ESAs). These are targeted on areas of high conservation value and provide incentives to farmers and crofters to protect and enhance environmental features of their land. By June 1995 there were 43 ESAs in the UK totallina approximately 3.5 Mha. A total of 15% of UK agricultural land is now covered by the ESAs.

Agriculture Departments are also operating farm capital grant and farm woodland schemes that provide funding for specific environmentally-beneficial measures. Other schemes under the EU Council Regulation EC2078/92 programme, include those, for habitat creation on long-term set-aside land, and for conversion to organic farming.

3.2 *EX SITU* CONSERVATION

Part of the plan for the plants listed in the Wildlife and Countryside Act is to conserve them off site (*ex situ*) in the seed banks such as the Wild Species Seed Bank at the RBG, Kew (Wakehurst Place). Similar arrangements are develo-

ping with Scottish National Heritage and the Countryside Council for Wales. *Ex situ* collections held in the UK exist not as a single national gene bank but as a decentralised network of collections of varying size and specialisation. Many plants are conserved in 'field gene banks' in botanical gardens, arboreta, and agricultural and horticultural institutions. These collections of growing plants are carefully maintained either out in the open or under glass. Clones, varieties and cultivars of particular species are kept to maintain stocks of genetic diversity. There are more than 50 botanic gardens and arboreta in the UK holding a rich variety of living germplasm. A list of some of the larger gene banks held in the UK is presented in Annex II. The collections are closely linked to active research on the species and often share the same site. Maintaining active collections in this way is the best way of ensuring the closest links between genetic resources and the main scientific beneficiaries.

Botanic Gardens Conservation International (BGCI), an international botanic garden network headquartered in the UK, maintains an extensive computer database monitoring and coordinating the collections of rare and endangered plants in cultivation in British and other botanic gardens and arboreta worldwide. Data is exchanged electronically between BGCI and many botanic gardens by means of an agreed international standard, the International Transfer Format for Botanic Garden Plant Records (ITF).

The UK Government funds a number of *ex situ* plant genetic resource collections.

- The National Fruit Collection, at Brogdale comprises top fruit and some soft fruit. Its collection of apples is one of the largest in the world. Material is supplied to fruit breeders in the UK and overseas, and is used for research. The Collection is also used as a reference collection for plant breeders' rights testing for the UK and the EU. In addition the UK has given long-term commitment to the European Co-operative Programme for Crop Genetic Resources Networks (ECP/GR) to maintain *Prunus* material at the National Fruit Collection, Brogdale.
- The Vegetable Gene Bank at Horticulture Research International (HRI), Wellesbourne covers in particular varieties of onions (*Allium*), carrot (*Daucus*) and *Brassicas*, all stored as seed. Material is made widely available, both nationally and internationally. The collection is designated as a base collection by IPGRI.
- The Wild Species Seed Bank at the Royal Botanic Gardens, Kew (Wakehurst Place) contains over 9,000 accessions, comprising 200 families and nearly 3,750 taxa. The two largest plant families are the Leguminosae with 2,297 accessions (about 660 species) and the Gramineae with 1,920 accessions (550 species).

- The Nottingham *Arabidopsis* Stock Centre at the University of Nottingham is wholly supported by the Biotechnology and Biological Sciences Research Council (BBSRC) and is a national and international resource maintaining and distributing plant material and information in support of research in all aspects of plant molecular biology and genetics.
- The Pea Gene Bank at the John Innes Centre in Norwich is a broad based collection used by many researchers and plant breeders. It is the second largest collection of pea germplasm in Europe and also acts as the International Centre for genetic stocks for the species.
- The BBSRC Cereal Collections (*Avena spp.*, *Hordeum spp.* and *Triticum spp.*) at the John Innes Centre in Norwich are the UK reference collections for cereals. They are international working collections that are used in for both research and plant breeding programmes.
- The Grasses and Clover Collection at the Institute of Grassland and Environmental Research (IGER) includes a number of important collections such as oats, rye grasses, white clover, European forage germplasm and *Triticale*. The collections are used by plant breeders and for research.
- The Commonwealth Potato Collection at the Scottish Crop Research Institute, Invergowrie. This collection consists of species belonging to *Solanum*, section potato Dumortier. It has in excess of 1,250 accessions representing 78 *Solanum spp.* Material is freely available to *bona fide* researchers.

There are also a number of important privately owned or funded organisations which maintain specialist collections of plants. The Henry Doubleday Research Association, for example, has large collections of old cultivars of garden plants and vegetables. Other collections are held by members of the many British National Societies for ornamental plants. Some 60,000 taxa of ornamental plants, mainly cultivars or species of exotic plants, are available through commercial nurseries in the UK. In addition over 600 National Collections of garden plants are cultivated in numerous UK public and private gardens and arboreta under the voluntary National Collections Scheme organised by NCCPG. Many UK Universities have small specialised collections of wild and cultivated plants of both native and exotic species which are used for research and training.

The Tree Register of the British Isles (TROBI) provides an index of significant specimen trees in major UK private and public gardens. The Woody Plant Catalogue held by the National Trust is the largest catalogue of woody wild collected plants in the world and contains over 35,000 accessions. Numerous forestry institutions also play a role in *ex situ* conservation specifically of trees. The Forestry Commission (see Annex I) and the Department for Agriculture for Northern Ireland maintain clone banks and provenance trials of

16 species of commercial importance in the UK with 13-120 individual trees of seed rather than clonal origin for each species.

3.3 DETAILS OF STORAGE FACILITIES

For sexually reproducing plants seed banks are the most efficient and effective method of long-term storage provided the seeds are 'orthodox'. Storage of seeds in UK national seed banks complies with international guidelines, such as those prescribed by the FAO. Cold storage (-10°C to -20°C) of seeds for some species increases long-term viability for at least 100 years, but for other species seed stores need to be replenished more regularly. Pollen can be stored in a similar way to seed, although there are thought to be very few collections based in the UK. *In vitro* preservation of parts of plants, such as meristem tips, buds or stem tips, is used infrequently in the UK and cryo-preservation is used to slow down growth rates of this material and enhance long-term conservation.

The Scottish Agricutural Science Agency (SASA) now stores a partial duplicate collection for the Royal Botanic Gardens (RBG), Kew (Wakehurst Place). RBG, Kew holds duplicate accessions for several other seed banks, including the International Livestock Centre for Africa (ILCA), Ethiopia and the Land Stabilisation Collection for the FAO. Approximately 70% of HRI's Genetic Resources Unit (GRU) base collections are safety duplicated with the Centre for Genetic Resources (CGN), the Netherlands, under international standard base store conditions. Conversely, safety duplicates are maintained for CGN and a number of other international and national collections at HRI.

3.4 DOCUMENTATION

As explained above, the UK does not have a single national seed bank, and as a consequence the level of documentation varies between collections. Some of the larger seed banks have either introduced or are introducing computerised databases. For example, documentation at HRI, Wellesbourne uses international descriptor standards with data stored using dBase on an IBM compatible PC. The data relating to the IPGRI designated base collections form part of the European Cooperative Programme (ECP) databases for *Allium* and *Brassica*. HRI's GRU acts as the database manager for the ECP *Allium* database as a part of the agreed UK inputs-in-kind to the ECP. Collections are documented fully for passport and stock control data. Crop collections are characterised to varying degrees based on minimal descriptors defined for *Allium, Brassica* and *Raphanus* by the ECP crop working groups and IPGRI,

and for *Daucus* by UPOV. These data are valuable indicators for users looking for specific provenance or characteristics.

3.5 EVALUATION

Evaluation and characterisation are two of the processes identified to improve the utilisation of PGR under EU Regulation 1467/94 on the conservation, characterisation, collection and utilisation of genetic resources in agriculture, where much emphasis is placed on improved co-ordination and collaboration. For some UK collections, such as HRI's GRU base collections, evaluation depends upon experts screening accessions and returning data for inclusion in the database. HRI's GRU has supported UK programmes screening for resistance to pests and diseases including carrot root fly, *Allium* white rot, *Pythium* in carrot, downy mildew in *Brassica*, Beet Western Yellows Virus in lettuce and Crook Root in Watercress. The strategic test collections are valuable reference standards which are being utilised increasingly in biotechnology.

3.6 REGENERATION

Regeneration is routinely undertaken for the major collections in accordance with recognised procedures. Outbreeding taxa need to be regenerated in isolation, and the equipment, resources and personnel required are significant. The majority of HRI's GRU collections are outbreeders, and therefore it is necessary to prioritise which accessions within the collections will be regenerated on an annual basis. In some cases population size is constrained by the size of the isolation units.

CHAPTER 4
In-Country Uses of PGR

4.1 USE OF PGR COLLECTIONS

As stated earlier, *ex situ* collections exist as a decentralised network of collections of varying size and specialisation, and it is not therefore possible to quantify the number of times that each species has been supplied for use within the UK. With the main publicly supported collections located at scientific or higher education institutes, it is implicit that germplasm will primarily be available for research purposes.

The 1992 Government review of UK policy on the *ex situ* conservation of PGR found that plant breeders in research institutes were the main users of germplasm. The main factors which were thought to account for the low level of PGR utilisation by industry, were a lack of knowledge about the existence of gene banks and the material held in them; an insufficient degree of characterisation and evaluation of material and the ready availability of short-term alternatives. However, most groups using the collections felt that PGR would become of increasing importance to plant breeders in the future. Concern about reducing synthetic agrochemicals in the environment and interest in novel crops for human consumption or industrial use were seen as factors likely to increase the search for sources of pest and disease resistance and for characters from exotic species which might be transferred by genetic modification techniques into adapted breeding lines.

PGR collections often serve a range of uses depending on their composition which is in turn dependent on their history and development. These uses may be specific (registration collection, genetic stocks, related species) or may cover a number of uses with different emphases. For example, the BBSRC Cereals collection maintained at the John Innes Centre (JIC) at Norwich serves as the national reference collection for material bred and trialed in the UK. An agreement with the British Society of Plant Breeders (cereal section) requires samples of all lines entering the National Listing to be sent to the collection. After a three year period they will be entered into the main collections and are available on request. The collections act as a reference collection for the future needs of plant breeders. HRI has a similar agreement with SASA.

The majority of breeding companies use collections either for accessions for use as potential parents in breeding programmes or for information relating to pedigree, characterisation or known genetic traits. Contacts with the bree-

ders can be well developed. In some instances, collaborative characterisation work of mutual interest is done by a reciprocal arrangement i.e. stocks for data.

Germplasm may also be used as a pool of genetic variation which can form the basis of crop improvement strategies, whether by traditional plant breeding or genetic transformation techniques. Seed samples are being sent to an increasingly wide range of recipients, such as university departments, agricultural institutes and NGOs working both in the UK and overseas, particularly developing countries. Collections can be screened to identify species or plant varieties with specific disease resistances and resistance to biotic stresses such as heat, salt and drought, or for medicinal compounds. For example, a blood-clotting protein that is helpful in the detection of a rare human blood disorder was isolated from one of the *Vicia* sp. accessions in the Wild Species Seed Bank at RBG Kew (Wakehurst Place).

PGR collections may also serve as genetic stock collections. For example the *Pisum* collection at JIC, Norwich contains a large number of genetic lines and acts as the international centre for genetic stocks for the species. This collection of genetic stocks aims to cover all mutations that are available in *Pisum* and underpins a large proportion of the fundamental research in peas worldwide today. Genetic stocks are of considerable importance in genetic analysis and in the increasingly important area of molecular mapping.

4.2 CROP IMPROVEMENT PROGRAMMES AND SEED DISTRIBUTION

The material stored in national seed banks is available on request to *bona fide* researchers, subject to satisfactory arrangements regarding Intellectual Property Rights. Several of the collections produce seed lists to publicise the contents of their seed banks, and it is likely that this information will eventually be available via computer networks such as the Internet. RBG, Kew have a "Royalty Sharing" agreement with recipients of material from the Wild Species Seed Bank. If recipients of the material want to commercialise it they need the permission of RBG, Kew whose policy is to apportion profits to the country of origin of the material. The Wild Species Seed Bank distributes more than 2,000 seed samples every year.

The Government funds a number of programmes which aim to improve the understanding of the more fundamental aspects of plant biology. Many of these programmes rely on the ready availability of PGR located in UK seed banks. In addition PGR collections are often used directly in crop improvement programmes. The Pome Fruit Breeding programme is an example of the potential for national collaboration utilising PGR collections to improve fruit

quality and resistance to diseases. This programme utilises selected materials from both national and overseas collections, with identified characters transferred from such sources, by hybridisation, into the national strategic breeding programme.

4.3 BENEFITS OF PGR UTILISATION

At present the potential benefits outweigh actual returns. However, there has been some commercial spin off from PGR utilisation. For example, PGR utilisation has resulted in several new commercial varieties of crops that are of economic importance in the UK. Both SASA and HRI are two of the many examples of government funded bodies which have provided the breeding industry both in the UK and worldwide with useful genotypes and gene combinations. Some of these have resulted in improved cultivars.

4.4 IMPROVING PGR UTILISATION

Improved documentation and accessibility to data have been important objectives in the last 5 years, with the standardisation and computerisation of large quantities of paper based records. The development of a joint *Allium* database between SASA and HRI is on-going and will be designed to accept other vegetable crops in the future. This should greatly improve accessibility to the large quantity of descriptive data already held by the two institutes.

A database of genetic information has been developed by SASA and John Innes Centre for Peas. There is a need to develop flexible, standardised software for gene databases in other crops, and these are now at the planning stage.

CHAPTER 5
National Goals, Policies, Programmes and Legislation

5.1 *IN SITU* CONSERVATION

The UK government has a three pronged approach to conservation: designation and protection of specific geographical areas; specific actions targeted towards individual species and measures aimed at the wider, countryside. The overall goal is to conserve and enhance biological diversity within the UK, and to contribute to the conservation of global biodiversity through all appropriate mechanisms. The objectives for conserving biodiversity include:

to conserve and where practicable to enhance:

- the overall populations and natural ranges of native species and the quality and range of wildlife habitats and ecosystems;
- internationally important and threatened species, habitats and ecosystems;
- species, habitats and natural and semi-natural habitats that are characteristic of local areas;
- to increase public awareness of, and involvement in conserving biodiversity;
- to contribute to the conservation of biodiversity on a European and global scale.

The JNCC published a UK Plant Conservation Strategy in 1994. This strategy sets out a framework for action by the statutory conservation agencies to conserve the native flora of the UK *in situ*. It covers both vascular and non-vascular plants.

5.2 *EX SITU* CONSERVATION

The UK policy on conservation of PGR was recently the subject of a Government sponsored review. The main recommendations of the review included the establishment of an Interdepartmental Group to review funding priorities for the conservation of PGR, and the production of a strategy document to consider long-term funding commitments to designated collections. The review reaffirmed the Government's commitment to participate fully in international efforts to establish comprehensive networks of *ex situ* PGR collections. Other national bodies have a role in PGR, for instance, the UK Plant Genetic Resources Group (UKPGR) has a wide technical base including - groups representing both *in situ* and *ex situ* interests, as well as conservation bodies, ecological groups, and commercial representatives. The Group regularly offers advice to Government departments on issues relating to PGR.

Currently some 50 *ex situ* collections in the UK are publicly funded in whole or part. Although most of these are funded directly by Government departments, a significant number are funded indirectly, through Research Councils, universities and agricultural colleges. The majority of Government funding in this area is directed to the collections referred to at paragraph [3.9]. Most botanic gardens are funded in the main by local authorities and universities, with the notable exception of the Royal Botanic Gardens, Kew and Edinburgh, which are grant funded by MAFF and SOAFD respectively.

Funding from the Ministry of Agriculture, Fisheries and Food (MAFF) is currently provided for the cost of maintaining certain core collections such as the Wild Species Seed Bank (RBG Kew, Wakehurst Place), the Vegetable Gene Bank (HRI, Wellesbourne), the National Fruit Collection (Brogdale) and the Pea Gene Bank at the JIC, Norwich; the acquisition and multiplication of new material; the maintenance of collections to approved standards; characterisation; the establishment and maintenance of databases and the provision of information and material.

Funding from the Scottish Office Agriculture and Fisheries Department (SOAFD) is currently provided to cover the cost of maintaining, extending and characterising certain core collections. Two of the most notable are the Commonwealth Potato Collection, and a *Rubus* collection, both of which are housed at the Scottish Crop Research Institute, Invergowrie. SOAFD's funding of the Royal Botanic Garden, Edinburgh, includes a significant contribution to the internationally important conifer conservation project, sites for which have been established throughout the UK.

The institutes supported by BBSRC house a number of core collections that are funded at least in part from the Government's science budget, most notably those located at the John Innes Centre (small grain cereals, wheat and related species, *Hordeum spontaneum*, peas and field beans) and the collections at the Institute of Grassland and Environmental Research (oats, rye-rasses, white clover, European forage germplasm and *Triticale*). The *Arabidopsis* Stock Centre at the University of Nottingham is wholly supported by BBSRC at present and is a national and international resource maintaining and distributing plant material and information in support of research in all aspects of plant molecular bioloay and genetics.

5.2.1 Botanic Gardens and other living collections

With the notable exceptions of some botanic gardens such as RBG, Kew, most botanic gardens have only relatively limited links with seed banks. However, they constitute an important germplasm resource, have an important role to play in *ex situ* conservation of non-crop species, and offer considerable potential for species, rehabilitation and biotechnological research. Unlike seed banks which tend to focus on a particular plant species or group, botanic gardens have historically collected a wider range of plants, from within a given geographical region.

5.3 TRAINING

Training in PGR techniques is currently undertaken at a number of Higher Education Institutes and at several institutes holding germplasm collections. For example, the University of Reading provides training for higher degree students in *ex situ* conservation by seed storage and the University of Birmingham undertakes taught and MSc. courses in Conservation and Utilisation of Plant Genetic Resources'. In addition, the University of Reading runs a joint M.Phil. course with the University of Birmingham, RBG, Kew and the Natural History Museum entitled 'Botanical Diversity: Classification, Conservation and Management'. RBG, Kew holds an annual series of international courses on plant conservation techniques, environmental education and botanic garden management. These courses are organised with the help of BGCI. Birmingham University has taught several short courses internationally, covering such topics as: Conservation Data Management and Analysis; Plant Exploration and Conservation Strategies; *In situ* Conservation; Plant Identification; Plant Systematics; Seed Conservation and gene bank Management; Biotechnology and *in vitro* Conservation and Quantitative Plant Breeding.

On a national level genetic and plant sciences feature in the school science curriculum. Many of the seed banks have open days to encourage an interest and understanding in the work of the collections (for example the Pea Seed Bank at the John Innes Centre, Norwich).

5.4 NATIONAL LEGISLATION

The following section details those aspects of UK legislation that may have an effect on PGR conservation. *In situ* conservation programmes such as the SSSI and ESA systems have been described elsewhere.

5.4.1 Plant Health Regulations (The Plant Passport system)

The Plant Health (Great Britain) Order 1993 came into force on 1 June 1993. Under the Order, particular plants and plant products require plant passports to circulate freely within the EU. These passports are a statement that the plants and plant material is free from quarantine pests and diseases and meets the requirements laid down in the schedules of the Order.

Any business which wishes to be involved in the movement of passportable material within the EU or the import of material into the EU for commercial reasons is required to register with the relevant authority. For example, in England and Wales, this is MAFF's Plant Health and Seeds Inspectorate which inspects business premises before providing the requisite authority to issue plant passports for their material. Where a country or region within the EU can prove that it is free from a particular quarantine pest or disease which is established elsewhere in the Community, it can seek Protected Zone status. Material entering such protected zones must be free of the relevant pest or disease, with this being clearly indicated on the plant passport, where one is required.

5.4.2 Sale, distribution and marketing of seeds

All aspects of production and marketing of seeds of the main agricultural species are prescribed in EU Seeds Marketing Directives. The Directives prescribe minimum quality standards for seeds, to ensure that purchasers are assured of receiving seeds of a reasonable and uniform quality, and require checks to be made on varietal and analytical purity and germination. The Directives also place restrictions on the number of generations of seed, to preserve the integrity of the product, and prescribe conditions and procedures for the official examination of crops and testing of seeds.

In November 1993, the European Commission put an extensive package of proposals to the European Council, (COM (93) 598 final), for a Council Directive to further harmonise and rationalise the existing procedures in line with the single market. Discussion is still in progress on the proposals which would, *inter alia*, enable the EU.

Standing Committee on Seeds to establish conditions to take account of developments in the area of "the conservation of genetic resources".

Council Directives 66/400/EEC, 66/401/EEC, 66/402/EEC, 66/403/EEC, 69/208/EEC, 70/457/EEC and 70/458/EEC set out the EU's legislation on the marketing of beet seed, fodder plant seed, cereal seed, seed potatoes, seed of oil and fibre plants and vegetable seed and on the common catalogue of varieties of agricultural plant species.

Seeds of the main agricultural species may only be marketed if they have been certified in accordance with the requirements of the appropriate directives and if the variety in question appears on the National List of the certifying Member State or on the EU Common Catalogue. To achieve listing status, the variety must undergo tests for Distinctness, Uniformity and Stability (DUS) and trials for Value for Cultivation and Use (VCU). Vegetable and amenity grass varieties do not undergo VCU trials. The UK Government has argued that the directive requirements should apply to commercial rather than amateur use and that the 'small packet' market used by gardeners should be exempted from these provisions. The UK and France have proposed an approach that would relax the rules for varieties over 15 years old that are sold only to amateurs in small packets. This is supported in the UK both by trade and conservationists.

Species covered by the Seeds Directives can only be traded legally if they comply with EU certification and listing requirements. However, farmers may in certain circumstances be permitted to save home produced seed of a listed variety for re-planting (farm saved seed). New Community legislation will even-

tually require the payment of royalties to the holder of plant breeders' rights. However, farm saved seed may not be traded legally.

5.4.3 Intellectual Property Rights

The UK has a comprehensive IPR legislative programme. Both patents and Plant Variety Rights have an indirect and beneficial effect on PGR conservation, by encouraging investment in new technologies and the development of new varieties, and affording a route through ownership/ licensing agreements for owners of genetic resources to be recompensed when material is developed and exploited commercially. There are currently no plans to amend our IPR legislation as a consequence of GATT. The UK Government fully understands the implications of the IPR legislation for genetic resources.

CHAPTER 6
International Collaboration

6.1 UNCED AND THE CONVENTION ON BIOLOGICAL DIVERSITY

The UK has maintained a strong commitment to the process of following up the Earth Summit in Rio de Janeiro in 1992, becoming in January 1994 one of the first countries to publish a national plan to implement Agenda 21. The Agriculture chapter of 'Sustainable Development - the UK Strategy' explicitly stated the Government's commitment to environmentally sensitive agriculture and further work for Common Agricultural Policy (CAP) reform to reduce levels of support and integrate fully environmental considerations.

The UK ratified the Biodiversity Convention on 3 June 1994 and has taken an active role in negotiations to implement it. The Convention reaffirms the sovereign rights of States over their natural resources and states that the authority to determine access rests with national governments. It expands on this by stating that Parties shall endeavour to create conditions to facilitate access and not impose restrictions and that access shall be subject to the prior informed consent of the country providing the resources and shall be on mutually agreed terms. The Article also provides for the sharing of benefits derived from genetic resources.

The UK believes that the response of the Parties to the Biodiversity Convention to implement these provisions should be two-fold. First, Parties should produce national strategies, plans and programmes setting out how they intend to implement their commitments under the Convention, including those on access to genetic resources Secondly, the Conference of Parties (COP) needs to consider in due course whether the Convention's provisions are being adequately implemented. This process should include close co-operation with relevant international fora, most notably the FAO's deliberations on the questions of farmers' rights and access to *ex situ* collections not acquired in accordance with the Biodiversity Convention.

The first COP also made some important decisions on its own consideration of PGR issues. The second COP will consider, *inter alia*, a compilation of existing legislation, administrative and policy information on access to genetic resources and the equitable sharing of benefits derived from their use and a compilation of information from Governments and international organisations on Article 16 (access to and transfer of technology). It will also consider the relationship between the Convention and the FAO Global System for

PGR for Food and Agriculture. A significant amount of the second COP's work will therefore be taken up by issues related to PGR. It will be essential to ensure that work carried out under the Convention and under the auspices of the FAO is complementary.

The Overseas Development Administration (ODA) is part of the Foreign and Commonwealth Office and is responsible for the UK Government's official Aid Programme. It provides assistance for conservation and research into PGR of value to developing countries in order to further its overall mission of promoting sustainable economic and social development and the welfare of people in developing countries.

In pursuit of these objectives, ODA supports programmes of research, conservation and management in renewable natural resources (RNR) at UK institutions, through multilateral organisations and in developing countries. The UK's policy on PGR assistance to developing countries is presented in more detail at paragraph 6.10.

6.2 INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

The ODA aims to promote sustainable economic and social development and welfare of people in developing countries. In pursuit of this objective, the UK was a founder member of the Consultative Group on International Agricultural Research (CGIAR), an informal association of over 40 countries, international and regional organisations established in 1971 to support a system of agricultural research around the world. ODA is now supporting fifteen of the international agricultural research centres in the CGIAR system, most of them located in developing countries. Their research includes improving plant varieties and methods of production, farming, systems, plant protection, post-harvest systems and various aspects of food policy. One of their particular strengths is their collections of genetic resources. Since 1975, institutions sponsored by the CGIAR have built up the world's largest collection of PGR - some 465,000 individual accessions accountinc, for 35% of global unduplicated holdings. The CGIAR's policy supports the unrestricted interchange of germplasm throughout the world. In 1994 ODA's support for core funding for CGIAR institutions concerned with plant sciences research amounted to £4.92.

In 1994 ODA contributed £550,000 towards the International Plant Genetic Resources Institute's (IPGRI) core funding. In addition ODA supports specific research projects carried out by IPGRI and other CGIAR institutions to conserve genetic resources, both in UK institutions and overseas.

6.3 REGIONAL INTERGOVERNMENTAL INITIATIVES

The UK is participating in Phase V of IPGRI's European Programme for Genetic Resources (ECP/GR), providing an annual contribution of $30,000 for five years. The UK also contributes in kind to ECP/GR, as several of the UK collections have database responsibilities. Two UK gene banks funded by MAFF are recognised as base collections by IPGRI: the Vegetable Gene Bank at HRI, Wellesbourne and the Wild Species Seed Bank, RBG, Kew (Wakehurst Place). HRI were instrumental in the development of the ECP *Allium* and *Brassica* networks and maintain the *Allium* database. A *Daucus* group is currently being initiated. The Institute of Grassland and Environmental Research (IGER), Aberystwyth maintain a database for *Lolium* and *Trifolium*, with a *Lathyrus* database maintained by Southampton University. An ECP/GR programme is being initiated for *Pisum* in 1995.

The UK is represented on the ECP/GR's Working Group for *Prunus*, which exists to bring together curators.of European Collections and some breeders in order to standardise recording methods and databases. Individuals associated with the National Fruit Collection (NFC), Brogdale participate in the ECP/GR workshop on *Prunus*. In addition NFC staff have undertaken to host an European *Malus* Workshop in 1995, with a view to establishing a Malus Working Group under the ECP/GR. The NFC is developing a *Malus* database which it is hoped will form the basis of a new European Apple Inventory.

6.4 BILATERAL INTERGOVERNMENTAL INITIATIVES

UK bilateral aid is organised mainly on a country programme basis. Activities include technical co-operation for conservation and utilisation of PGR where this fits in with country programme objectives agreed between the UK and overseas governments. Examples of work funded by country programmes include support for the National Bureau of PGR in India to develop an Indian national network of PGR collections and for a new National Herbarium in Bangladesh. A large number of forestry projects have as a major objective the conservation of biodiversity, including the Western Ghats in India, Mount Cameroon conservation in Cameroon, Mount Mulanje conservation in Malawi and ecological research in Zimbabwe. ODA is also supporting the forest conservation and tree improvement project in Honduras.

Technical co-operation is also provided to facilitate access to germplasm for research and development programmes (e.g. Cashew in Tanzania, Cocoa in Ghana and various crops for diversification in Zanzibar). ODA's country

programmes also fund training for developing country scientists and technicians in PGR related areas of expertise.

As part of its commitment to the Biodiversity convention, the UK Government announced the Darwin Initiative in 1992. This initiative builds on the UK's strengths in scientific, educational and commercial aspects of biodiversity with the aim of helping those countries rich in biodiversity but poor in financial resources. Over 40 UK institutions and 20 countries (including Brazil, China and Russia) are co-operating as a result of this initiative.

UK institutions actively collaborate with institutes from other countries. For example, HRI's GRU is actively involved internationally through crop networks, support to overseas development projects and training. The unit also has links with other groups such as the United States Department of Agriculture's Crop Advisory Committees, and the Oilcrops Network for East Africa and South Asia. HRI is a member of a Concerted Action on strawberry genetic resources, funded by the European Union; the group maintains a European strawberry collection of old cultivars, and distributes lists for all European strawberry germplasm collections. It is also a participant in three EU shared cost projects, concerned with genetic improvement of apple, *Prunus* and *Rubus* (raspberry and blackberry) and exchange of germplasm constitutes an important part of these projects.

The John Innes Centre (JIC) has a bilateral agreement with the Nordic Gene Bank on work relating to the *Pisum* genetic stocks. The JIC is involved in several biodiversity studies using DNA markers to identify differences between varieties. At present, these markers are being used in joint programmes between the JIC, the University of Birmingham and IRRI on rice; on pearl millet between JIC, ICRISAT and West Africa; on finger millet between JIC and Kenya and on foxtail millet between JIC and China. Much of this work is funded through the ODA. The JIC also collaborates on *Brassicas* with groups in China, central and eastern Europe and Japan.

CHAPTER 7
National Needs and Opportunities

7.1 *IN SITU* CONSERVATION

The UK recognises that human development, and the human use of land and natural resources, have always affected other species and their habitats; and have often accelerated the processes of change or loss of biodiversity. No ecosystem in the UK has been unaffected by human activity, whether directly or indirectly; and most of the landscapes that we now regard as traditionally British have been created or heavily modified by man. This century has seen a formidable increase in the pace and scale of human intervention in the natural world and, as a result, an accelerated pace of loss of biodiversity.

However, although the protection and enhancement of biodiversity is extremely important in its own right, it should be seen as inseparable from the initiatives arising from the Earth Summit. The publication in 1994 of the UK's Biodiversity Action Plan was in response to Article 6 of the Convention on Biological Diversity to develop national strategies for the conservation of biological diversity and the sustainable use of biological resources.

The overall goal of the UK Biodiversity Action Plan is to conserve and enhance biological diversity within the UK and to contribute to the conservation of global biodiversity through all appropriate mechanisms. The underlying principles are:

1. Where biological resources are used, such use should be sustainable.
2. Wise use should be ensured for non-renewable resources.
3. The conservation of biodiversity requires the care and involvement of individuals and communities as well as Governmental processes.
4. Conservation of biodiversity should be an integral part of Government programmes, policy and action.
5. Conservation practice and policy should be based upon a sound knowledge base.
6. The precautionary principle should guide decisions.

The UK objectives for conserving biodiversity are:

1. To conserve and where practicable to enhance:
   a. the overall populations and natural ranges of native species and the quality and range of wildlife habitats and ecosystems;
   b. internationally important and threatened species, habitats and ecosystems;
   c. species, habitats and natural and managed ecosystems that are characteristic of local areas;
   d. the biodiversity of natural and semi-natural habitats where this has been diminished over recent past decades.
2. To increase public awareness of, and involvement in, conserving biodiversity.
3. To contribute to the conservation of biodiversity on a European and global scale.

The UK Government and others published 59 broad targets which would contribute to the objectives of the Action Plan. A review is currently taking place of progress to date, and it is intended that a report will be published during the winter months of 1995.

Specific objectives for the UK are to:

1. Identify, designate, and protect sufficient appropriate sites to achieve conservation and, where possible, enhancement of *in situ* plant genetic resources;
2. continue to promote further 'greening' of the EU Common Agricultural Policy, and press for closer linkage between agriculture and environmental policy objectives;
3. encourage an expansion of woodland and forest cover;
4. keep existing schemes which encourage environmentally friendly farming under review to ensure objectives of conserving and enhancing wildlife habitats are achieved;
5. continue to control by means of regulation the use and storage of environmentally damaging pesticides and fertilisers, where necessary by introducing new measures.

7.2 *EX SITU* CONSERVATION

The preceding section has described how biodiversity in the UK is maintained through the conservation of habitats and ecosystems. Such *in situ* conservation is insufficient to maintain genetic stocks of some species, either because:

- they are naturally rare;
- they are directly at risk as a result of human activities or exploitation;
- they or their natural habitats are in some way threatened; or because;
- they are difficult to obtain from the wild.

In these cases conservation of species away from their natural habitats, so called *ex situ* conservation, can play a critical role in supporting species through crisis periods. *Ex situ* populations can provide valuable resources for research into basic aspects of species biology which may be critical in devising appropriate and effective *in situ* programmes.

In 1992 the UK Government carried out a review of UK policy for the *ex situ* conservation of plant genetic resources. The main proposals were:

1. to contribute to and where possible enhance the conservation of biological diversity, complementing *in situ* measures for instance where a plant population is severely threatened and allowing for subsequent re-introductions;
2. to counter a contraction of the crop genetic base;
3. to ensure that genetic resources are available as a basis for present and future research both conventional and biotechnological;
4. to contribute to international conservation efforts, in particular Articles 9 and 15 of the Convention on Biological Diversity;
5. to meet the UK's specific international obligations relating to genebanks with formal international status; and, more generally, to play a role in international negotiations and co-operation;
6. to encourage increased use of PGR collections;
7. to maintain statutory cultivar collections;
8. to provide a source for education, training and amenity purposes.

CHAPTER 8
Proposals for a Global Plan of Action

The UK welcomes the recent agreement between FAO and the CGIAR Centres under which the CGIAR collections are held in trust by the IARCS under the supervision of the FAO. In our view the CGIAR institutions should continue to collect, evaluate, conserve and use the genetic resources of their mandated crops and related wild species. IPGRI should assist in the collection, conservation and use of all crop and forest species, but should work closely with all interested national agricultural research systems and institutions outside the CGIAR (e.g. PORIM on Oil Palm, BUROTROP on Coconut and Oil Palm, INIBAP on bananas and COGENT on coconuts, ICRAF on multipurpose trees, the private and government sectors on other commodity crops (such as tea, coffee, cocoa, cashew and rubber) and the International Centre for Under-utilised Crops (ICUC).

Co-ordination of all these collections should be covered by agreements between the parties concerned, and a comprehensive database should be maintained by FAO, incorporating the existing databases where they exist. FAO should ensure compatibility between databases and make data freely available and exchangeable between all *bona fide* users. Collections of wild materials should be freely available for use by the collectors, and duplicates should be left in the care of the authorities in the country of collection.

Ex situ collections of species with orthodox seeds should be held in cold stores, and should be duplicated for added security. *Ex-situ* collections of species with recalcitrant seeds should be held, where the technology exists, under tissue culture conditions as either zygotic embryos or vegetative plants under slow-growth conditions. Living collections of all species, but especially perennials with recalcitrant seeds, should be encouraged in botanical gardens and/or in special germplasm gardens planted for the purpose.

FAO should develop and co-ordinate the global network, and should establish an independent group to mediate in any dispute. These activities must be prioritised within the existing budgetary provision.

ANNEX 1
Forest Genetic Resources

1.1 INTRODUCTION

The historical picture of forests in the United Kingdom is one of gradual loss over a very long period, followed by expansion of tree cover this century. Available evidence suggests that the proportion of the United Kingdom covered by woodland and forest was once around 80%, but fell below 50% more than 2,000 years ago, below 20% by the year 1,000 AD, and had reached a level of about 10% by the middle of the fourteenth century. Although offset by planting in the eighteenth and nineteenth centuries, the total area of woodland cover continued to fall and was only 5% by 1920 with later expansion mainly due to planting of non-indigenous species. Thus of the 10% woodland cover which has been restored today only a very small fraction of woodlands are the direct descendants of "ancient" forest and none has been unaffected by man.

1.2 INDIGENOUS TREES

Most native trees in the UK are broadleaves. The main exception is Scots pine which is regarded as being native only to the Highlands of Scotland. Some common species of broadleaves and all the other conifers, except yew and juniper, are introductions. Beech is native only in the south of England, but the other native broadleaves are generally fairly widely distributed though with a reduced range in uplands and the north.

In all there are 34 tree species native to UK. Productive forestry is mainly dependent on introduced species with only Scots pine, oak, ash and beech, and sometimes birch, being natives of commercial forest significance. There is, however, considerable interest in the potential importance of birch in upland areas where genetic selection could enhance both form and growth rate.

The felling of trees in UK is regulated through felling licences in almost all cases and there is a very strong presumption that native woodland, and especially ancient semi-natural woodland, will be conserved by appropriate management and planting/regeneration.

1.3 NATURE CONSERVATION

The native pinewoods of Scotland are an endangered habitat in the European Commission's Habitat Directive. An inventory of genuinely native pinewoods has been compiled and the woodlands classified into 7 regions of differing genetic characteristics based on resin analysis. Areas within these regions have been registered as seed sources.

None of the other commercial native species is under threat. Elm *(Ulmus)* species do not normally form woodlands being mainly hedgerow trees, but have been very badly affected by Dutch Elm Disease in all areas, the genetic loss being offset by the vegetative regrowth characteristic of the species. Another non-woodland tree *Populus nigra*, has recently become the subject of a conservation programme due to scarcity and an apparent lack of replanting in recent decades.

Government policy for conservation of native species rests primarily on *in situ* conservation. Exceptions are:- Scots Pine clone banks and a series of random mating gene pools; two collections of *Populus nigra* clones; provenance collections for *Quercus robur* and *Quercus petraea*, some of which are likely to be of native origin; and seed storage for native Scots pine. A programme towards conservation of birch and ash has been commenced with the establishment of clone banks.

The use of native trees of local origin is promoted in the regeneration of existing woodlands of native species and the creation of new ones. Where natural regeneration is not possible or has to be supplemented by planting, owners are encouraged by additional financial incentives to use stock of local origin. In woods designated as Sites of Special Scientific Interest, such conditions are usually obligatory with a key object of management usually being the preservation of local genetic integrity in the habitat. In such cases competing non-indigenous species are usually removed. Woodland SSSIs therefore represent a major commitment to the conservation of the native woodland genetic resource.

The fact remains, however, that our current knowledge of genetic variation in our indigenous broadleaved species is poor and that our ideas about the geographic localness are often based on the impact of topography, historic land use and tree form rather than on formal identification of provenance. Until we have more of this information we will rely on a precautionary principle based on the above criteria which tend not to be species specific.

1.4 USE OF GENETIC RESOURCES IN UK

For all species except native Scots pine, UK is divided into 4 regions of provenance. Collections from registered stands are recorded with a serial number in addition to the provenance reference; collections from unregistered stands are allocated only the provenance reference. For native Scots pine, 7 collection zones are defined within the Highlands of Scotland and also serially numbered according to the particular source recorded in the national seed register.

Trade in seed and plants is covered by legislation and material is sold either by seed merchants, private tree nurseries or the Forestry Commission. The main commercial species are covered by the Forest Reproductive Materials Regulations (1977) which covers registered seed (either from selected seed stands or seed orchards) of 13 species plus 1 genus - *Populus* - for which only tested material can be marketed. However, registration of seed is also extended to species not covered by the Forest Reproductive Material Regulations where they may, for example, be marketed under the OECD scheme. Only reproductive material certified under the categories "selected" or "tested" can be freely marketed.

Oak and beech are not always available from registered sources because of the infrequency of seed years and the difficulty of seed storage. For these and other species where there is a shortage of registered material, the Forestly Commission may grant seed collectors specific authority to collect from unregistered stands. Seeds for other broadleaved species come from unregistered stands for which no formal permission is required within the scope of the FRM regulations and in which the majority of collections are made.

Apart from Scots pine, oak and beech, all the seed for native species is therefore able to be collected from unregistered sources. However, conditions attached to grant-aid for forestry and the management of nature reserves usually require that such seed for native species be of local, well-adapted, provenance if the plants are to be used for conservation reasons, especially on ancient woodland sites. Where ample seed is available from registered sources the Forestry Commission will refuse applications to collect that species from unregistered sources.

Once collection has been completed, collection organisations are required to notify the Forestry Commission of the amount of fruit, cones or seed collected and, if applicable, seed extracted. If the Forestry Commission is satisfied with the information and any reports from its inspections it will issue:

- if the stand is registered, a "Master Certificate of Provenance";
- if the stand is not registered, a "Certificate of Provenance";
- if the seed has to be collected under derogation (due to shortage of registered supplies), a "licence to market".

Without one or other of these certificates the seed collected may not be legally marketed anywhere in the European Community.

In addition to maintaining registers of selected seed stands the Forestry Commission is obliged to register seed collectors, seed extractories and seed stores where any OECD-certified seed is being stored and nurseries where OECD-certified plants are being raised. These requirements match those of the Forest Reproductive Material Regulations.

1.5 POLICY, LEGISLATION AND FUNDING

The impact of the EEC and OECD Regulations on commercial tree seed and vegetative material has already been described. The Forestry Commission, as the Government Department responsible for the application of regulations, has long experience in plantation forestry where the benefits of ensuring correct choice of provenance have been very clearly demonstrated. It is government policy to apply these regulations rigorously. The derogations required for the supply of adequate quantities of oak seed do, however, result in the importation of oak from continental Europe and there are mixed views among conservationists as to whether this will dilute an already very mixed gene base in any critical way. Because many Sites of Special Scientific Interest are oak woodlands, where imported seed would not be allowed, there will be many sites where any genuinely local gene base will be protected. Research in-

to the variability of the gene base of oak and other native broadleaved species has not yet been undertaken, but is likely to be a feature of the next decade.

Since the 1920s the Forestry Commission has conducted species and provenance trials of all the main conifer species of commercial importance in British Forestry and these are continuing under the auspices of the International Union of Research Organisations. The Forestry Commission conducts tree improvement programmes for Sitka spruce, Lodgepole pine, hybrid larch, Douglas fir, beech, Scots pine, oak and birch. The last four of these are indigenous species.

Forestry Commission expenditure of genetic resources in 1993/94 was as follows:

In situ conservation	
	not separately costed from management

Ex situ conservation		£
	arboreta	130,000
	species/provenance collections and gene pools	100,000
	Genetic evaluation and tree breeding	600,000

There are two major *arboreta* which, together with some others, are also managed as a recreation resource in part supported by self-generated income.

The government also supports major domestic and international tree collections at the Royal Botanic Gardens at Kew and Edinburgh.

ANNEX 2
List of PGR Collections in the UK

The following collections are either funded wholly or in part by the Government

Collection and Curator	Number of Accessions	Contact Address
Forage grasses, forage legumes and cereals (B.G. Waters and J. Tinman)	1835	Department of Agriculture Plant Testing Station Crossnacreevy Belfast Northern Ireland. BT6 9SH
Poplar, Willow, Acer, London Plane, Cypress and other trees (P. Tabbush)	8 major *arboreta*	Forestry Commission Forestry Research Station Alice Holt Lodge Wrecclesham Farnham Surrey. GU10 4LH
Tree Seeds (Dr P. Gosling)	600 (u 200 species)	(as above)
Tree Improvement Collection (includes; trees, seeds, pollen and tissue culture of 16 species) (Dr A.M. Fletcher)	12,000	Forestry Commission Northern Research Station Roslin Midlothian. EH25 9SY
Apples, Pears and quinces (F.H. Alston)	~ 700	Horticulture Research International, East Malling, West Malling Kent. ME196BJ
Cherry, plum and related species (Prunus *sp.*) (K.R. Tobutt)	~ 300	(as above)
Raspberries, blackberries and related species	(Rubus sp.) (V.H. Knight) 125	(as above)
Hardy Ornamental Nurscry Stock (Dr B.H. Howard)	~1,000	(as above)
Farm Woodland Collection (K.R. Tobutt)	285	(as above)
Strawberries (*Fragaria* sp.) (Dr D.W. Simpson)	387	(as above)
The Vegetable Gene Bank (includes; *Allium* sp., *Brassica* sp., *Raphanus* sp., *Daucus* sp. and *Lactuca* sp.) (Dr D. Astley)	11,720	Horticulture Research International Wellesbourne Warwick. CV35 9EF

Collection and Curator	Number of Accessions	Contact Address
Near Isogenic Lines of Tomato (Dr F.A. Langton)	~ 900	(as above)
Hop Collection (*Humulus lupulus*) (P. Darby)	~ 600	Horticulture Research International Department of Hop Research Wye College Wye, Ashford Kent. TN25 5AH
National Willows Collection (R.I. Parfitt)	~ 1000	Institute of Arable Crops Research Long Ashton Research Station Bristol. BS18 9AF
Pines etc. (*Pinus* sp. and *Picea* sp.) (Dr D.C. Malcolm)	?	Institute of Ecology and Resource Management University of Edinburgh Darwin Building Mayfield Road Edinburgh. EH9 3JU
Oat Collection (Avena *sp.*) (J.M. Leggett)	~ 4,360	Institute of Grassland and Environmental Research Welsh Plant Breeding Station Plas Gogerddan Aberystwyth Dyfed. SY23 3EB
Rhizobium Collection (Dr M. Dyc)	536	(as above)
Grass and Legumes (I.D. Thomas)	9,287	(as above)
BBSRC Cereal Collections; Wheat Barley and Oats (M.J. Ambrose)	22,813	John Innes Centre for Plant Science Research Norwich Research Park Colney Lane Norwich Norfolk. NR4 7UJ
John Innes *Pisum* Collection (M.J. Ambrose)	3,000	(as above)
Wheat Precise Genetic Stocks (T.E. Miller)	6,099	(as above)
Rye, Wheat and related spp. (T.E. Miller).	2,574	(as above)
Birch and Poplar (*Betula* and *Populus*) (Dr M.G.R. Gannell)	75	Institute of Terrestrial Ecology Edinburgh Research Station Bush Estate Penicuik Midlothian. EH26 0QB
National Fruit Collection (includes top fruit, bush fruit and ornamentals) (Ms H. Case)	3,828	National Fruit Collection Wye College Brogdale Farm Brogdale Road Faversham Kent. ME13 8XZ

Collection and Curator	Number of Accessions	Contact Address
Fibre Flax and Linseed, Forage and Amenity Grasses (D.T. Johnston)	~ 400	Northern Ireland Horticultural and Plant Breeding Station Loughgall Armagh. BT61 8JB
Wild and semi-cultivated species of Potato; *Solanum sp.* (P. Watts)	35	(as above)
Multipurpose seeds for dry zones (seed of *Acacia* sp., *Pinus* sp. etc.) (A. Pottinger)	3,840	Oxford Forestry Institute Department of Plant Sciences University of Oxford South Parks Road Oxford. OX1 3RB
Barley Collection (*Hordeum* sp.) (Dr W. Spoor)	1,000	Scottish Agricultural College West Mains Road Edinburgh. EH9 3JG
Fibre Flax and Oil-bearing Linseed (Dr G. Marshall)	350	Scottish Agricultural College, Auchincruive Ayr. KA6 5HW
UK Potato Cultivar Collection (H. Dickinson) and Potato Microplant Collection (Miss S. Goodfellow)	1,160 400	Scottish Agricultural Science Agency East Craigs Edinburgh. EH12 8NJ
Vegetable Crop Collections (including the UK Vcgetable Definitive Reference Collection and SASA Vegetable Cultivar Collection) (Miss C.M. Thomson)	2,706	(as above)
Oil and Fodder Collections (G. Campbell)	416	(as above)
UK *Pisum* Cultivar Collection and UK Pea Definitive Reference Collection (G. Campbell)	894	(as above)
Cereal Crops Sced Collection (Miss C. Struthers)	3,0	(as above)
Raspberries, blackberries and related species (*Rubus* sp.) (mainly virus indexed) (R. J. McNicol)	507	Scottish Crop Research Institute Ivergowrie Dundee. DD2 5DA
Blackcurrants and related species (Ribes sp.) (R.M. Brennan)	860	(as above) Cranberries, Blueberries and related species and woody perennials; *Vaccinium sp., Hippophae sp., Aronia sp., Amelanchier sp., Rosa sp.,*

Collection and Curator	Number of Accessions	Contact Address
Sambuccus sp. (R.M. Brennan)	90	(as above)
Narcissus Collection(S. Dawson)	201	(as above)
Commonwealth Potato Collection (*Solanum* sp.) (Dr M.K. Wilkinson)	1,250	(as above)
Potato Dihaploid Collection (M.J. DeMaine)	1,500	(as above)
Cultivated Potato Collection (I.N. Chapman)	700	(as above)
Faba bean and related species (*Vicia* sp.) (Dr G. Ramsay)	754	(as above)
Barley Collection (*Hordenum* sp.) (A. Young)	1,66	(as above)
Wheat (*Triticeae*) (B.P. Foster)	138	(as above)
Living Plant Collections (not stored as seeds) (J. Main)	39,055	Royal Botanic Gardens, Edinburgh20A Iverleith Row Edinburgh. EH3 5LR
Living Plant Collections (not stored as seeds) (L.C.D. Curator)	83,000 (34,000spp.)	Royal Botanic Gardens Kew Richmond Surrey. TW9 3AB
The Wild Specics Seed Bank (Seeds of wild species from the UK; including most covered by Schedule8 of the Countryside Act, and day zone species of potential economic value) (R.D. Smith; S. Linington)	9,080 (3,750 spp.)	Royal Botanic Gardens Wakehurst Place Ardingly Nr. Haywards Heath West Sussex. RH17 6TN
Beet Collection (*Beta* sp.) (Dr B.V. Ford-Lloyd)	1,025	School of Biological Sciences The University of Birmingham Edgbaston Birmingham. B15 2TT
Nottingham *Arabidopsis* Stock Centre (Dr B. Mulligane)	~ 7,000	School of Biological Sciences University of Nottingham University Park Nottingham. NG7 2RD

Collection and Curator	Number of Accessions	Contact Address
Lupin Collection (*Lupinus*) (Dr M. Phoplonker)	1,100	School of Plant Sciences University of Reading Agricultural Botany Plant Science Laboratories Whiteknights PO BOX 221 Reading. RG6 2AS
Cocoa Collection (Dr P. Hadley)	150	School of Plant Sciences Department of Horticulture Plant Science Laboratories Whiteknights PO Box 221 Reading. RG6 2AS
Seeds of major components of ecological groupings in Britain (Dr G. Hendry)	3,000	Department of Animal and Plant Sciences PO Box 601 University of Sheffield Sheffield, S10 2UG
Vetches and Peas (*Vicieae* includes *Lathyrus* sp.) (Dr F.A. Bisby)	3,500	Department of Biology University of Southampton Medical and Biological Sciences Building Bassett Crescent East Southampton. SO9 3TU

Abbreviations

ASSI	Area of Special Scientific Interest.
BBSRC	Biotechnology and Biological Sciences ResearchCouncil.
BGCI	Botanical Gardens Conservation International.
CAP	Common Agricultural Policy.
CGIAR	Consultative Group on International Agricultural Research.
CGN	Centre for Genetic Resources, the Netherlands.
DANI	Department of Agriculture for Northern Ireland.
DOE	Department of the Environment.
DUS	Distinctness, Uniformity and Stability testing.
ECP	European Co-operative Programme.
ESA	Environmentally Sensitive Area.
EU	European Union, formerly known as the European Community (EC).
GATT	General Agreement on Tariffs and Trade.
GRA	Genetic Resources in Agriculture.
HDRA	Henry Doubleday Research Association.
HRI	Horticulture Research International.
HRIGRU	Horticulture Research International Genetic Resources Unit.
JIC	John Innes Centre.
JNCC	Joint Nature Conservation Committee.
ICRAF	International Council for Research in Agro-Forestry.

ICRISAT	International Crop Research Institute for the Semi Arid Tropics (India).
IGER	Institute of Grassland and Environmental Research.
IPGRI	International Plant genetic Resources Institute.
IPR	Intellectual Property Rights.
IRRI	International Rice Research Institute.
IUCN	World Conservation Union.
LNR	Local Nature Reserve.
MAFF	Ministry of Agriculture Fisheries and Food.
NGO	Non-Governmental Organisation.
NASC	Nottingham *Arabidopsis* Stock Centre.
NCCPG	National Council for the Conservation of Plants and Gardens.
NIAB	National Institute of Agricultural Botany.
ODA	Overseas Development Administration.
OECD	Organisation for Economic Cooperation and Development.
OST	Office of Science and Technology.
PHSI	Plant Health and Seeds Inspectorate.
RBG	Royal Botanic Gardens.
RHS	Royal Horticultural Society.
RNR	Renewable Natural Resources.
SACs	Special Areas of Conservation.
SASA	Scottish Agricultural Science Agency.
SCRI	Scottish Crops Research Institute
SOAFD	Scottish Office Agriculture and Fisheries Department.

SSSI	Site of Special Scientific Interest.
TROBI	Tree Register of the British Isles.
UK	United Kingdom of Great Britain and Northern Ireland.
UKPGR	United Kingdom Plant Genetic Resources Group.
UPOV	Union for the Protection of New Varieties of Plants.
VCU	Value for Cultivation and Use.