Defra Review of Policy on Genetic Resources for Food and Agriculture: Annexes

Annex 1: Stakeholders involved in the policy review process

Organisation	Contact	Attended conference	Commented on conference output	Interviewed	Other
BBSRC	Adrian Pugh	✓		✓	
British Beet Research Organisation	John Macleod	✓			
British Pig Association	Marcus Bates	✓	✓	✓	
British Potato Council	Ewen Brierley	✓			
British Society of Plant Breeders	Roger Turner and Sue Wigzell	✓		✓	
CABI	David Dent and David Smith	✓	✓	✓	
Cardiff University	Mike Bruford	✓			
CBS Technologies	John Yates	✓			
Department for International Development	Linda Brown and Jon Tanner	✓		✓	
Elm Farm Research Centre	James Welsh	✓			
English Nature	Brian Johnson	✓			
Food Standards Agency	Paul Cook	✓			
Forestry Commission	Gordon Patterson	✓		✓	
Grazing Animal Project	Claire Weaver				✓
Henry Doubleday Research Institute	Bob Sherman	✓		✓	
HGCA	Graham Jellis			✓	
Horticultural Research	Dave Astley, Ken	✓	✓		

International	Tobutt				
IGER	Mike Leggett	✓			
Imperial College at Wye	Mike Jeger	✓			
Institute of Food Research	Ian N Roberts	✓	✓		
Intermediate Technology Development Group	Patrick Mulvany	✓			✓
John Innes Centre/ UKPGR	Mike Ambrose	✓	✓	✓	
Joint Nature Conservation Committee	Paul Rose			✓	
Meat and Livestock Commission	Chris Warkup and Gert Nieuwhof	✓		✓	
National Beef Association	Lesley Lewin			✓	
National Farmers Union	Andrew Clarke	✓	✓	✓	
National Sheep Association	Chris Lloyd	✓			
PlantNet	Judith Cheney	✓			
Rare Breeds International	Lawrence Alderson	✓	✓	✓	
Rare Breeds Survival Trust	Rosemary Mansbridge	✓		✓	
Roslin Institute	John Woolliams	✓	✓	✓	
Royal Association of British Dairy Farmers	Tim Brigstocke			✓	
Royal Botanical Gardens Kew	Kerry ten Kate, Paul Bridge	✓	✓		✓
Scottish Agricultural Science Agency	Gerry Saddler	✓			
Scottish Crop Research Institute	Roger Ellis	✓	✓		
SEERAD	Charlie Greenslade	✓		✓	
The Sheep Trust	Dianna Bowles, Sam Jones	✓			✓
University of Aberdeen	Jim Prosser	✓	✓		
University of Birmingham, department of biosciences	Nigel Maxted	✓			✓
University of Birmingham, microbiology department	Nigel Brown	✓	✓		

University of Edinburgh	William Hill	✓		✓	
University of Lincoln	Stephen Hall	✓			
University of Newcastle	Mike Goodfellow	✓			

Annex 2: Current Position of GRFA in the UK

Plants

All the major commercial crops grown in the UK are of non-native origin. However, the UK holds collections of plant GR that are internationally important, including the Commonwealth Potato Collection at SCRI, HRI Vegetable Genebank, the National Fruit Collection and the National Cereal Collection. Other *ex situ* collections of plant GR in the UK include peas, oats, hops, soft fruit (e.g. raspberries, blackcurrants), grasses and forage crops. A thorough review of *ex situ* plant GR collections was carried out in 1991. The majority are kept by research organisations for use in research. Key players in plant genetic resources are brought together through the UK Plant Genetic Resources group (UKPGR), which includes researchers, collection curators , industry and NGOs.

There is little *in situ* conservation of plant GR. There are 66 native UK species of economic value found in the wild, including some wild relatives of cultivated plants. Some may be protected by chance in nature reserves and through agri-environment schemes. However, these species are not monitored or recorded, except for one wild relative of asparagus which is a priority species under the BAP. There is a small amount of on-farm or home garden conservation of landraces and old varieties. Examples include ancient orchards, cultivated barley landraces and heritage vegetable varieties grown by enthusiasts.

Animals

There is a wide diversity of native and imported farm animal breeds in the UK, including up to 85 sheep; 72 cattle; 15 pig and 8 goat breeds listed on the Defra national database. There are also 237 breeds of ducks, geese and poultry, many of which are kept for showing rather than production. Farm animals can be divided into mainstream breeds, those widely used for commercial production; and breeds at risk, which includes locally adapted, distinctive and rare breeds.

The control and development of genetic resources for commercial production is different for each species. Commercial pig and poultry breeding is carried out by international breeding companies, who sell hybrid breeding stock and germplasm, and hence have complete control of their genetic resources. At the other extreme, the sheep industry is the least controlled and is subject to the least genetic improvement. Choice of rams for breeding may be influenced by tradition and showring appearance rather than performance information. Currently, approximately 50% of bulls used for beef breeding and just 20% of rams are performance recorded.[1]

In situ conservation is the prime method of conserving farm animals, with ex situ methods used as a back up. Management of animal GRFA is therefore

[1] Personal Communication, Chris Warkup, Meat and Livestock Commission

dependant upon commercial and conservation breeding strategies, and is intrinsically linked with industry competitiveness, heritage protection and environmental management. The vast majority of farm animal genetic resources exist on-farm, though there are also some small feral populations of cattle and sheep in the UK.

Ex situ conservation of animals involves cryopreservation of semen, eggs and/or embryos. This technology is well advanced for cattle, but less developed for other species. For pigs, semen freezing is difficult and unreliable. Ex situ collections are held by breeders, in particular artificial insemination companies, and by NGOs with the purpose of conserving breeds at risk.

Micro-organisms

Micro-organism GRFA include bacteria, yeasts, fungi and algae. The United Kingdom National Culture Collection (UKNCC) co-ordinates the activities, marketing and research of the UK national service collections of microbial organisms. The UKNCC was formed with the intention of making the collections self-funding, following withdrawal of funding by DTI in 1989.

The UKNCC consists of 9 public service collections:

- CABI Bioscience collection (fungi, bacteria, nematodes)
- Culture Collection of Algae and Protozoa
- European Collection of Cell Cultures (animal, human and viruses)
- National Collection of Pathogenic Viruses
- National Collection of Industrial, Food and Marine Bacteria
- National Collection of Pathogenic Fungi
- National Collection Plant Pathogenic Bacteria
- National Collection of Type Cultures (medically important bacteria)
- National Collection of Yeast Cultures

All except the type cultures are relevant to food and agriculture to some extent. The most relevant collections in terms of GRFA are the CABI collection and the yeast cultures.

Numerous collections are also held by universities and individual researchers. Micro-organism collections, including those under UKNCC, claim to be at risk from insecurity of funding. For example, BBSRC is currently considering withdrawing funding from the National Collection of Industrial, Food and Marine Bacteria. DTI is currently reviewing collections funded by BBSRC (see 3.3.7).

Many more micro-organisms exist than have so far been identified and cultured. Soil biodiversity is potentially of major importance for food and agriculture, but our level of understanding of this is currently very low. For this reason, in situ micro-organisms are an essential resource – although identifying or monitoring these resources is problematic.

Genetic stocks

These are resources developed in the laboratory for genetics and genomics research. One example is precise genetic stocks, lines developed through chromosomal manipulation for detailed analysis of traits in plants with multiple chromosomes. Arabidopsis is a simple brassica used as a model plant for research, due to its small genome. It is important for research in classical plant genetics as well as molecular genetic studies in plant physiology, biochemistry, and development. The Nottingham Arabidopsis Stock Centre, funded by BBSRC, provides seed and information resources to the research community.

Genetic stocks generated in the course of a research project may be thrown away once the project is completed. For microbes, the 1977 Budapest Treaty[2] requires researchers to lodge any materials generated through research in a gene bank before publishing results. However, due to financial constraints, these lines may be disposed of to make room for new accessions. There is no such agreement for plant genetic stocks, although BBSRC sometimes specify as a condition of funding that any genetic resources generated in a research project must be lodged in a gene bank.

[2] 1977 Budapest Treaty on the International Recognition of the Deposit of Microorganisms for the purpose of Patent Procedure.

Annex 3: Previous Policy Objectives for Conservation of Plant Genetic Resources

The policy objectives for conservation of plant genetic resources outlined in the 1996 MAFF research strategy were:

1. To ensure that the genetic resources are available as a basis for research – both conventional and biotechnological – not only for example to determine mechanisms of resistance to pests and diseases, but also as a basis from which to develop new crop varieties to meet future changes in climate, consumer demand and the economics of the industry;
2. To meet the UK's specific international obligations relating to gene banks with formal international status; and more generally, to play a full role in international negotiations, in particular in the European Co-operative Programme of IPGRI, and as part of a world wide network of gene banks;
3. To facilitate the characterisation and utilisation of genetic resources in agriculture; and
4. To allow for the identification of research needs based on material in UK collections, where this research is justified by policy or strategic requirements, and research into techniques related to the storage and conservation of plant material.

Annex 4: Recommendations made in the UK Country Report on Farm Animal Genetic Resources (AnGR)

(extract from the report)

5. Recommendations for enhanced co-operation in the field of farm animal biodiversity.

5.1. Recommendations.

5.1.1. **International co-operation** on AnGR currently is achieved effectively through several channels. These should be reinforced and become more interactive:

5.1.1.1. **The National Co-ordinator for Animal Genetic Resources (NC)** acts at Governmental level for the UK and plays an active role through the European Regional Focal Point (ERFP) of FAO. The NC represents the UK on animal genetic resources at the FAO Intergovernmental Commission on Genetic Resources for Food and Agriculture.

Data on AnGR in the UK is submitted to the DAD-IS database in Rome through the NC. There is a pressing need for greater harmonisation of databases at national, European regional and global level. It is hoped that a part EU funded 5th Framework Programme (FP5) project (EFABIS) started in 2002 will enable the software programmes to accomplish this to be developed. This work should be encouraged.

It is UK Government policy to conserve and enhance biodiversity, and to lead integration of these with other policies across Government and internationally. Therefore the UK should play an active role in developing pan-European AnGR conservation activities especially as animal breeds do not respect national boundaries and international co-operation has cost-benefits.

5.1.1.2. **Rare Breeds International** interacts with FAO at the global level and EAAP at the European regional level, advising member NGOs with regard to evolving international standards. Procedures for biological impact studies have also been developed and can be used in a national context to minimise substitution of native by exotic AnGR (Rare Breeds International 2001, Personal Communication). Stronger collaboration between RBI and the ERFP for AnGR is recommended particularly in the area of establishing internationally recognised criteria for endangerment across Europe.

5.1.1.3. **Research institutes and NGOs** effect collaboration at European regional level under EU legislation, and also at a global level for some breeds and research topics. Animals were inadequately represented in projects approved under FP5; only 4 out of 21 projects were concerned with AnGR. A collaborative proposal (the so-called DIVA project) to establish a network of excellence focusing on AnGR seeks to re-dress the balance in FP6. UK institutes should be active in pursuing such funding opportunities for AnGR research and development.

5.1.1.4. **International trade.** FAO should be aware of the effects of international trade on AnGR. It is recommended that FAO should enhance its ability to provide unbiased advice on breeds to enable developing countries to make better-informed decisions on the breeds that are most likely to contribute to national development in their own particular circumstances. The use of high-genetic non-adapted animals may cause problems.

The UK has an active export market, which can underpin the conservation of AnGR, and which may assist in the alleviation of hunger and poverty in some areas of the world. Prior to the recent BSE, Classical Swine Fever and FMD outbreaks, exports of pig breeding stock had a value of £100M annually (including hybrid parent stock). Similarly British exporters of cattle and sheep breeds have historically had a huge impact on the development of AnGR around the world. Every effort should be made to facilitate the re-establishment of this business where there is genuine demand, by seeking the lifting of restrictions imposed as a result of the recent disease status of the UK. Some UK developed poultry strains are used world-wide, as indeed some valuable genetic material is imported. It is important that conservation of indigenous breeds should never be used as a reason for inhibiting the international exchange of useful genetic material. Revitalising international trade in the UK's animal genetic resources is considered a key priority to assist in maintaining a threatened animal breeding infrastructure by bringing in much needed income to fund evolving breeding objectives associated with sustainable development of the livestock sectors in the UK.

5.1.1.5. **Imported products.** It is important to minimise the dangers to the conservation of AnGR arising from the importation of food and other animal products infected by zoonotic and other notifiable animal diseases by ensuring effective border controls.

5.1.1.6. **International Collaboration.** In view of the increasing globalisation of commercial animal breeding (especially in the dairy, pig and poultry sectors) and the fact that the long-term economic sustainability of commercial breeding companies cannot be guaranteed it is recommended that FAO keeps a close watch on their commercial viability and competitiveness and the high performance AnGR that they retain. The loss of such resources could have serious consequences for global food security in the future.

5.1.2. **European Regional Co-operation**:

It is recommended that European and more especially EU Member States' co-operation on AnGR be encouraged at Governmental, NGO and Research Institute level, particularly in the area of conservation and utilisation of genetic resources. There are cost benefits to a European approach to these issues and the principal vehicle to greater co-operation is through the ERFP (See 5.1.1 above) with technical back-up from the European Association of Animal Production (EAAP). The UK should continue to play a full role in the development of the ERFP. There are a number of priorities that should be progressed at European level:

~ standardise criteria for the categorisation and prioritisation of breeds in AnGR.

~ harmonise national AnGR databases with the EAAP database in Hanover and DAD-IS

~ develop joint AnGR conservation management plans through the ERFP and EAAP.

~ harmonise zootechnical and disease control regulations in relation to AnGR at EU level

5.1.3. **National Co-operation.**

Programmes for the conservation of AnGR will be applied most effectively by the joint efforts of Government and private organisations and individuals. Government should be urged to provide pump-priming funds to the livestock breeding sector, noting that the issues are environmental and cultural, not solely agricultural. More importantly, the public at large through voluntary contributions should be encouraged to provide subsequent inputs of expertise and finance. The existing collaborative framework in the UK between academia and the livestock industry can be developed by improving networks such as Faraday Partnerships to facilitate flows of concepts and information, promote the partnership ethic, promote core research and promote business-relevant postgraduate training.

5.1.3.1. **Mainstream Breeds.** Recommendations for co-operation on breeds used in mainstream agriculture are catered for under overall national agricultural policy and commercial interests in the UK. Mainstream breed interests are well represented by a range of species associations (NBA, NSA, BPA, NPA, BPC etc) who also represent the interests of individual mainstream breed societies. The recommendations for national co-operation in this report therefore focus principally on the enhancement of farm animal genetic diversity and the specific actions needed to encourage the conservation and utilisation of our native and exotic breeds at risk.

5.1.3.2. **Breeds at Risk (Locally adapted, Distinctive and Rare).** National co-operation is recommended in the following areas:

~ Evaluation of global status. Recognising the value of wider dispersal of each breed (subject to the correct environment), and evaluating each national breed population in the context of its global status is recommended. In doing so, due consideration must be given to the divergence over time of populations separated by barriers to gene flow and/or contrasting environment

~ Use of biological impact studies. Assessment of the possible effect of substitution of native AnGR by exotic breeds by the application of genetic (biological) impact studies (Rare Breeds International 2001) preceding importation, including the evaluation of incoming genetic material is considered advisable.

~ Provision of dedicated resources. Provision of specific resources for native breeds at risk, including dedicated public and

private funding where available, through collaboration within a concerted national conservation strategy (see 4.1.1. above) is recommended. The following projects have been identified as collaborative ventures worthy of co-ordinated national support:

Longer Term Projects

- The creation of national rare, locally adapted and distinctive breeds gene banks
- The creation of a national rare breeds library

Medium Term Projects

- The development of communication networks among Government, Breed Societies, NGOs, extension services and research institutes
- The maintenance and improvement of the Breed Society infrastructure
- The characterisation of breeds for the purposes of linking local and specific adaptations and niche markets or specialist uses

Short Term Projects

- The construction and maintenance of a national rare breeds pedigree database

- Assistance with provision of computerised recording systems to Breed Societies

5.1.4. **National NGOs.** There is an urgent need for more effective co-ordination and complimentary action among NGOs and breed organisations operating at the national level. Harmonisation of conservation criteria and goals with regional and global policy is unlikely to be effective until this is achieved. Criteria for recognition and prioritisation of native breeds have been identified and are under review with EAAP and FAO (Alderson G.L.H, 2001). These procedures could help to form the basis of a national programme for conservation of native AnGR.

5.1.5. **Human resources.** The UK has a significant reservoir of human resources with international experience, and with expertise in the practical management of minority AnGR and the methodology of genetic conservation. These resources should be harnessed through workshops and seminars to disseminate a wider understanding of AnGR and ability both nationally and internationally.

5.1.6. **National Action Plan** The creation of a National Action Plan, facilitated through the National Co-ordinator, for the conservation and utilisation of AnGR in the UK based on the recommendations in this Report is strongly recommended. A possible template for the process that might be followed in establishing a NAP is given in Appendix 8.

5.1.7. **National Steering Committee.** The initiative created by SoWAnGR has established a valuable foundation in the form of the NCC on which to build an ongoing structure for the effective monitoring and management of AnGR in UK. The creation of a Steering and Advisory Committee in the UK is strongly recommended.

Annex 5: Defra funded research relevant to food and agriculture

The projects listed below are all those broadly relevant to genetic resources for food and agriculture. It should be noted that the majority of these are not using material from ex situ collections.

Project Code	Project Title	Total Cost (£ K)
Sustainable Arable Farming		
AR0105	Improvement of pea seed protein through genetics and biotechnology	538
AR0705	Development & selection of oat germplasm and genetic stocks leading to varieties for milling, feed and new markets	156
AR0706	Novel variation in oats to improve sustainable production, disease resistance and use	408
AR0914	Generating and evaluating a novel genetic resource in wheat in diverse environments	337
Agri-industrial Crops		
NF0411	Molecular investigation of diversity in wild source germplasm to support Miscanthus breeding	127
NF0507	Functional genomics in marine algae to discover genes that can be used to produce docosahexaenoic acid in oilseed crops	380
Horticulture and potatoes		
HH0908SMU	Mushroom strain improvement through genetic engineering technology	514
HH0909SFV	Genetics of transformation and regeneration in horticultural brassicas	281
HH0910SFV	New techniques for genetic improvement of horticultural brassicas	1323
HH0911SFV	Genetic improvement of lettuce	841
HH0913TFV	DNA markers in onion improvement	332
HH0914TFV	DNA markers in leek improvement	313
HH0917SFV	Assessment of the molecular diversity of resistance genes within vegetable brassica genetic resource collections	231
HH1023SX	Genetic characterisation and genomic organisation of factors affecting fruit texture	276
HH1026SHN	Conventional and biotechnological genetic improvement of hardy nursery stock	380
HH1027SSF	Genetic development of raspberry with improved pest and disease resistance	329
HH1029STF	Genetic improvement of top fruit by development and application of molecular markers	748
HH1030STF	Genetic improvement of cherries and plums including the development of marker-assisted	325

	selection	
HH3201SSF	Genetic improvement of strawberry for sustainable production in the UK	947
HH3202SHO	Sustainable hop production in the UK	1468
HH3701SX	Characterisation of genes regulating texture and shelf-life in fleshy fruits and tools for fruit quality	519
HL0110LFV	Genetic modification of Brassica oleracea for resistance to turnip and cauliflower mosaic viruses	181
Organic farming		
HL0150LOF	Varieties and integrated pest and disease management for organic apple production (LINK)	285
OF0304	Varieties of field vegetables and potatoes for organic production and marketing	198
Salmon, whaling and inland fisheries		
SF0229	Habitat utilisation and population dynamics in wild salmonids	469
SF0238	Impact of introduced fish species on aquatic ecosystems	452
SF0241	Impacts of intensive in-river aquaculture on wild salmonids	324
Poultry		
LK0625	Identifying QTL segregating in commercial broiler populations	240
LS3101	Identification of candidate genes for improved reproductive efficiency in broiler production	449
OF0153	Effect of breed suitability, system design and management on welfare and performance in traditional and organic poultrymeat	288
Sheep		
LK0628	QTL identification and utilisation in sheep sire referencing schemes	154
LS2202	Development of selection indices for longwool sheep to breed halfbred ewes of superior economic performance	955
LS3001	Identifying genetic markers for carcass and meat quality traits in sheep	687
LS3514	The role of sire referencing schemes in terminal sire sheep to improve the carcass quality of crossbred lambs	43
LS3613	Utilisation of selection criteria in white clover to produce varieties suitable for grass/clover swards	795
LS3616	Develop marker-assisted selection criteria to improve the value and utilisation of grasses in livestock production	540
LS3618	Identify markers associated with crown rust	223

	resistance in ryegrass	
LS3631	High sugar ryegrasses for improvement of production efficiency of ruminant livestock and to reduce environmental N pollution	122
Beef		
LK0630	Roslin Bovine Genome Mapping	476
Welfare		
AW0126	Environmental and genetic influence on the development if adverse behaviour in pigs	282
AW0134	Identifying the genetic causes of sow aggression towards their offspring	479
AW1127	Genetic and nutritional solutions to osteoporosis in hens	467
LK0622	Selecting for reduced aggression in pigs	223

Annex 6: Activities by Other Government Departments, Agencies, Research Institutes, Universities, Sponsored Bodies, Levy Bodies, NGOs and Industry

Other government departments

DTI
The Office of Science and Technology at DTI sponsors the research councils, and is currently undertaking a review of ex situ collections financed through the research councils. DTI previously supported the UK National Culture Collection, but ceased in 1989.

DfID
For the International Treaty on Plant Genetic Resources, DfID lead on finance and technical assistance for developing countries, farmers' rights and CGIAR centres. DfID funds biodiversity projects in client countries, in response to the needs of the individual countries.

Devolved administration

Northern Ireland
A top fruit collection is maintained by the Northern Ireland Horticulture and Plant Breeding Station.

Scotland
The Scottish Agricultural Science Agency (SASA) holds a great deal of ex situ plant GR, including the Commonwealth Potato Collection, as well as barley and soft fruit. The collections include landraces and wild types. SEERAD spends £519K on projects including components of maintenance of germplasm collections. In total £3, 828 K is spent on research projects with elements of work on germplasm evaluation and/or conservation of genetic resources.

Wales
NAW has no specific programme on genetic resources, and considers it a non-devolved area. Priorities for GRFA policy are to support organic agriculture and guard against threats from GMO contamination.

Agencies and sponsored bodies

English Nature and JNCC
English Nature is responsible for SSSIs and Nature Reserves, and is also leading on implementation of some schemes under the Biodiversity Action Plan (BAP). Species relevant to food and agriculture are not currently covered by these reserves, except for grassland habitats, although some may occur in reserves by chance.

Royal Botanical Gardens at Kew
Kew gardens holds large collections of living and ex situ plants, some of which are relevant to food and agriculture. The Millennium Seed Bank aims to

conserve seeds from every species growing wild in the UK. Kew is also active in international agreements and activities to conserve GRFA.

CABI
Defra subscribes to CABI, which amongst other activities keeps a collection of fungi, bacteria and nematodes which forms part of the UK National Culture Collection.

Horticulture Research International (HRI)
One element of HRI's work is conservation, management and characterisation of vegetable crop genetic resources, including the maintenance of a gene bank containing over 13,000 accessions of vegetable genetic material. HRI also undertakes research on plant genetic resources and genome analysis.

Meat and Livestock Commission
The Meat and Livestock Commission (MLC) works on the development of sheep, beef and pigs, with a remit to improve the efficiency of the red meat industry with due regard to the interests of consumers. Its work includes genetic improvement of livestock. MLC spends approximately 1 million per year on improvement of sheep and beef, and around 100K per year on pig breeding. MLC also carries out performance recording and genetic evaluation for 30 breeds of sheep and 30 breeds of cattle. Currently around 50% of bulls used, and less than 20% of rams used, are from performance recorded herds.

HGCA
HGCA is the levy funded body responsible for development of cereal and oilseed crops. Plant breeding work is approximately 10% of HGCA's research and development programme.

Research Institutes

BBSRC fund institutes that maintain collections and conduct research based on GRFA. The institutes with work relevant to GRFA are:
John Innes Centre Plant and microbial science, including research on crop genetics for cereals, brassicas and legumes. Holds national cereal and pea collections, and genetic stocks of wheat and barley. Also developing millet germplasm.
Roslin Institute Research including farm animal genetics, behaviour and welfare. The Faraday Partnership for farm animal genetics and genomics is based at Roslin.
Institute of Grassland and Environmental Research Collections of grasses, forage species and nitrogen-fixing bacteria (Rhizobia). Research on grazing systems and grass and forage varieties. Crop breeding programmes for grasses, forage legumes and oats.
Rothamstead Improvement of crops including wheat, sugar beet and willow. Research includes improving disease resistance in sugar beet using genes from wild relatives; and using molecular genetic techniques to gain information for the management, conservation and exploitation of plant genetic resources, using willows, lettuce and coconut as examples.

Charitable organisations

The **Rare Breed Survival Trust** (RBST) works to conserve over 70 rare, native breeds of sheep, cattle, goats, pigs, horses, ponies and poultry. The RBST is currently raising £2.5 million for its ReGENEration project, to set up a national conservation archive for rare breeds. This will involve cryogenic storage of semen, eggs, embryos and bloods from Trust listed rare breeds.

Rare Breeds International is works in a number of countries, through national organisations (e.g. RBST and breed societies) where possible. Its work in the UK includes inputting into policy and some practical activities. RBI co-ordinated a census of UK breeds in 2002.

The Sheep Trust was recently formed from the Heritage GeneBank, an initiative set up during the foot-and-mouth outbreak to protect native sheep breeds. The Trust deals with native breeds at risk not covered by RBST. The Heritage GeneBank consists of cryoconserved semen from 7 native sheep breeds. A further 14 are included on the Trust's priority list.

The **Henry Doubleday Research Association** (HDRA) keeps a Heritage Seed Library containing 700 varieties of vegetables. These are available to members to grow. Heritage varieties are also grown in HDRA gardens and at some historical buildings.

Industry

Companies such as Unilever hold their own genetic stocks that are not in the public domain. Plant GRFA formerly held at the MAFF Plant Breeding Station moved to the private sector when the station was privatised. The majority of animal GRFA are controlled by private individuals and breeding companies. Breed societies operate for all livestock breeds, registering pedigree information, although some pure-bred populations of certain breeds are not recorded in their official breed society herdbooks.

Universities

Some researchers hold their own private collections. Many micro-organisms and genetic stocks are conserved in this way.

Annex 7: International agreements concerning GRFA

PROVISIONS OF INTERNATIONAL AGREEMENTS OF POSSIBLE RELEVANCE TO NATIONAL PROGRAMMES

Convention on Biological Diversity

Article 7 (Identification and Monitoring)

Each Contracting Party shall, as far as possible, and as appropriate, in particular for the purposes of Articles 8 to 10:

(a) Identify components of biodiversity important for its conservation and sustainable use.

(b) Monitor through sampling and other techniques, the components of biological diversity identified above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use.

(d) Maintain and organise, by any mechanism, data derived from the identification and monitoring activities above.

Article 8 (*In situ* conservation)

Each Contracting Party shall, as far as possible and as appropriate:

(c) Regulate or manage biological resources important for the conservation of biological diversity whether within or outside protected areas. With a view to ensuring their conservation and sustainable use.

Article 9 (*Ex situ* conservation)

Each Contracting Party shall, as far as possible and as appropriate, and predominantly for the purpose of complimenting *in situ* measures:

(a) Adopt measures for the *ex situ* conservation of components of biological diversity, preferably in the country of origin of such components

(b) Establish and maintain facilities for *ex situ* conservation of and research on plant, animals and micro-organisms, preferably in the country of origin of genetic resources
(d) Regulate and manage collection of biological resources from natural habitats for *ex situ* conservation purposes so as not to threaten ecosystems and *in situ* populations of species, except where special temporary *ex situ* measures are required

Article 10 (Sustainable use of components of biological diversity)

Each Contracting Party shall, as far as possible and as appropriate:

(a) Integrate consideration of the conservation and sustainable use of biological resources into national decision-making

(b) Adopt measure relating to the use of biological resources to avoid or minimise adverse impacts on biological diversity

(c) Protect and encourage customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation and sustainable use requirements

(e) Encourage co-operation between its governmental authorities and its private sector in developing methods for sustainable use of biological resources

Article 12 (Research and training)

The Contracting Parties, taking into account the special needs of developing countries shall:

(a) Establish and maintain programmes for scientific and technical education and training in measures for the identification, conservation and sustainable use of biological diversity and its components and provide support for such education and training for the specific needs of developing countries

(c) In keeping with the provisions of Articles 16, 18 and 20, promote and co-operate in the use of scientific advances in biological diversity research in developing methods for conservation and sustainable use of biological resources

International Treaty on Plant Genetic Resources for Food and Agriculture

Article 5 (Conservation, Exploration, Collection, Characterisation, Evaluation and Documentation of Plant Genetic Resources for Food and Agriculture)

5.1 Each Contracting Party shall, subject to national legislation, and in co-operation with other Contracting Parties where appropriate, promote an integrated approach to the exploration, conservation and sustainable use of plant genetic resources for food and agriculture and shall in particular, as appropriate:

(a) Survey and inventory plant genetic resources for food and agriculture, taking into account the status and degree of variation in existing populations, including those that are of potential use and, as feasible, assess any threats to them;

(b) Promote the collection of plant genetic resources for food and agriculture and relevant associated information on those plant genetic resources that are under threat or are of potential use;

(c) Promote or support, as appropriate, farmers and local communities' efforts to manage and conserve on-farm their plant genetic resources for food and agriculture;

(d) Promote *in situ* conservation of wild crop relatives and wild plants for food production, including in protected areas, by supporting, *inter ali*a, the efforts of indigenous and local communities;

(e) Co-operate to promote the development of an efficient and sustainable system of *ex situ* conservation, giving due attention to the need for adequate documentation, characterisation, regeneration and evaluation, and promote the development and transfer of appropriate technologies for this purpose with a view to improving the sustainable use of plant genetic resources for food and agriculture;

(f) Monitor the maintenance of the viability, degree of variation, and the genetic integrity of collections of plant genetic resources for food and agriculture.

5.2 The Contracting Parties shall, as appropriate, take steps to minimise or, if possible, eliminate threats to plant genetic resources for food and agriculture.

Article 6 (Sustainable Use of Plant Genetic Resources)

6.1 The Contracting Parties shall develop and maintain appropriate policy and legal measures that promote the sustainable use of plant genetic resources for food and agriculture.

6.2 The sustainable use of plant genetic resources for food and agriculture may include such measures as:

(a) pursuing fair agricultural policies that promote, as appropriate, the development and maintenance of diverse farming systems that enhance the sustainable use of agricultural biological diversity and other natural resources;

(b) strengthening research which enhances and conserves biological diversity by maximising intra- and inter-specific variation for the benefit of farmers, especially those who generate and use their own varieties and apply ecological principles in maintaining soil fertility and in combating diseases, weeds and pests;

(c) promoting, as appropriate, plant breeding efforts which, with the participation of farmers, particularly in developing countries, strengthen the capacity to develop varieties particularly adapted to social, economic and ecological conditions, including in marginal areas;

(d) broadening the genetic base of crops and increasing the range of genetic diversity available to farmers;

(e) promoting, as appropriate, the expanded use of local and locally adapted crops, varieties and under-utilised species;

(f) supporting, as appropriate, the wider use of diversity of varieties and species in on-farm management, conservation and sustainable use of crops and creating strong links to plant breeding and agricultural development in order to reduce crop vulnerability and genetic erosion, and promote increased world food production compatible with sustainable development; and

(g) reviewing, and, as appropriate, adjusting breeding strategies and regulations concerning variety release and seed distribution.

Article 7 (National Commitments and International Co-operation)

7.1 Each Contracting Party shall, as appropriate, integrate into its agriculture and rural development policies and programmes, activities referred to in Articles 5 and 6, and co-operate with other Contracting Parties, directly or through FAO and other relevant international organisations, in the conservation and sustainable use of plant genetic resources for food and agriculture.

7.2 International co-operation shall, in particular, be directed to:

(a) establishing or strengthening the capabilities of developing countries and countries with economies in transition with respect to conservation and sustainable use of plant genetic resources for food and agriculture;

(b) enhancing international activities to promote conservation, evaluation, documentation, genetic enhancement, plant breeding, seed multiplication; and sharing, providing access to, and exchanging, in conformity with Part IV, plant genetic resources for food and agriculture and appropriate information and technology;

(c) maintaining and strengthening the institutional arrangements provided for in Part V; and

(d) implement the funding strategy of Article 18.

Article 16 (International Plant Genetic Resources Networks)

16.1 Existing co-operation in international plant genetic resources for food and agriculture networks will be encouraged or developed on the basis of existing arrangements and consistent with the terms of this Treaty, so as to achieve as complete coverage as possible of plant genetic resources for food and agriculture.

16.2 The Contracting Parties will encourage, as appropriate, all relevant institutions, including governmental, private, non-governmental, research, breeding and other institutions, to participate in the international networks.

Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture

Priority Activities

I *In situ* conservation and development

1. Surveying and inventorying PGRFA

2. Supporting on-farm management and improvement of PGRFA

3. Assisting farmers in disaster situations to restore agricultural systems

4. Promoting *in situ* conservation of wild crop relatives and wild plants for food production

II *Ex situ* conservation

5. Sustaining existing collections

6. Regenerating threatened *ex situ* accessions

7. Supporting planned and targeted collecting

8. Expanding *ex situ* conservation activities

III Use of plant genetic resources

9. Expanding characterisation and evaluation and the number of core collections to facilitate use

10. Increasing genetic enhancement and base-broadening efforts

11. Promoting sustainable agriculture

12. Promoting the development and commercialisation of under-utilised crops and species

13. Supporting seed production and distribution

14. Developing new markets for local varieties and diversity-rich products

IV Institution and capacity building

15. Building strong national programmes

16. Promoting networks for PGRFA
17. Constructing comprehensive information systems for PGRFA
18. Developing monitoring and early warning systems for loss of PGRFA
19. Expanding and improving education and training
20. Promoting public awareness of the value of PGRFA conservation and use

Annex 8: Summary of stakeholder views gathered in one to one interviews

Plant breeders

Priorities for government policy

- Continuity of genetic resources, ensuring they are efficiently resourced and secure.
- Collections should be funded by Defra, not by BBSRC.
- Ensuring germplasm is accessible and is used
- GR collections should be linked with an active research programme
- Need to improve access across the world to well characterised material. Breeders have commented that they need money to access collections in other countries.
- UPOV is an important first step, should cover as many countries as possible.
- There needs to be a greater understanding of plant breeding issues in government.
- Government should not limit use of GM technology

Gaps

- Knowledge of what is in the collections from plant breeding perspective. Where are the genetic resources in the UK? How well organised are the collections? Are they viable in the long term – they are at risk if kept by amateurs.
- No central information source, so people working in the area are not aware of where germplasm is available.
- Oilseed rape – do not know what is happening to germplasm.
- Wheat – lack of research.

Risks

- Do not see any risks
- Security of collections
- Competitiveness of UK agriculture.
- Erosion of genetic resistance to pathogens.
- Changing needs – mean old material may be important in future.
- Decline in breeding research
- State funding for plant breeding unco-ordinated in UK.

Policies with negative impacts

- GMOs. Rules defining prior informed consent, trading regulations etc can be used to prevent movement of genetic resources for breeding or food.

Opportunities for better use of GRFA

- More breeding work.
- Collections must be used, or they will become moribund. LINK is a good way of doing this, and Commonwealth Potato Collection is a good model.
- Management system including breeders and industry, to enable stakeholders to direct research and make sure it is meeting users' needs.

Other

- Breeders have a system in place which effectively categorises and maintains samples of all the cereal and legume varieties that are bred. The breeders liase closely with farmers and industry with respect to the development of new varieties to keep farmers competitive in market place.
- Plant breeders' rights do not stifle biodiversity, the evidence shows the opposite is true.

Other plant interests

Priorities

- Priority is to support further study, exploration of collections and further use. Not just maintenance.
- Government priority should be to maintain GR where they do not have direct market value, as levy boards are focussed on market value of genetic resources.
- It is easy to get money for near-market commercial breeding, so money should go into national collections and gene banks. This will enable breeders to incorporate the traits they want.
- Use of resources is important, in order to find out what characteristics they have.
- Characterisation
- Getting data widely catalogued and available.
- Industry will only fund things of interest, Government needs to fund basic research.

Risks

- Climate change. It is not necessary to collect specifically in response to this threat, but to analyse what we already hold.
- If work is driven by market, might lose GR of value in future
- Collections funded by BBSRC, including the Arabidopsis stock centre and national cereal and pea collections are insecure because funding collections is not within BBSRC's remit.
- Goals of commercial production do not favour diversity within species.
- Use of genetic resources is very narrow. We are not introducing new genes enough.
- Many characteristics are based on multiple genes, so current focus on genetic coding for a particular characteristic could leave us with weaker varieties.
- Not enough resources are used, so it is hard to identify what might be useful.
- GR is very poorly funded internationally, especially in countries with most biodiversity.
- GMOs are also a risk.

Gaps

- Precise genetic stocks are not generally held in public domain. These have sped up research and breeding significantly.
- Material generated by research may be lost to public domain. Making GR publicly available should be a condition of research funding.
- Representation of wild species. Must hold more than one individual of each species.
- Ignorance that conservation is actually going on. What are the qualities and genetic profile of conserved material?
- It is hard to get funding for horticulture work, because it is not agriculture.
- Major gap = lack of funding for characterisation and databasing.
- Money that is available is often for a single crop, which is not suitable for NGOs.

- Alternative food sources/crops are also important – for example, species suitable for use as industrial crops in the future.
- Industry has a very narrow view of what people want. Nutrition is an important area that no-one seems to be much interested in.

Policies with negative impacts

- National listing is focussed on a very narrow definition. Is there scope for flexibility to allow more diversity or to allow mixtures?
- Focus on wildlife biodiversity is a barrier - narrow understanding of biodiversity, excludes agriculture.
- Internationally, some major players are not interested in protecting the rights of farmers and indigenous people. Europe is good at working together on this, the European voice is important.

Opportunities for better use of GRFA

- There is more to be gained from more fully characterising what we have than from collecting more.
- Work on GR and nutrition

Farm Animals: Mainstream Breeds

Priorities for government policy

General

- Important that mainstream breeds are seen as a part of genetic resources. Need to get right balance, too much is driven by endangered species of little commercial value.
- Sustainable use, including improvement of GR, not conservation.
- Be clear what the purpose of any conservation is.
- Government should not divert resources from other important areas – should be largely left to industry. There is not much government can do to affect mainstream breeds, as they operate internationally.
- Government should give pump-priming funding and act as a facilitator.
- Work within framework of legislation to ensure industry is not disadvantaged
- It is important that the UK's multi-million pound GR export business is not overlooked.

Co-ordination

- Be more joined up - e.g. on genebanks, we have RBST genebank, NSP bank and heritage gene bank. Is there a co-ordinated plan here? What are the purposes of these genebanks?
- Government needs to co-ordinate, e.g. different genetic evaluation systems.

Development of GR

- Priority is to promote better use of what we have already. Inefficient breeds/individuals are bad for efficiency and for the environment.

Engaging with industry

- Defra must engage with breeding companies. It is not possible for pig and poultry farmers to meet Defra's objectives unless breeding companies are. A first step is to gather information on characteristics of interest to Defra, e.g. fertility, welfare, environmental impacts. Farmers could be paid for providing information gathering service.
- Defra needs to have dialogue with AI companies.

Research

- Breeders must be enabled to meet Defra's objectives. This means supporting research and development.
- No idea about effects of strains, breed differences on issues like ammonia. Need data with breeding, feeding and management elements in it.
- Most performance testing is production oriented. If government want to look at other areas, e.g. welfare, lameness, fertility and mastitis, need to get research going in this area.

Information and education

- There is a lack of knowledge, even among college lecturers. AI representative is main source of information for most dairy farmers.
- Education is important, so that customers know what to ask for from breeding companies
- Need to provide clear information to stakeholders on what Defra's objectives are – for example, many did not realise that Defra's wish to reduce emissions impacted upon them.

- Industry needs steer on how sustainable development fits into dairy farming.

Gaps
- Lack of phenotypic characterisation is a barrier to utilisation.
- Need to set proper objectives for gene banks – what are they for?
- Defra and dairy industry – although Defra has a branch dealing with milk, there is no-one specifically responsible for dairy cattle issues..
- A single national database to improve storage of all information would eventually improve access to information

Risks
- Becoming too homogenous – but we are a long way from this.
- Risks are overplayed. There is no evidence that populations are "running out" of genetic diversity.
- Losing genetic traits which may be useful to us in the future – but not a risk so long as hobby farmers are around.
- Stagnation – must continue to improve in order to have viable livestock industry, otherwise will have no GR to conserve.
- If work is driven by market, might lose GR of value in future. Goals of commercial production do not favour diversity within species

Policies with negative impact
- EU directives on animal transport that seek to promote animal welfare without consideration for the well-managed international trade in high value animals could destroy the export trade in high value genetics. Legislation should differentiate between export for slaughter and export of high value breeding animals.
- Over regulation of legitimate producers in an attempt to stamp out illegal trade which takes no notice of the regulations in the first place only serves to drive honest farmers out of the industry.
- Changes to CAP could be a risk. If farmers are paid on the basis of farmed area rather than headage, they may give up raising livestock altogether. Potential threat to some breeds in extreme conditions.
- Breeding companies could export much more, but are hampered by Defra export regulations. However, other countries can import anything to us.
- Unilateral imposition of animal welfare measures causes difficulties – need level playing field.

Opportunities for better use of GRFA
- Need to make better use of what we have. Using inefficient breeds/individuals for commercial production is bad for the environment, as well as performing poorly competitively. Should encourage use of performance recorded herds through the new broad and shallow support scheme. Government could calculate the environmental benefits of using highest quality sires.
- Education - farmers need to understand process of breeding and what is available to them. Then they will ask breeders for traits that are important.
- Performance recording - farmers could be paid to record information on e.g. on disease, emissions, welfare or other areas where government has

an interest. Results could be studied to separate genetic effect from environmental effect. If there is genetic component – work with breeders to reduce problem.

- Enabling breeding groups to manage their own resources. There is a role here for developing user friendly, visual software.

Farm animals: Breeds at risk

Priorities for government policy

- ensure the conservation of breeds of special genetic importance – those with local adaptation, those suitable for conservation grazing, and breeds that are distinctive or have great genetic distance.
- Maintain GR where they do not have direct market value.
- Maintain traditional farming systems so that traditional breeds and farming methods are preserved and actually used.
- recognition of rare breed animal genetic resources by national and EU Government as a vital national resource, to be given specific consideration in all future legislation.
- Provision of funding for projects
- UK should implement EU Rural Development Regulation scheme to make payments to keepers of traditional and rare breeds.
- Information on real local adaptation
- Maintaining original qualities of breeds e.g. hardiness, thriftiness, resistance to disease.

Gaps

- amount of breed pedigree data in paper format – unused and inaccessible
- lack of comparative rare breed characterisation data
- Lack of a national conservation germplasm archive
- Lack of a well-resourced and efficient information network.
- Prioritisation -list of breeds currently used by Defra as its standard reference is inadequate.
- Need more detailed information on the perceived qualities of locally adapted breeds- much of this evidence is anecdotal at present.
- Lack of emphasis on traditional British breed qualities by present day breeders e.g., hardiness of breeds, adaptation of breeds to natural habitats;
- Difficulty in achieving optimal grazing of some wildlife sites using only continental and modern breeds which are less able to digest rough forage and cope with rough terrain found on some wildlife sites;

Risks

- Government policy is the prime risk – see below
- Uniformity – reducing consumer choice, risk of inbreeding and increased vulnerability.
- Loss of good eating qualities of meat
- Loss of resistance to diseases

Government policy that negatively impacts

- Danger that legislation in UK will limit the supply of home-produced livestock
- National Scrapie Plan could mean extinction for some rare breeds
- The OTMS favours intensively farmed beef cattle and inhibits the use of rare breeds on grass-fed systems.
- Failure to adopt the Rural Development regulation section on support for specific rare breeds

- EU requirement that equines be recognised as food providers, resulting in need for equine passports
- Policies threatening small and medium-sized abattoirs - the industry has little confidence for the long-term future.
- MLC gradings mitigate against rare breeds
- Current movement restrictions
- Inability to export boars to the RBST affiliated AI station in N Ireland
- Differential legislation between UK/EU regarding semen collection/storage
- The general intensification of livestock farming has led to an increased concentration on feeding concentrates to livestock stock and there has been a lack of focus on the benefits of grass-reared animals, especially the eating qualities of slow-reared traditional/rare breeds.

Opportunities for better use of GRFA

- rare breed animal genetic resource evaluation/characterisation (all animals)
- concerted conservation breeding schemes and/or germplasm storage (all animals)
- conservation grazing schemes (sheep, equines, cattle)
- specialist food/product market (poultry and livestock breeds)
- extensive systems (poultry and livestock breeds)

Microbes

Priorities for government policy

- A co-ordinated policy on genetic resources is required to help us know what to conserve; to minimise duplication of effort; and to achieve a balance - between in situ and ex situ programmes, and repository and research functions.
- Investment in microbial issues – plant and animal resources are mostly secure, the micro-organisms on which they depend or are not.
- Improve collaboration between Government funded research programmes and research institutions housing genetic resources. Improve co-ordination of research. Expand plant genetic resource networks to cover the micro-organisms on which they depend – to ensure that associated micro-organisms are also being preserved.
- Government needs to decide who is responsible for maintaining core national collections of DNA and genetic material, including information and availability. BBSRC has no remit to support collections if they are not required for research.
- Need to have some permanent, secure funding for collections. There is a difficulty of having to design ad hoc projects to fit in with research programmes to obtain funding.

Gaps

- It is assumed that micro-organisms are preserved in situ in nature reserves. But micro-organisms are far more susceptible to effects of e.g. pollution than plants.
- Some groups are poorly covered by collections – certain fungi, symbiants and obligates.
- Some micro-organisms cannot be cultured

Risks

- Considerable investment in creating clone libraries and mutants from genomics and post-genomics programmes risks being lost through lack of consideration and funding of preservation of material.
- Loss of microbial taxonomists, particularly for fungi. Taxonomy and collections are intimately related.
- Environmental and climate change, new virulent and resistant diseases, pollution (causing changes in micro-organisms)
- Land use change. Intensive farming may alter micro-organism populations irreversibly, will we be able to revert back to other crops?
- Microbial and cell line collection holdings outside the UKNCC – 40 collections over 100 000 strains are insecure. Many collections are disappearing – worldwide, around 300 of an original 800 have disappeared.
- Inability to harness beneficial micro-organisms in agricultural practices – many opportunities exist that are not being exploited due to lack of investment and of a co-ordinated approach.

Policies with negative impact

- Short term funding. BBSRC cannot fund things on the basis of potential future need. Cannot expect academics to decide whether or not material is worth keeping. Need a body responsible for this, who will decide whether to keep GR or not.
- Access and benefit sharing. This is done on a voluntary basis, creating an uneven playing field
- Patenting of micro-organisms themselves

Opportunities for better use of GRFA

- Research funding should include some portion that goes towards making cultures publicly available. Currently, much material is lost to public use.
- The potential for transgenic technologies to benefit from microbial genes is enormous, but as yet we don't have the information to assess this.
- Characterisation and provision of that information in databases is essential if collections are to be used and exploited. Information must be available through intelligent, search software, accessible through Web sites
- Exploitation is severely limited by lack of characterisation and available data. Conversion of existing knowledge into on-line searchable format would significantly increase the value and usefulness of collections.

Other

- It is impossible to fund microbial collections from income generated by sales of cultures, public finance is essential for maintenance of collections.
- Natural History Museum could be responsible for looking after data and collections that are not of immediate use.

Other stakeholders

Summary of responses from JNCC, Intermediate Technology Development Group (ITDG) and DfID

Priorities for policy

- Consider impact of UK policy elsewhere – it will influence other countries' policies. A strongly conservation focussed policy, as opposed to encouraging sustainable use, could have negative impacts in other countries.
- Look at the impacts of national policies, particularly CAP, on the mix of breeds farmed in the UK.
- It must become part of the sustainable development agenda.
- Look at views in other sectors, and secondary/tertiary impacts e.g. on nature, rural economies.
- Joined up government – Defra policy should be in step with DfID and DTI.
- Need an ecosystem approach, studying interactions of GR with landscape management, and interactions of species in the agricultural environment.
- More emphasis should be placed on in situ, agri-environment, sustaining integrity of GR, maximising utilisation.
- Animal welfare regulations should not be compromised in the name of GR.

Risks

- Impacts on ecosystems.
- Threat from GMOs, both from alien introgression, and from patenting, reducing ability to use GR.

Gaps

- CBD and UK BAP. Implementation is almost exclusively through species specific subplans. Neglected areas are: GR; microbial resources; access and benefit sharing.
- Co-ordination of CBD outside BAP is unco-ordinated.
- Should be conserving GR of possible commercial interest – this should be a criteria for conservation, not just numerical scarceness.

Policies with negative impacts

- Need to integrate activities under FAO, CBD, WTO, WIPO, CG institutes and UPOV - all are very important in management of GRFA, and all have policies that conflict with one another.

Opportunities for better use of GRFA

- JNCC's work could be used more to the advantage of genetic resources. There is no link at present.

Annex 9: Summary of stakeholder views and priorities developed at the Harvesting Diversity conference

This summary table aims to draw together the comments of delegates at *Harvesting Diversity,* in both the working groups and the plenary sessions. The table contains key issues and actions which, in the opinion of delegates, are priorities for a policy on the conservation and sustainable use of genetic resources relevant to food and agriculture.

Explanation of terms used

Collection: A store of genetic resources capable of being regenerated (e.g. living organisms, seeds, semen, embryos).
We recognise that other collections, e.g. blood, non-viable semen, are also genetic resources. At this stage, our focus is upon collections of regenerable material as a priority; however, other resources are not excluded.

***Ex situ* conservation:** Conservation of components of biological diversity outside their natural habitats (e.g. seed banks, cryopreservation)

***In situ* conservation:** Maintenance of species in the surroundings where *they have developed their distinctive properties. This includes on farm, in genetic reserves and in home gardens.*

On-farm conservation: A type of *in situ* conservation. Species are conserved through their use by farmers and others.

Genetic erosion: Loss of genetic diversity

Genetic pollution: Genetic erosion due to introgression of alien genes. This may be from either genetically modified or conventionally bred species.

Acronyms used

ECPGR: European Co-operative Programme on Genetic Resources
GRFA: Genetic resources for food and agriculture
BAP: Biodiversity Action Plan

ISSUE	ACTIONS (Who responsible)	OBSERVATIONS (comments, sector specific issues, etc.)
Ex situ and in situ resources		
A) Inventory of existing GRFA *ex situ* and *in situ*	1. Identify all *ex situ* collections in private and public hands (**Collection managers**, **DEFRA** to co-ordinate) 2. Identify important *in situ* sites, animal populations, landraces and farmer varieties (**DEFRA** to co-ordinate **Relevant stakeholders)**	**1(a)** *Ex situ* collections to include all regenerable material in gene banks and field collections **(b)** Include lesser known groups, especially micro-organisms. **2(a)** Establish database **(b)** More accurate survey of livestock resources needed, including livestock outside breed societies. **(c)** Survey in garden and de-listed plant varieties, especially vegetables.
B) Complementary conservation	1. Ensure appropriate integration of in situ and ex situ strategies**. (DEFRA, BBSRC, English Nature, collection managers**)	**1(a)** Appropriate balance differs for each species. **(b)** Need to integrate the two, link up different institutions in each sector. **(c)** including ex situ duplication of in situ GRFA where appropriate
C) Threatened resources	1. Develop policy for threatened GR (**DEFRA** to co-ordinate **relevant stakeholders)**	**1(a)** For emergency situations such as disease outbreaks, or when a resource is at serious risk. ***(b)*** *To support restoration of landscapes, need to understand geographical variation of accessions.* **(c)** Co-ordinate activities of NGOs.
Ex situ collections		
D) Long term viability	1. Identify collections (**Collection managers**, **BBSRC**, **DEFRA**) 2.Establish status of collections (**Collection**	**1(a)** Clarify objectives of collections. **(b)** many microbial collections contain some material relevant to food and agriculture and some not. **2(a)** Publicly financed, privately financed, at risk

	managers, **DEFRA** to co-ordinate) 3. Ensure key collections can be adequately maintained (**Collection managers**, **BBSRC**, **DEFRA**) 4. Consider possible means to adequately maintain non-key collections (**Collection managers, BBSRC, DEFRA**)	**(b)** Openly available on request or restricted? **3(a)** Key collections are those of greatest national and international importance **(b)** Co-ordinate and prioritise internationally **(c)** Create forum to include all collection holders in prioritising collections and influencing policy. **(d)** Prioritisation should consider need for regeneration, threatened species, financial security, safety duplication, uniqueness. **(e)** refer to international standards for maintaining. **(f)** determine responsibility for maintaining. **(g)** conservation as an "insurance policy" should be priority – if collections have to raise own money, this need will not be met. **(h)** Improve ex situ techniques (e.g. pig embryos). **4(a)** Case-by case basis
E) Efficiency	1. Increase national and international co-operation (**Collection manager**) 2. Rationalisation (**Collection managers**)	**1(a)** Increase co-operation through, e.g.: UK PGR Group; ECP/GR; UKNCC; European Focal Point for Farm Animal Genetic Resources **(b)** Increase cross-sectoral co-operation **2(a)** Co-operation with other collections (national and international) **(b)** combining collections internationally could impact negatively on cost and availability.
F) Collecting	1. Identify and prioritise gaps in collections (**Relevant stakeholders**) 2. Fill gaps through either exchange, acquisition or collecting (**Collection managers, research institutes, DEFRA**)	**1(a)** Use output of D) above **(b)** UK and non-UK material **2(a)** Co-ordination nationally and/or internationally **3(a)** Need agreed policy for deciding whether particular GR created during research should be conserved, and how.

	3. Ensure conservation of genetic stocks arising from genetic, genomic and post genomic research.	
In situ and on farm collections		
G) Non-cultivated GRFA	1. Determine status of important wild growing GRFA (**DEFRA**) 2. Identify presence of important GRFA in protected areas (**Relevant stakeholders, protected area authorities, DEFRA**) 3. Protected area authorities to manage important GRFA, where known, within their jurisdiction (**DEFRA** with **relevant authorities**) 4. Monitor, assess and tackle threats	**1(a)** Use European list of wild species relevant to food and agriculture. **2(a)** Raise interest in GRFA in nature conservation community. **3(a)** This could be a specific programme, not necessarily part of the main protected area programme **(b)** consider extending SSSI criteria **(c)** Consider presence of any valuable GRFA when establishing any new protected areas **4(a)** Genetic pollution and erosion. ***(b)*** *model implications of climate change.* **(c)**Reduce threat of exotic diseases and invasive alien species
H) Landraces, farmer varieties, conservation varieties, traditional and minority breeds.	1. Monitor, record use, characterise. 2. Tackle threats for components of GFRA and develop programme to retain viable populations.	**2(a)** Genetic pollution and erosion **(b)** Promote role of traditional breeds and farming systems in landscape management, e.g. via agri-environment schemes **(c)** Apply RDR scheme to support rare breeds ***(d)*** *Where at risk, ensure continued availability e.g. in ex situ collection.* **(f)** Identify threats from market changes and CAP **(g)**Reform agricultural policy and fisheries policies to promote diversity.

		(h) For animal breeds need to identify “champions” where none exist. **(i)** Fully utilise breeds that have contributed significantly to breeding worldwide. **(j)** Capitalise on UK expertise in livestock breeding, managing natural and semi-natural systems and microbiology.
Use of GRFA		
I) Promote use of GRFA	*1. Identify uses for GRFA.* 2. Identifying economic opportunities for under-utilised genetic resources 3. Promote use of genetic resources that are better for sustainable development (**DEFRA**, **farming community**)	**1(a)** in particular, GRFA in need of conservation **2(a)** Increase genetic enhancement and base broadening efforts. Seek to use genetic stocks arising from genetic, genomic and post genomic research, esp. in pre-breeding activities. Encourage breed societies to get involved in this. **3(a)** e.g. requiring lower inputs.
J) Characterisation and evaluation	1. A programmed approach taking into account needs of breeders and other users(**Collection managers**, **research institutes** and **breeders**) 2. Meet needs of broadest possible stakeholder group, not only researchers/ companies who maintain the collection. 3. International co-operation to share efforts. 4. Determine who should carry out	**1(a)** Collections should be linked to evaluation and pre-breeding programmes **(b)** More information will increase value of collections to research and industry **(c)** Need common framework for deciding what priorities are, and common methodology for characterisation. **(d)** Passport data must be accessible to users **2(a)** characterisation and evaluation should meet needs of other users where appropriate, e.g. including taste and nutritional information. **(b)** Make information more available to other stakeholders, e.g. farmers, museums, besides those

	evaluation.	that collection is focussed upon. **4(a)** Researchers have limited funds. Involvement of users is best, as they know what is needed.
K) Information	1. Establish national information system (**Relevant stakeholders**, **DEFRA** to co-ordinate) 2. Develop collection databases (**Collection managers**, **DEFRA** to co-ordinate)	**1(a)** Umbrella system, establishing links to existing databases. New databases created only where necessary **(b)** Need to include paper based and historical information. **(c)** Consider relationship with UK Focal Point on Access to Genetic Resources and Benefit Sharing **(d)** Link to National Biodiversity Network database, and international databases. **(e)** accessible for stakeholders **2(a)** Accessions and associated information **(b)** Is information freely available? **(c)** National and international co-operation
General		
L) Relationship with other policies	1. Identify and exploit synergies with other DEFRA policies (**DEFRA**) 2. Identify conflicts between policy on GRFA and other DEFRA policies, and resolve where possible (**DEFRA**) 3. Work with other departments to integrate GRFA conservation/ sustainable use into policy on health, energy etc (**DEFRA**).	**1(a)** e.g. agri-environment schemes and BAP could include farm biodiversity, conservation grazing and in situ conservation, including micro-organisms. **2(a)** Monitor impact of breeding strategies, breeders' rights, national list and varietal release legislation. Aim to maximise diversity through these. **(b)** need early consultation with stakeholders. **(c)** ensure domestic legislation does not stifle UK competitiveness in research and trade in our GR.
M) Knowledge	*1. Increase knowledge of fungal, soil and microbial biodiversity*	**1(a)** Including relationships with higher organisms

	2. Improve understanding of links between farming and biodiversity, and farming and landscape.	
N) Raising awareness	1. Promote public awareness of the value of GRFA conservation and sustainable use (**All stakeholders, DEFRA)** 2. Raise awareness with politicians, scientific community, breeders, users, food industry. **(All stakeholders, DEFRA)**	**1(a)** Make use of existing facilities (Plantnet and others). **(b)**Promote links between city and rural farms. **(c)** Needs to be targeted (e.g. Millennium Seed Project, meat from identified breeds). **(d)** Include microbes.
O) Education and training	*1. Maintain and improve UK expertise for GRFA.* 2. Ensure results of relevant research reaches users, including farmers **(DEFRA, research institutes)**	**1(a)** Ensure succession of expertise, including technicians, systematics experts. **(b)** Review training courses for farm animal GR. **(c)** Co-operate with agricultural colleges to develop continuing professional development. **(d)** Support development of molecular ecology by rapid identification and characterisation of micro-organisms for food and agriculture.
P) Co-ordination	1. Greater interaction between sectors in step with government policy. (**All stakeholders**) 2. Promote networks for GRFA **(DEFRA, all stakeholders)** 3. National co-ordination, including Scotland and NI. (**DEFRA, devolved administrations**)	**1(a)** Communicate about current activities, in particular: information systems, monitoring, education and training, public awareness. **(b)** build on existing forums – UKPGR and National Consultative Committee. **2(a)** use ECPGR as platform for implementing e.g. global plan of action. **(b)** take part in ECPGR, Euforgen, Planta Europa. **3(a)** including inventory work

Areas of disagreement:

GMOs
Some saw GMOs as a key threat to the integrity of GRFA, and thought any policy should include measures to tackle these risks. Others saw GMOs as posing no greater threat than conventional crops. A number of stakeholders saw GM technology as an important means of exploiting GRFA.

Environmental Impact Assessment for importation and release of new varieties.
While some stakeholders saw this as a useful way of protecting GRFA and wider biodiversity, others saw it as an unnecessary restriction upon exporters and breeders of GRFA.