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UK Country Report on Farm Animal Genetic Resources 2012






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Foreword

The UK has one of the richest native Farm Animal Genetic Resources (FAnGR) populations in the world. This report identifies 235 UK native breeds of farm livestock. Over 75% of these are at risk of extinction, as a result of small breeding population size, geographical concentration, or both.

It is vital that our FAnGR – including breeds at risk, and those not at risk, and the genetic variation within them – are conserved and used sustainably. They are an important component of wider biodiversity which intrinsically deserves protection. Also, having diverse FAnGR will help us to respond to new challenges, such as feeding a dramatically growing global human population and potentially developing our FAnGR to adapt to climate change. Our FAnGR are of great economic importance, being the foundation for livestock products in the UK's £72 billion food and drink industry. Many of our FAnGR, especially grazing animals, have a key role in managing the farmed environment and landscapes. They are of great social, cultural, and heritage importance. Finally, we have formal commitments to manage these resources – at domestic, European, and wider international levels.

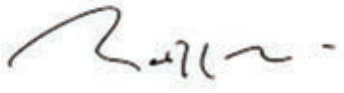
Over the last 15 years, the strong tradition of caring for FAnGR by individual breeders, breed societies, charities and other non-governmental organisations has been augmented by a growing involvement of government, recognising the increasing threats to FAnGR and the obligations to protect them. This involvement has included support for a series of technical advisory committees, including the current Farm Animal Genetic Resources Committee (see www.defra.gov.uk/fangr). These have assisted in the production of reports supporting conservation and sustainable use of FAnGR, of which this 2012 UK Country Report is the latest contribution.

The report outlines the context for conserving and sustainably using our FAnGR, describes and applies the robust definitions for FAnGR that have been developed, especially for identifying breeds at risk, and describes the current status of the UK's FAnGR. The report outlines progress that has been made in influencing animal health, environmental and biodiversity policies so that they recognise the role of FAnGR; and in research that supports conservation and sustainable use of FAnGR. It also highlights the challenges that remain in many of these areas and in promoting better characterisation of our FAnGR, in developing more automated mechanisms for monitoring their status and in establishing a comprehensive approach to the *ex-situ* cryoconservation of the UK's native breeds. Science and technology have a key role in protecting our FAnGR. Many of the tools available to assist in conservation and sustainable use of FAnGR are science-based. The report discusses how new scientific knowledge and new technologies will offer both opportunities and threats to the conservation and sustainable use of our FAnGR.

Reports like this need a lot of work, and we thank the FAnGR Secretariat in Defra for their work on it, the many breed societies, breeders and industry organisations, Defra and Devolved Administration staff, and FAnGR Committee members that have contributed and commented.

We commend this report to Defra and Devolved Administration ministers, and to all concerned with the important work of conserving and sustainably using our Farm Animal Genetic Resources.

Professor Ian Boyd
Chief Scientific Adviser
Defra



Professor Geoff Simm
Chair
Farm Animal Genetic Resources Committee

Chapter 1: Introduction

1.1. Background

The UK published its first Country Report on Farm Animal Genetic Resources (FAnGR) in 2002. This second report provides an updated appraisal of the status of and trends in our domestic FAnGR, including a comprehensive Inventory of all breeds present in the UK. It is an assessment of UK livestock biodiversity and of the work that is being done to manage these resources.

The importance of FAnGR has been recognised at both international and UK levels. In 2007, the UN Food and Agriculture Organisation's (FAO) Global Plan of Action provided a detailed assessment of animal genetic resources for food and agriculture and the importance of understanding, prioritising and protecting them. The UK has been a Party to the Convention on Biological Diversity since 1992 and the CBD's Strategic Plan for Biodiversity 2011-2020 sets a specific target to develop and maintain strategies for minimising genetic erosion and safeguarding the genetic diversity of farmed animals[1]. In the UK, the 2011 England Biodiversity Strategy[2] set out a commitment to protecting farm animal biodiversity and to collect a new Inventory of Breeds in 2012. The biodiversity strategies being prepared in Scotland, Wales and Northern Ireland should also recognise the importance of FAnGR.

This report contains information on the current state of the UK's FAnGR. It will help us to deliver on our international and domestic commitments to survey and monitor these resources, review how they are currently being used and conserved and how this is likely to change in the future. The collection of updated information has also helped in developing and revising official lists of UK breeds, including the UK Breeds at Risk (BAR) list for breeds that may be exempted from precautionary culling in the event of an exotic disease outbreak, and the UK Native Breeds at Risk (NBAR) list which is important for UK Rural Development Programmes and the provision of financial support for animal genetic resources.

1.2. The importance of farm animal genetic resources in the UK

The UK is home to some of the richest and most diverse Farm Animal Genetic Resources in the world, with approximately 700 breeds including cattle, sheep, goats, pigs, horses and ponies and poultry. Indeed, the UK contains more than 9% of the 7,634[3] total global livestock breeds.

UK FAnGR remains a key asset in economic, environmental, social and cultural terms. It is a resource which is too important to neglect. We have also made formal commitments to manage these resources – at domestic and international level.

The sustainable use, development and conservation of FAnGR can contribute to a range of important policy goals. The success of the UK livestock sector is heavily dependent on the performance and capabilities of the breeds and genetic strains that deliver the industry's raw materials. Diversity in animal genetic resources is crucial to continue adapting and developing livestock production to meet rising global demand for meat, milk and eggs. These resources may also prove vital to improving our capacity to adapt to climate change or the emergence of new animal diseases. Up to date evidence is needed to support further work to study the key characteristics of our FAnGR and evaluate their potential.

1 Target 13 states "*By 2020, the genetic diversity of… farmed and domesticated animals… including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity*."

2 *Biodiversity 2020: A strategy for England's wildlife and ecosystem services* (Defra, 2011, PB13583).

3 UN-FAO's Commission on Genetic Resources for Food and Agriculture identified 8,262 reported breeds, including 628 breeds classified as extinct in a report on *Status and Trends of Animal Genetic Resources 2012* – available at: http://www.fao.org/docrep/meeting/027/mg046e.pdf.

There is a strong tradition of caring for animal genetic resources in the UK – thanks largely to the activities of individual breeders, breed societies, charities and non-governmental organisations. However, the management of these resources is becoming an even greater challenge as the livestock sector continues to undergo changes as a result of intensification, different patterns of demand, economic pressures and the emergence of new disease threats – and there are particular risks for small or geographically-concentrated breed populations.

1.3. Scope of this report

This report covers the main farm animal species present in the UK: pigs, cattle, sheep, goats, horses and ponies and poultry species. It also covers other species such as bison, buffalo, ratites, camelids, deer, wild boar, guinea fowl, pheasants, quail, partridge and non-domestic duck. However, aquatic resources and bees are currently considered to be out of scope. The focus is on *in situ* breed populations (where animals are maintained in their normal production environments or in protected areas), but an initial exercise has also been carried out to identify *ex situ* collections (those which involve the storage of genetic material).

We hope that this report will be of value to all those in the UK with an interest in using, developing and protecting our FAnGR. This includes breeders, breed societies, associations and non-governmental organisations who are directly involved in the management and conservation of FAnGR, as well as policymakers, academics and national experts on FAnGR who have an interest in making sure that our national and international commitments are met and key issues and trends are being monitored and addressed appropriately. The report will also be of interest to international experts and organisations such as the FAO who are involved in European and global assessments of the state of agricultural biodiversity in the livestock sector.

1.4. How this report has been developed

This report draws on support and contributions from the Farm Animal Genetic Resources expert Committee, which provides advice to Defra and the Devolved Administrations in Scotland, Wales and Northern Ireland on all FAnGR issues. Membership of the Committee includes geneticists, industry leaders and key personnel from livestock breeding companies and conservation groups. Further information is available at: http://www.defra.gov.uk/fangr/.

In February 2013, the draft report was shared with stakeholders and published on the Defra website. Stakeholders provided valuable comments and these have further strengthened this final report.

As well as analysing the information provided by breed societies and associations for the 2012 Inventory of Breeds, this report brings together a range of information from other publications. It provides an update to the 2002 UK Country Report, which was produced as the UK's contribution to the FAO's '*First Report on the State of the World's Farm Animal Genetic Resources*' (2007). It also presents an analysis of progress under the '*UK National Action Plan on Farm Animal Genetic Resources*' (2006). Information from UK Government publications, including '*Agriculture in the United Kingdom*' (2011), has been used to provide additional background material on the role of animal genetic resources within the UK livestock sector. National and international biodiversity strategies have helped to present a wider picture of the conservation and utilisation of our FAnGR.

1.5. Sources of UK breed information and monitoring of FAnGR

In 2012, breed societies and organisations representing all the major species of FAnGR, as well as representatives of the UK's overseas territories, were contacted by the FAnGR Committee and asked to provide information that would be used to update the 2002 Inventory.

This information provides an up to date baseline to ensure that changes in animal genetic resources can be monitored and trends examined. It will be recorded on the EFABIS (European Farm Animal Biodiversity Information System) and DAD-IS (Domestic Animal Diversity Information System) databases, which are the European and UN-FAO international reporting systems for monitoring FAnGR. Information recorded on these databases will also form the basis of the next UN-FAO State of the World Report on Animal Genetic Resources, due in 2015.

Information on FAnGR breeds is collected by individual breed societies and organisations. Although large mainstream breed societies employ staff, many UK breed societies are small-scale organisations run by volunteers. Around 75% of breeds use intermediary industry bodies to store their information electronically, but this information is not stored routinely in a central database and it has been necessary to contact breed societies and organisations directly in order to compile the National Breed Inventory. Defra and the FAnGR Committee will establish an improved central database for the UK to support more regular monitoring of UK FAnGR in future, including trends and potential threats.

It is a significant step forward to have received responses on some 56% of cattle, sheep, goat, pig and horse and pony breeds from breed societies and other organisations. Where responses have not been received for the 2012 inventory exercise, breeds appear in the Inventory on the basis of other relevant studies and information as indicated in Appendix 2. Combined with the returns from breed societies and organisations, we have population data on 70% of the UK cattle, sheep, goat, pig, horse and pony breeds listed in the 2012 Inventory. Information on poultry breeds is available in *Poultry in the United Kingdom* (November 2010), although this report provides some limited updates.

In the Non-Governmental Organisation (NGO) sector, the Rare Breeds Survival Trust (RBST) monitors breeds and produces an annual Watchlist of rare breeds (https://www.rbst.org.uk/rare-breeds-watchlist). The British Pig Association carries out annual surveys for 14 pig breeds (see www.britishpigs.org). The Sheep Trust works to protect heritage sheep breeds in the UK, with a particular focus on protecting geographically-concentrated breeds (www.thesheeptrust.org).

Farm Animal Genetic Resources – who does what?

Government: It is the responsibility of UK Government and the Devolved Administrations to maintain an appropriate national policy framework to protect and conserve our FAnGR and ensure that we meet our international commitments.

FAnGR Committee: The FAnGR Committee is an expert committee reporting to Defra and provides advice to Defra, the Devolved Administrations in Scotland, Wales and Northern Ireland and other stakeholders on all issues relating to FAnGR, particularly their conservation and sustainable use.

Rare Breeds Survival Trust: RBST is the UK's only charity dedicated solely to conserving all Britain's native farm livestock. RBST maintains a "Watchlist" that is updated and published annually, classifying breeds into six different categories depending on the level of risk that they face. Since its foundation in 1973, none of the threatened breeds that RBST has listed has been lost, and many have increased in number sufficiently to leave the Watchlist.

Breed Societies and associated umbrella organisations: These organisations (e.g. British Pig Association, National Beef Association, Scottish Beef Association, National Sheep Association, Royal Association of British Dairy Farmers) have a key role in providing information on FAnGR and maintaining and preserving breeds. They have provided valuable information for the UK National Breed Inventory. Breed societies are responsible for maintaining herd, flock and studbooks, conserving the purity of their breeds and planning measures to improve or enhance the breed.

Breeding companies: Several international breeding companies hold populations of rare or traditional breeds and strains, as an insurance policy against changing market demand, and to help protect important FAnGR. UK Pig and Poultry Breeding Companies maintain their own nucleus populations of globally important breeds. They operate their own herdbooks under EU zootechnical legislation. Information on population sizes is not published in the UK National Breed Inventory as it is commercially confidential.

Voluntary Organisations: Voluntary conservation bodies such as Wildlife Trusts and the National Trust in England and Wales, National Trust for Scotland, etc. have a key role in promoting biodiversity and environmental conservation. For example, the National Trust uses rare native breeds on many of its historic properties and also encourages the use of native breeds by its tenant farmers. The Cobthorn Trust curates the National Poultry Collection and the Sheep Trust works with breeders and organisations in the UK and EU to protect geographically-concentrated sheep breeds, defined as Heritage breeds. Rare Breeds International provides conservation experience from UK FAnGR to overseas bodies.

Farmers, local organisations and interested parties: Livestock farmers are responsible for the management of much of the UK's landscape and biodiversity and are the keepers and protectors of most of our FAnGR.

Government Bodies and Agencies: Bodies including Natural England, Scottish Natural Heritage, the Countryside Council for Wales (CCW's functions will be delivered by Natural Resources Wales from 1 April 2013) and the Northern Ireland Environment Agency act as government advisors on the natural environment and as such have a key interest in protection and sustainable use of FAnGR.

Research Institutes: Several Research Institutes and Universities conduct research relevant to protecting, characterising and developing the UK's FAnGR.

1.6. Structure of the report

The rest of this report is set out as follows:

- **Chapter 2** provides an overview of UK agriculture and livestock production, including developments since the 2002 Country Report.
- **Chapter 3** describes the current state of UK FAnGR. It draws on information provided in the 2012 Inventory of Breeds (see Appendix 2).
- **Chapter 4** describes how our FAnGR are used.
- **Chapter 5** includes an analysis of latest progress with our genetic resources, including action by UK Government, NGOs, breed societies and charities.
- **Chapter 6** sets out the long term international and domestic policy framework for future conservation and sustainable use of our FAnGR.
- **Chapter 7** looks to the future, setting out key issues and trends which may influence the conservation and sustainable use of FAnGR, the implications of this and the approaches needed to exploit the unique characteristics of FAnGR and manage potential threats.

Chapter 2: UK agriculture and livestock production

2.1. High level overview of UK agriculture

Agriculture is crucial to the UK economy, food production and food security and it is central to our way of life. Agriculture forms an integral part of the rural infrastructure, is a significant employer particularly in rural areas and has a vital role in conserving biodiversity and the natural environment.

Agriculture accounts for 70% of total land use within the UK. In 2011, the total area of land on agricultural holdings in the UK was 17.2 million hectares. Around 72% of this is grassland used for grazing livestock and the remainder is used to grow crops. Over 7 million hectares of farmland in the UK are managed under agri-environment schemes, which incentivise farmers to adopt land management and farm practices that are beneficial to the environment (*Defra: Agriculture in the UK 2011*).

UK agriculture's contribution to the national economy was estimated at £7.1 billion in 2010. By value, it provides us with around 60% of our food. The food and drink industry was estimated to contribute £24.6 billion to the national economy in 2010 – and is the dominant form of land use. Agriculture provided direct employment to 476,000 people (including farmers and spouses) in 2011. (*Defra: Agriculture in the UK 2011*).

2.2. UK livestock numbers

Information on livestock numbers in the UK in 2011 and some longer term trends are summarised below:

- Compared with 2011, the UK dairy herd levelled at 1.8 million cows in 2012. This stability follows a trend of long term decline in the number of cattle and producer numbers. Dairy production takes place all over the UK, but in England and Scotland has become increasingly concentrated in the grass-growing regions of the west.
- The total number of cattle and calves in the UK has been fairly stable for the last few years, though over the longer term the number has fallen by an average of 1% a year since the mid 1970s. There were 1.7 million beef cows in the UK in 2012 – the first decline in numbers for three years.
- The outbreak of Foot and Mouth disease in 2001 led to a 15% reduction in the sheep flock between June 2000 and June 2002. From 2005 the Single Payment Scheme replaced most of the direct aid paid to farmers in the United Kingdom, thus removing the incentive to maintain sheep numbers to receive subsidy payments. Since 2005 the sheep flock has fallen by an average of 2.7% a year. Sheep numbers, however, increased in 2012 and the total now stands at just over 32 million animals. Compared with 2011, there were increases of 2.4 and 1.5% in the number of ewes and shearlings and number of lambs respectively.

- The outbreak of Classical Swine Fever in 2000, followed by the outbreak of Foot and Mouth in 2001 led to the start of a decline in the pig herd. Lower productivity as the result of pig wasting diseases, changes to animal welfare legislation and lack of profitability in the industry contributed to the decline. The UK pig herd has reduced by 45% between the peak in 1998 and 2012 although the decline has been less steep recently due to increased productivity and improved profitability. The total number of pigs in 2012 was 4.5 million, which includes 4.0 million fattening pigs and 0.5 million breeding pigs. The average pig herd size on a modern commercial farm is in the region of 500 breeding sows. Pig production in the UK is unique with a large portion of the national herd living outdoors. In addition higher welfare standards were introduced in the UK some 13 years ahead of other EU countries. This has created a demand for a specific type of breeding pig adapted to these conditions. UK pig breeding companies have developed breeding programmes and management systems to suit these high welfare and outdoor production enterprises.
- Since the 1980s numbers of chicken and table fowls steadily rose as consumer demand for chicken increased, peaking in 2005 at 120 million birds. Since then numbers have fallen and in 2012 there were 103 million birds in the UK. The number of birds in the laying flock (i.e. those producing eggs for human consumption) has been relatively stable in recent years, despite falling slightly in 2008/9. Total poultry numbers in 2012 were 160 million, representing a decrease compared with 2011 which could be due to increased input costs, especially feed prices.

Compared with other EU Member States the United Kingdom is:

- the largest producer of sheep meat;
- the third largest producer of cows' milk;
- the fourth largest producer of beef and veal.

Other major FAnGR include the following:

- Goats are traditionally kept in the UK on a small scale and to produce milk for local consumption. Goats' milk has begun to appear routinely on supermarket shelves as a response to specialist demand. The UK dairy goat population remains quite small but the wide selection of genetic material, in the form of several dairy breeds, has enabled concerted and prolonged selection for higher yield and butterfat content. Changes in the tastes and preferences of the UK population have also seen an increased demand for goat meat.
- Equines are used for a wide range of sporting and recreational purposes and also play a role in land and forestry management, tourism and cultural aspects of the UK.

Minor FAnGR species are discussed at Appendix 3.

2.3. Future trends and challenges

As global populations rise and diets and consumption patterns change, there is a substantial challenge to the world food system. There is a global need to produce more food in the future. However, there is also increasing awareness of environmental pressures and limits, and the need to protect and enhance our valuable natural resources and natural capital, particularly where they have been degraded. A summary of some of the new demands and challenges facing UK agriculture is set out below.

Securing global food supply

In 2011 the UK Government's Chief Scientific Adviser published the Foresight report on the Future of Food and Farming. This identifies the scale of the challenge if the world is to feed its population sustainably in future. The pressures and projections in the report include:

- a world population increasing to 9bn by 2050;
- changing demands in diet, with increased demand for meat and dairy products in developing countries;
- increased competition for land, water and energy; and
- responding to the impacts of climate change. The UK is already vulnerable to extreme weather such as flooding and drought. Climate change is expected to increase the likelihood of these events and more generally lead to hotter, drier summers and wetter, warmer winters.

The report emphasises the need to work towards a "sustainable intensification" of the global food supply chain. It stresses that, without change, the global food system will continue to:

- degrade the environment;
- compromise the world's capacity to produce food in the future; and
- contribute to climate change and the destruction of biodiversity.

In response to the report Defra has signed up to an action plan that includes:

- championing an integrated approach by governments and international institutions to food security that makes links with climate change, poverty, biodiversity, and use of energy, water and land;
- taking forward work on international biodiversity;
- promoting the importance of sustainable intensification (increasing productivity while reducing the negative effects of farming, meeting environmental commitments and striving for environmental improvements);
- pressing for trade liberalisation and meaningful Common Agricultural Policy (CAP)/Common Fisheries Policy reform; and
- working with industry to increase the productivity and competitiveness of UK food and farming while reducing Greenhouse Gas (GHG) emissions and ensuring that agriculture and the food sector can contribute fully to the green economy.

Domestic Climate Change targets

The UK's Climate Change Act of 2008 set the world's first legally binding target of an 80% cross-economy reduction in greenhouse gases by 2050 (against 1990 levels). By 2020, all sectors should have delivered a one third reduction, with agriculture making a reduction of three million tonnes of carbon dioxide equivalent (CO_2e) as its contribution.

The Government is working closely with industry as it seeks to deliver its voluntary approach to this initial 2020 target by stimulating behaviour change at farm-level, but it is now widely recognised that further changes will be needed in subsequent years. The biological challenges inherent in producing food mean that unless technological solutions are found, farming and food businesses in the UK may be producing up to a third of the economy's GHGs by mid-century, up from 9% currently.

Common Agricultural Policy[4]

CAP negotiations are unlikely to conclude until late 2013. In October 2011 the European Commission published regulatory proposals for the post-2013 CAP (2014-2020) and they are currently being negotiated for the first time, under co-decision arrangements between the Agriculture Council and the European Parliament. The Commission has accepted that they will likely come into force from January 2015 and would replace the current main CAP Regulations. The Commission will come forward with transitional arrangements for 2014.

The UK wants an efficient and responsive agricultural sector in the EU and we want the future CAP to achieve this. In this context, the UK is in favour of a greener CAP and one which is realistic, practical and straightforward to administer. Past reforms have made good progress in moving away from subsidies linked to production and the UK wants this to continue.

The proposed new Rural Development Regulation has six priorities. These include fostering knowledge transfer and innovation in agriculture and enhancing competitiveness of all types of agriculture. The Regulation emphasises that the conservation of genetic resources in agriculture should be given specific attention in the context of climate change mitigation and protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic diversity.

Improving Production and Environment

Defra established the Green Food Project following a commitment made in the Natural Environment White Paper in 2011. The project has looked at the challenge of increasing food production whilst also enhancing the environment in England, considering how we might reconcile any tensions that this raises.

This partnership project brought together Government, industry, environmental and consumer organisations to examine some of the challenging food security related policy issues that have been difficult to resolve to date, identifying the mutual opportunities and the difficult tradeoffs that need to be considered now and in the future. The project examined a range of key issues that will be integral to producing food and managing natural resources going forward such as how to manage competing pressures on land use and on natural resources, how to embrace new technology, the implications of changing consumer behaviour and the potential to innovate.

4 This information is correct at the time of producing this report.

Project conclusions were published in June 2012. These address a range of topics, primarily: research and technology, knowledge exchange, future workforce, investment, building effective structures, valuing ecosystem services, land management, consumption and waste.

Ecosystem services

Ecosystem services can be defined as services provided by the natural environment that benefit people. These benefits include resources for basic survival like those enabling sustainable food production. While there is no single system for categorising all ecosystem services, the Millennium Ecosystem Assessment (MEA) framework[5] is widely accepted as a useful starting point. The MEA identifies four broad categories of ecosystem services including the category of 'provisioning services' where we obtain products from ecosystems such as food, freshwater, fibre and genetic resources. FAnGR is therefore a key provisioning service within the context of ecosystems services and work is underway to ensure that FAnGR is fully recognised and integrated into all relevant ecosystems services policies and actions.

Conclusion

The challenge of feeding a growing population and improving the environment at the same time is a significant one. Farm animal genetic resources have an important role to play in this. The wide range of production, adaptation and other characteristics in our FAnGR and the potential to produce new attributes through selection, for example, will help us to tackle these challenges. Protecting, characterising, sustainably using and further developing our FAnGR and the systems in which they are used will therefore be vital.

5 More information is available at: http://www.unep.org/maweb/en/index.aspx

Chapter 3: Farm animal genetic resources in the UK

3.1. What types of FAnGR are we interested in and why?

It is important that we are able to define what is meant by a breed so that we can be clear on how FAnGR in the UK can be recorded and monitored, protected and sustainably used.

Simply defined, a breed can be taken to mean a specific group of animals that, through selection and breeding, have similar characteristics (including for example appearance and behaviour) that are passed on to their offspring and which distinguish them from other animals of the same species.

The FAnGR Committee has developed some more technical definitions which are set out at Appendix 1. These take account of a number of important considerations in gathering information for the UK Inventory. We are interested in:

- **All breeds that meet this wide definition within the UK.** We are interested not only in breeds that are farmed in the strictest sense but also some breeds which are not subject to any routine handling by a farmer. Whilst the Inventory focuses on farmed animals, it also includes information on "feral" breeds where these fulfil, or potentially fulfil, a role in the rural economy. A full definition agreed by the FAnGR Committee is provided in Appendix 1.
- **Breeds that are considered "native".** The Committee's definition of a native breed is provided below. The UK is home to 235 native breeds according to this definition and it is important to protect the rich diversity of our native breeds, the majority of which are considered to be "at risk". Many of these native breeds are associated with the traditional land management required to conserve important habitats.
- **Breeds that are resident in the UK but are not considered "native".** The UK has a role in protecting a significant proportion of breeds worldwide: approximately 700 breeds of FAnGR across the major species of cattle, sheep, goats, pigs, horses and ponies and poultry are resident in the UK, representing over 9% of the 7,634 existing global breeds (UN-FAO, 2012). The Inventory includes information on all known breeds resident in the UK.
- **The criteria needed to define whether a particular breed is at risk of being lost in the UK.** The UK Government has produced lists of breeds considered to be at risk in the UK, which are based on whether a breed is scarce in terms of actual numbers, measured using the number of pedigree breeding females. These lists and their criteria are explained in greater detail at Appendix 1. Some breeds may also be considered to be at risk because they are concentrated in a particular geographic location, which might mean that they are particularly susceptible to a disease outbreak. The Inventory outlines where a breed is known to be at risk due to geographic concentration but further work will be required to provide a more comprehensive profile of breeds that are geographically-concentrated. Loss of genetic diversity is also a concern which will require further consideration in future.
- **Non-native breeds that are present in the UK and are considered to be at risk globally.** The Inventory includes all breeds known to be living in the UK and Appendix 2 also indicates where non-native breeds are considered to be at risk globally according to UN FAO definitions for numerically scarce breeds. A breed is only shown to be at risk if its total global population does not exceed the appropriate UN FAO threshold. This means that a breed may be present in small numbers in the UK but is not identified as being at risk if the total worldwide population exceeds the UN FAO threshold.

- **All breeds of FAnGR even those not considered to be at risk of being lost.** The Inventory includes all known breeds present in the UK, including mainstream commercial breeds because we are interested in protecting the diversity and sustainable use of all our breeds. While the need to protect FAnGR that are particularly scarce in terms of the number of animals is a key priority, high population breeds may also be considered "at risk" on the basis of other criteria. For example, where a breed has a large number of pedigree breeding females but these have been bred from a much smaller number of males (technically, the "effective population size" is low), then genetic diversity will tend to be lost quite rapidly and the breed might lose resilience to changing conditions or to disease. Ongoing monitoring of our breeds should help us to establish the "effective population size" of our breeds.
- **The point at which a new group of animals can be considered to have become accepted as a breed.** There are some "breeds" included in the Inventory that have not been in existence for long enough to meet the FAnGR Committee's definition of a "breed" outlined in full below. The Committee is working with industry to agree a process for designating "breeds in development" where breeders are working towards creation of a breed that would meet the FAnGR Committee's breed definitions. The Inventory at Appendix 2 identifies possible candidates for "breed in development" status but further work will be needed to confirm this.

3.2. Overview of farm animal genetic resources in the UK

The major species of FAnGR are discussed in this chapter. An overview of minor species is included at Appendix 3.

A complete list of all known breeds of cattle, sheep, goats, pigs and horses in the UK is given in Appendix 2, which is taken from the UK National Breed Inventory. The Inventory has been compiled using information received from breed societies and organisations following a request from the FAnGR Committee in 2012. It includes the number of pedigree registered breeding females for each breed, where this is known, because this is key in assessing breeding populations. The Inventory also indicates the particular status of each breed, including whether the breed is considered to be native or at risk according to specific criteria. The definitions of these terms are explained in greater detail at Appendix 1. In many cases direct comparisons between 2002 and 2012 data cannot be made, particularly where additional information has been made available. Comparisons between 2002 and 2012 data are therefore only discussed in this report where it is appropriate to do so.

The UK is responsible for assessing the state of the FAnGR in its Overseas Territories and Crown Dependencies. A questionnaire was sent out to the appropriate authorities in these territories. Information will be made available on the FAnGR website in due course.

Key findings since the 2002 Report are:

- No native breeds have been lost in the UK.
- Recent changes to the UK Breeds At Risk (UK BAR) list[6] provide an indication of breeds that have seen population increases or decreases in recent years. For cattle, sheep, goats and pigs:
  - Five breeds are no longer considered to be "at risk" according to UK BAR criteria because their populations now exceed the numeric thresholds for inclusion. The status of a further five breeds will be reviewed as a result of population data provided in the Inventory.
  - 16 breeds have seen population declines and are now considered to be "at risk" according to the UK BAR criteria.

  For equines:

  - Equines were included on the UK BAR list for the first time in 2012. 15 breeds currently appear.
- Limited data are available for poultry breeds but from the data available it is clear that some breeds of poultry are in critically low numbers (e.g. UK native breeds of geese).

3.3. What and where are our key farm animal genetic resources?

Our UK Farm animal genetic resources are divided below into the following main groups: mainstream breeds; native breeds (including two subdivisions for native breeds at risk); exotic breeds globally at risk; and breeds in development. The following sections explain these categories and the UK's interest in the breeds that fall within them.

3.3.1. Mainstream breeds

Mainstream breeds have an important economic role: they are present in high numbers in the UK and are the basis of our multi-billion pound livestock and livestock products industries. Moreover, ongoing selective breeding of our farm livestock is a highly cost effective way of improving productivity, and meeting other societal needs, including those of improving animal health and welfare and reducing environmental impact of livestock production. As explained at section 3.1, some high population breeds may still be considered "at risk" on the basis of other criteria, such as low "effective population size" or "geographical concentration" and it is therefore important that we continue to monitor them. A further risk in relation to mainstream breeds is the potential loss of functional fitness, as a result of too much emphasis on production-related traits in selection. This may directly or indirectly lead to welfare problems such as leg weakness in broilers, or to impairment of other characteristics, such as fertility in dairy cattle.

Crossbreeding is widely practised in the pig, poultry, beef, sheep and horse sectors. However, the lower reproductive rate of ruminants means that, even with crossbreeding, there may be relatively large populations of purebred animals. The UK is home to some of the world's leading pig and poultry genetics companies which maintain nucleus populations of mainstream breeds that are of global importance.

6 Criteria for this list are included at Appendix 1.

These relatively small and geographically-concentrated populations sit at the top of hybrid breeding pyramids and are responsible for the majority of UK commercial pork and poultry production. They are also exported to form the basis of pork and poultry production in many other countries.

Non-native breeds make an important economic contribution to UK agriculture. Around 90% of cattle used in the dairy industry are Holstein Friesian, a mainstream breed strongly linked with overseas populations. Five mainstream beef breeds (Limousin, Charolais, Aberdeen Angus, Belgian Blue/British Blue and Simmental) account for over 75% of sires used in the UK and about 55% of the genes of slaughtered cattle[7]. Of these, only Aberdeen Angus is a UK native breed.

Three mainstream breeds (Texel, Suffolk and Charollais) play a major role in the sheep industry as terminal sires, which are used for breeding the slaughter / meat production generation. The sheep breed with the largest number of pedigree registered breeding females reported in the Inventory is the Swaledale, a native breed of hill sheep. Scottish Blackface and Welsh Mountain sheep are considerably more numerous than the Swaledale, but individuals of these two breeds are not pedigree registered. Other native breeds, such as the Lleyn (see case study below), have become increasingly popular due to their efficiency and “easy care” attributes.

Figure 1: Holstein Friesian dairy cattle

Crown Copyright

7 Todd, D.L, Woolliams, J.A., Rougsedge, T. (2011) Gene flow in a national cross-breeding beef population. *Animal* **5**, 1874-1886.

Mainstream breeds and the role of selective breeding

Individual businesses that improve mainstream breeds through selective breeding can have very substantial impacts on livestock agriculture across the globe. The UK is home to a number of breeding companies and breeding operations with significant global market shares in broiler chickens and turkeys, pigs, dairy cattle and ducks. In intensive livestock, with more routine access to data, even relatively small differences in the performance of breeding stock from different sources can be detected and shown to be relevant to business competitiveness. This can result in very strong competition between breeding companies and consolidation of these businesses – to the extent that a very small number of companies are, in some species, collectively responsible for the genetics of the majority of the world's production animals.

An illustration of the potential impact of FAnGR selection by these businesses is provided in a Case Study of a UK Technology Strategy Board co-funded project with the breeding company Aviagen. This project is about how molecular genetic tools may help speed up the rate of selective improvement of feed efficiency in broiler chickens. If this project is successful (to the lower end of expectations) it could allow 20% faster improvement in this trait. Multiply this small improvement forward to the year 2025 and then also multiply by the global use of Aviagen breeding stock and the overall impact would be a global saving of approximately 2.85m tonnes of poultry feed and a reduction of about 16m tonnes (CO_2 equivalents) of greenhouse gases for the same meat output in the year 2025 alone. The nature of selective breeding means that the impact would be even greater the year after, and so on.

Further information on this project can be found here.

Cherry Valley Duck.
Supplied by Cherry Valley Farms Ltd.

Another illustration of the global impact of FAnGR selection by UK breeding companies is provided by Cherry Valley Farms Ltd. The company was established in Lincolnshire in 1959 by Sir Joseph Nickerson and produced the UK's first oven ready duck. A pedigreed primary breeding programme of Pekin meat type ducks started soon afterwards. Due to the rapid growth and development in recent years of the Chinese and South East Asian duck industry, a parallel multi-strain pedigree breeding programme was set up in China in 2003.

Cherry Valley Farms is the foremost integrated duck company in the UK, and the primary breeding operations have become the dominant supplier of breeding stock in all markets in which there has been an involvement, (China, South East Asia, Europe and Australasia). An illustration of the company's success is provided by the Chinese market. Utilising around 2,700 million ducks per annum China is the world's most important duck market and the biggest producer and consumer of duck. The Cherry Valley bird now represents a very significant proportion of the breeding stock used in China. This illustrates the value of selective breeding to specific industries and hence the impact of a UK breeding company undertaking selective breeding on world livestock production.

3.3.2. Native breeds

Reflecting their local adaptations, many breeds have strong regional roots and some have played an important role in the economic, social and cultural development of the nation. There are a total of 235 UK native breeds of cattle, sheep, goats, pigs, horses and ponies, fowls, ducks, geese and turkeys that meet the FAnGR Committee's definition of a "native breed".

Of our 235 native breeds, 199 are also considered to be at risk and eligible for support under agri-environment schemes through EU rural development programme legislation (on the UK NBAR list) and 179 are considered to be at particular risk in the event of an outbreak of exotic disease and may be considered for sparing from culling (on the UK BAR list). This is kept under close review by the FAnGR Committee, particularly where breeds are considered endangered in the context of objective criteria appropriate for UK circumstances.

The Inventory provides the following key findings on native breeds:

- There are 35[8] native breeds of cattle: at present, 29 are on the UK NBAR list and 21 are included on the UK BAR list.
- Although all 11 native pig breeds meet the UK BAR criteria, eight of these breeds have an increased number of pedigree registered breeding females since the 2002 Inventory. Two native pig breeds have seen significant reductions of the breeding female populations to around one tenth of the 2002 figures. The decline of the Large White population is of particular concern because of the significant role in the world's pig industries of this breed and its mainstream derivations.
- 63 sheep breeds in the Inventory are native breeds: at present, 46 are on the UK NBAR list and 36[9] are on the UK BAR list.
- All five native breeds of goat appear on the latest UK BAR list.
- 15 of the 21 native equine breeds are included on the UK BAR list, which included equines for the first time in 2012.
- Information on poultry species remains largely unchanged from that available in *Poultry in the United Kingdom* (2010), from which we were already aware that some breeds of poultry are in critically low numbers. Population numbers of goose breeds are of particular concern. The number of known keepers of UK native goose breeds meeting UK BAR criteria is very low and most keepers normally keep only a few geese of each breed, with just two or three geese not being unusual.

Case studies on some of our native breeds are provided below.

8 This includes some "original" populations – for example Hereford and Hereford Traditional are listed separately. A full definition of "original" population is provided by RBST at: https://www.rbst.org.uk/watchlist-criteria.pdf

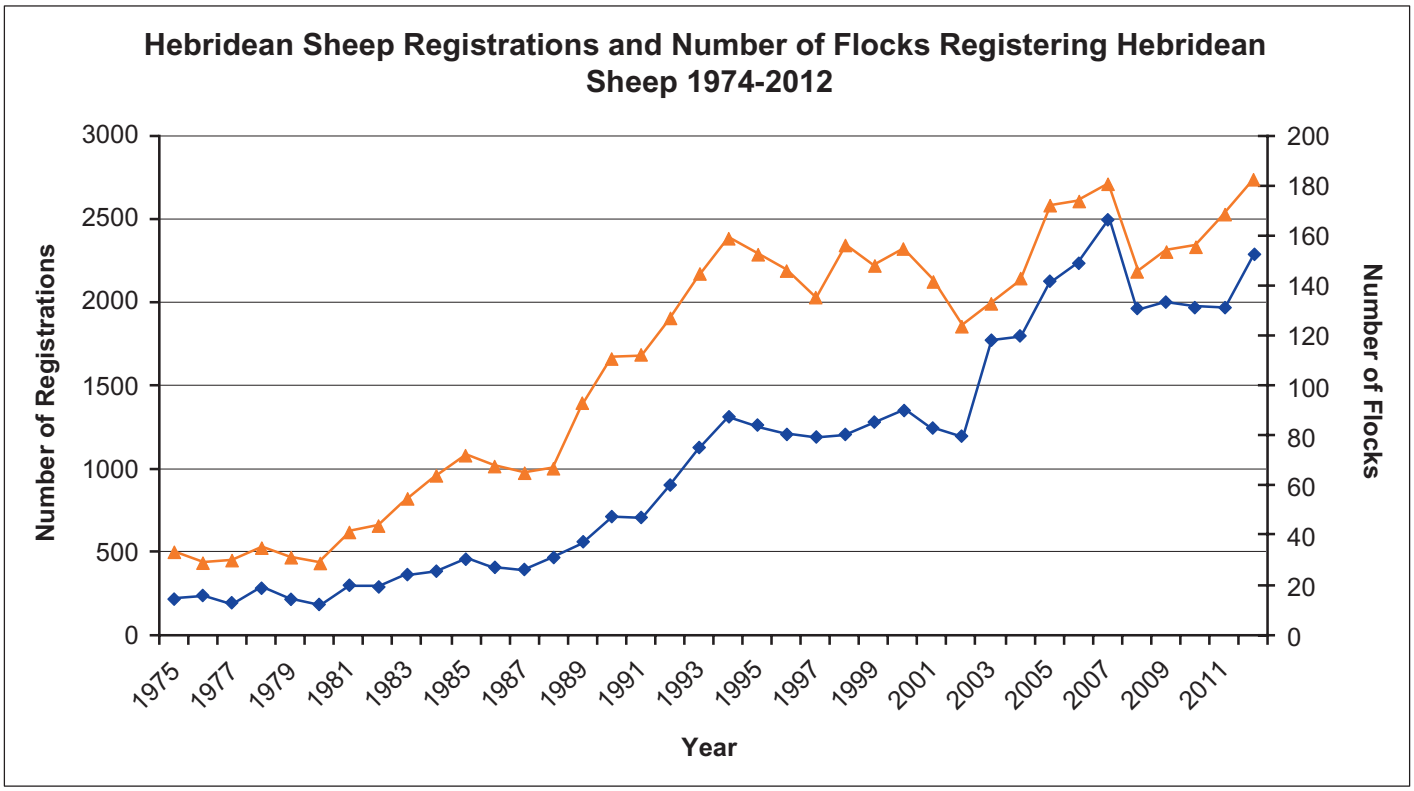
9 A further eight sheep breeds appear on UK BAR because of their geographically-concentrated status.

Success Case Study: Hebridean Sheep

Hebridean sheep are a small, primitive breed that survived for most of the 19th and 20th centuries in very low numbers as an attractive adornment to country house parklands in Scotland and England. It was identified as a rare breed in the initial surveys of the Rare Breed Survival Trust (www.rbst.org.uk) in the early 1970s; from 1974 the breed was registered in the Combined Flock Book (which included several breeds of sheep and goats), but from 1994 this role was taken on by the Hebridean Sheep Society (HSS).

For many years the number of Hebridean sheep registered averaged approximately 250 per year, but in the late 1980s this began to rise sharply, and by 1994 over 1500 registrations were recorded (Figure 1). In part this reflected an increasing number of enthusiastic breeders who appreciated the appearance, thrifty nature and ease of lambing that characterises the Hebridean breed; this led to the formation of the HSS (www. hebrideansheep.org.uk), which actively promoted the breed. However, the increasing population also resulted from the development of conservation grazing, a role to which the Hebridean was well-suited.

Figure 3: Annual registrations of Hebridean sheep (blue line, left axis) and number of breeders registering sheep (red line, right axis) 1974-2011 (*Richard Small, unpublished*)



This combination of an increasing number of breeders and the new role in managing habitats for conservation ensured that there was a ready market for breeding stock, so encouraging existing breeders. Although generally not attracting the sums other pedigree sheep may achieve, the breeders can at least cover most of their costs.

Figure 4: Hebridean sheep

Photograph supplied by Richard Barker

Currently annual registrations average approximately 2000 sheep, of which 93% are ewes. Clearly many ram lambs (and sheep that are not registered) are not used for breeding, and a market for the meat from surplus animals and the wool from living animals was needed. Payment for the fleece rarely covers shearing costs as Hebridean wool is either dark brown or black and hence cannot be dyed.

The need to develop markets for Hebridean meat and wool is a challenge for breeders, the HSS and conservation managers (the largest Hebridean flocks are run by conservation organisations such as the Nottinghamshire and Yorkshire Wildlife Trusts). Marketing initiatives include Heathland Hebrideans (www.heathland-hebrideans.co.uk), which markets meat and fleece products from three flocks used for the management of several Sussex conservation sites, and young breeder and butcher Gareth Barlow's enterprise (www.howardianhebrideans.co.uk).

Lleyn sheep: success for a conserved genetic resource

The Lleyn breed originates from the Lleyn peninsula in North Wales and while popular locally, was relatively unfamiliar elsewhere in the UK. The breed has had a long history with considerable variation in its fortunes over the years. In the mid 1960s Lleyn sheep numbered only 500 ewes in 10 flocks. By 1985 there were 4,000 sheep in 231 flocks and in 2012, 90,000 sheep in 950 flocks. The breed can now be found almost all over Britain and Ireland, in both lowland and upland grazing systems.

The success of the breed is largely attributable to its particular combination of traits: in particular, it combines intermediate body size with prolificacy (200% lambing rates are common), so achieves a high weight of lamb reared per kg of ewe body weight – a common measure of biological efficiency.

The mix of attributes of the breed means it has proved popular with producers running closed self contained flocks, which improves flock biosecurity and traceability. In these systems, a proportion of the flock is pure bred to produce replacement females, while the remaining ewes can be crossed with a terminal sire (specialist meat) breed to produce high quality prime lambs.

Photograph supplied by Tony Houlden

Ixworth fowls

The Ixworth breed of fowls was developed some 80 years ago by Reginald Appleyard in the village of Ixworth in Suffolk. It was specifically designed to be a white feathered, white skinned, top quality meat breed which was quick maturing and the hens of which would also be capable of worthwhile egg production. The breed soon proved to fulfil all these requirements with a reputation for trouble free management and the excellence of its carcase conformation. However, much commercial poultry production has moved away from pure breeds to hybrids developed and marketed by multinational breeding companies. Since 1945 this change in the industry rapidly eclipsed such breeds as the Ixworth.

During the second half of the 20th century several poultry breeds with useful utility properties became extinct. It was thought that the Ixworth was one such breed and was regarded as having died out by the 1960s. With the formation of the Rare Breeds Society in 1969 awareness of the rarer pedigree breeds was raised and remnant populations of some of them rediscovered. Since that time the breed has been brought back from the brink and is now in demand for the present day requirements for breeds suitable for free range systems.

Photograph supplied by the National Poultry Collection

The Ixworth breed has retained much of its utilitarian merit, with some strains in particular producing good numbers of eggs. As a pure breed capable of such production on traditional extensive systems the Ixworth has few equals. Its continued existence as a pure native breed with actual commercial merit is a clear example of the wise maintenance of the genetic resources of the United Kingdom.

Suffolk Horse

The Suffolk Horse is one of the UK native breeds of horse which is most at risk; the current population of breeding females is estimated in 2012 to be 160. This figure is made up of female horses from the age of 3 to the age of 15. However, some of these will not be in breeding condition, and others will not be bred from for a range of other reasons.

The Suffolk Horse is thought to be the oldest British breed of heavy horse, with lines going back to at least 1768. The breed was concentrated in Suffolk, only moving out across the country in the early twentieth century. However, the need to increase food production during the Second World War and the consequent surge in mechanisation led to a rapid decline in breed numbers.

In the 1960s there were so few foals being born that the risk of extinction was recognised, breeding efforts were increased and numbers are slowly increasing, but the breed is still very much at risk. However, in recent years an average of around 40 foals has been registered annually.

Photograph suppllied by Nigel and Chris Oakley, Rede Hall Farm

One of the breeders contributing to the increase in numbers is Nigel Oakely at his farm, Rede Hall Farm, near Bury St Edmunds. Nigel and his wife Chris run the farm (http://www.redehallfarmpark.co.uk/) and are active in increasing the numbers of Suffolk horses. They have around 15 Suffolk horses on the farm at any one time and use the adult horses to work on the farm to pull machinery and help in their business of growing and harvesting thatching straw.

They also use the horses for tourism and supplying horses for both television and the film industry, as well as teaching people to drive the horses to the British Horse Driving Standard.

3.3.3. Exotic breeds globally at risk

There are 276 non-native breeds that are at risk globally and are resident in the UK. A list of these breeds is available at: http://www.defra.gov.uk/fangr/breeds-at-risk-register/. It is particularly important to preserve the UK's exotic breeds where:

- the UK population makes up a substantial part of the global population; or
- where the breed concerned makes an important economic contribution to UK agriculture, and has been selected to be significantly different from the population in the country of origin.

3.3.4. Breeds in development

The FAnGR expert Committee has provided a definition for UK breeds in development (see 3.1 above) for groups of animals that do not yet meet the Committee's definitions for a "breed" or "native breed". Some potential candidates for "breed in development" status are identified in the Inventory at Appendix 2. Further work is required to confirm candidates classified for this "breed in development" status.

3.3.5. Geographic concentration of breeds

It is important that we know where our breeds are located, particularly where breeds are concentrated in one location because this might make them especially susceptible to threats, such as a disease outbreak.

As part of the work in developing a revised list of breeds that meet the UK BAR criteria and are potentially exempt from culling in the event of an exotic disease outbreak, the FAnGR Committee also undertook some work to identify breeds that can be considered to be at risk because they live in a concentrated area. This was based on independent research by the Sheep Trust[10] and RBST. The Committee's definition of geographic concentration is provided at Appendix 1.

The breeds that the Committee has identified as meeting its definition of geographic concentration are indicated in the latest UK BAR list which is available at http://archive.defra.gov.uk/foodfarm/farmanimal/diseases/atoz/fmd/documents/uk-breeds-at-risk.pdf.

In addition, as part of the Inventory exercise, breed organisations were asked to indicate whether they thought that their breed was particularly geographically-concentrated. In addition to the breeds in the UK BAR list above, over 30 breeds have indicated in information provided for the UK Inventory of Breeds that they may meet the Committee's definition of geographic concentration. Further work will be required to confirm the status of these breeds as geographically-concentrated. The central database that Defra and the FAnGR Committee will establish should be used to identify geographic concentration of breeds more accurately in future, for example by recording the "outward" (first half) of the postcode of geographic locations, subject to the agreement of breed organisations. It is hoped that the database would also enable us to monitor other threats to our FAnGR, including loss of genetic diversity.

10 Carson, A., Elliott, M., Groom, J., Winter, A., Bowles, D. (2009) Geographical isolation of native sheep breeds in the UK – evidence of endemism as a risk factor to genetic resources. *Livestock Science* **123**, 288-299.

Chapter 4: How FAnGR are being used

Chapter 3 set out the different types of FAnGR we have in the UK. These FAnGR are used in a wide variety of valuable ways, from the use of mainstream breeds in commercial production systems to the use of minority breeds in wildlife and landscape conservation strategies through grazing schemes. Development of new uses and markets is also important to our native breeds and their conservation: for example, Shropshire sheep are increasingly used in conifer and fruit tree plantations, which has helped increase the population and security of the breed. A number of examples of use of FAnGR in the UK are provided below.

4.1. Commercial production systems

It is predominantly mainstream FAnGR that are used in large scale commercial production systems. Products are aimed at the mass market and provide the major portion of the domestic and export food supply.

Most of the UK's multiple retailers now also offer a premium for meat wholly or partly from UK native breeds. Typically the retailer will pay a premium for meat produced utilising traditional native breed sires and the products are promoted on the basis of their high quality and excellent flavour. This has also led to an increase in the numbers of particular breeds, including some of those that had previously been in decline.

Success of Aberdeen Angus-sired branded beef

Figure 5: Aberdeen Angus bull

Supplied by of Dovecote Park Ltd.

By the mid 1980s populations of most native British beef cattle breeds were in steep decline, following the rise in popularity of Continental European beef breeds, imported from the 1960s onwards. For instance, in 1986 only 2,609 pedigree Aberdeen Angus calves were registered. Yet by 2012 over 15,000 pedigree registrations were processed. This virtual six fold rise over twenty five years was almost entirely due to the rising influence of successful UK retailer branded Aberdeen Angus beef programmes.

Starting from very small beginnings in 1991 Waitrose, in partnership with Dovecote Park, and separately Marks and Spencer, grew their own label branded Aberdeen Angus beef programmes to significant businesses with the active support of the Aberdeen Angus Beef Society. The Society had initially pioneered its Certified Aberdeen Angus beef programme in 1984, and both Waitrose and Marks and Spencer subsequently developed their own independent bespoke brand assurance schemes. Both the retailer own label brand and the Society's certification scheme were UK-pioneered initiatives. Sales growth built momentum through the 1990s, through the BSE crisis, and by 2011 accounted for almost 40% of Waitrose beef sales. Similar breed-specific schemes have now been announced by all major UK retailers, and the breed-branded beef market in Britain continues to grow, and provide essential support to our native beef breeds.

Populations of the Angus breed in particular have increased dramatically, with Angus sired calf registrations now accounting for over a quarter of a million per annum, largely as a result of these schemes, with the breed currently accounting for around 11% of all cattle registered in the UK.

Figure 6: Angus-sired branded beef in store

Supplied by Dovecote Park Ltd.

4.2. Systems producing specialist products

These production systems tend to use native and often rare breeds of FAnGR and have become established as part of the overall conservation effort for breeds at risk. Products including high value meat, dairy products, eggs, fibre, hide and skin are aimed at small, specialised markets including specialist independent retail outlets and farmers markets. Consumers are also able to satisfy a desire to support local production with reduced food miles whilst also enjoying the experience of purchasing direct from the producer and helping to support the conservation of native breeds. For specialist marketing to work consumers must be prepared to pay a premium for the product.

Heal Farm Market Trailer

Supplied by Anne Petch, Heal Farm Fine Food

Local Foods from Native Breeds

The UK has a number of breeds which are both locally adapted, and historically linked to local produce. Double Gloucester cheese, found in any supermarket, was originally made from the milk of Gloucester cattle in the county of Gloucestershire. One of the oldest documented breeds in the UK, the Gloucester was linked by the 15th century to the production of Single and Double Gloucester cheese and remained in demand well into the 18th century. Numbers declined dramatically during the 19th and 20th centuries as they were displaced, initially by several disease outbreaks, and then replaced by higher yielding breeds and more industrialised food production techniques.

Throughout the 20th century the breed courted extinction, and on several occasions numbers fell to less than two hundred individuals. Thanks to the determination of a very small group of dedicated Gloucestershire farmers the breed has survived, complete with its particular dairy characteristics. Whilst most Double Gloucester cheese produced today comes from standard dairy cattle breeds, there are a very small number of specialist dairies in Gloucestershire who now successfully make

traditional Single Gloucester cheese from the milk of Gloucester cows. Quite different to the supermarket product, Single Gloucester is now a registered EU PDO (Protected Designation of Origin). It must be made from whole milk in the County of Gloucestershire and the producers of the cheese must have a registered herd of Gloucester cows. Sold locally and in specialist London shops, it is a highly prized speciality.

Figure 7: Joe and Adam Henson cutting Greystones' Single Gloucester Cheese

Supplied by Gloucestershire Wildlife Trust

Caron and Robert Stewart started the Clash herd of British Saddlebacks in 2006 on the Scottish coast. They have built up a network of butchers and restaurants including the prestigious Turnberry Hotel to market the pork from their 26 sows. They also attend Farmers Markets but find these very time consuming. In order to develop their business further they have created a range of pies and salamis which can be sold by other farm shops and speciality retailers. Caron is typical of many new small scale keepers of native breeds as she combines a part time job outside agriculture with their passion for pig keeping.

Figure 8: Caron Stewart and some of her British Saddlebacks

Supplied by Caron and Robert Stewart

In Northern Ireland, Kenny and Jennifer Gracey have gone down another route to sell beef from their Belted Galloway and Longhorn Cattle as well as their British Saddleback pigs. They set up their own farm shop as a base for their business. They work tirelessly to promote the benefits of beef from their traditional breeds by attending Food Fayres and Farmers Markets as well as carrying out their own deliveries after experiencing difficulties with couriers companies handling such a perishable product. Kenny admits that the workload is very demanding but the rewards of seeing Longhorns and Belted Galloways grazing the fields at Forthill Farm make it worthwhile.

Figure 9: Belted Galloways at Forthill Farm, Northern Ireland

Supplied by Kenny and Jennifer Gracey

Due to concerns about the authenticity of beef being sold as Welsh Black, the Welsh Black Cattle Society has set up an Accredited Pedigree Welsh Black Beef Suppliers Scheme. The Welsh Black Cattle Society Beef Promotions Committee is working to promote Welsh Black Beef produced from Pedigree Welsh Black herds. Accreditation is awarded to premises such as farm shops, butchers, hotels, restaurants, box schemes and farmers markets stalls that sell 100% Pedigree Welsh Black Beef from accredited Pedigree herds. Premises who sell 100% Welsh Black beef will receive certificates to register their business. Presently there are ten outlets selling Welsh Black Beef that are accredited together with adding value, authenticity and traceability to their product.

4.3. Habitat conservation strategies

Conservation grazing involves the use of grazing animals to manage sites of conservation interest to encourage the wildlife that they support. The Grazing Advice Partnership (GAP) and its Welsh counterpart Pori Natur a Threftadaeth (PONT) have helped develop conservation grazing throughout the UK. These schemes tend to use less intensive land management techniques and many schemes use native and rare breeds of grazing livestock[11]. Horse logging – taking timber out of an area using UK native breed horses rather than heavy mechanical equipment – provides an example of forestry management that can be undertaken without causing major damage to the soil, to the flora and watercourses and with no pollution.

11 Small, R.W. 2010. Conservation grazing: delivering habitat management for conservation with livestock. *Journal Royal Agricultural Society England* 171, 38-44: http://www.rase.org.uk/what-we-do/publications/journal/2010/06-hft3723djdhf74jdi9.pdf

Photograph supplied by Peter Coates (www.airedalewoodman.co.uk)

Conservation Grazing and FAnGR

Many of the UK's habitats that are now valued for their biodiversity were created by, or for, farm animals. These habitats include various types of upland and lowland grasslands and heathlands, hay meadows and pasture-woodlands. Other habitats, such as sand dunes, salt marshes and even woodlands may benefit from light grazing. If any of these habitats are not grazed they are likely to lose their special conservation value as they become invaded and eventually dominated by scrub and trees through the process of ecological succession.

As well as sharing a history of traditional management through grazing, many of these habitats share another characteristic: relatively poor soil nutrient concentrations. This is important for reducing the vigour of otherwise dominant plant species and hence allows a greater variety of plant species to survive. However, it also means that, in agricultural terms, the productivity of the vegetation is low.

In the past this low productivity has often meant that either the land is abandoned for agriculture, allowing the process of succession to scrub and woodland or more often that artificial fertilisers are used which greatly reduce plant diversity. The few remaining good quality areas are now highly valued for conservation and are often protected as nature reserves.

Figure 10: Soay sheep on the Uphill SSSI, Somerset on a frosty morning

Photograph supplied by Vinah Bell for The Cobthorn Trust

Livestock that can flourish on the relatively poor forage of these nature reserves include hardy and thrifty native breeds such as Shetland, Longhorn, Belted Galloway and Highland cattle and sheep breeds such as Hebridean and Soay (Figure 10).

Figure 11: Exmoor ponies near Stoke Pero

Photograph supplied by Sue Baker

Ponies too have been used, including Exmoor (Figure 11), Welsh Section A semi-feral and Highland. Bagot goats have been used in the management of chalk heaths in Sussex. Pigs have a more limited function in conservation management but have been used in woodland regeneration.

Figure 12: Shetland cows on Flanders Moss Summer 2012

Photograph supplied by Kate Sankey, West Moss-side Farm

Flanders Moss, near Stirling in Scotland is the largest remaining area of raised bog in the UK. Now managed by Scottish Natural Heritage and local farmers, the Moss has been largely treeless for a long time. However, past management has led to parts of the Moss drying out and trees such as pine and birch starting to spread across the bog. In recent years, seasonal grazing of Blackface sheep and Shetland cattle (Figure 12) has been introduced to control this.

Thus conservation grazing has become a 'new' use for many breeds at risk and has the potential to make a significant contribution to the conservation of Farm Animal Genetic Resources. However, one concern is the increasing use of exotic species (e.g. water buffalo) and breeds (e.g. Konik ponies), which not only displace native breeds from this new function but (if newly imported) may pose a disease threat to all the UK's FAnGR.

4.4. Climate change

Genetics can deliver significant environmental benefits. For example, in 40 years of genetic progress the amount of manure produced has been halved. Over the same period of time, the amount of land needed to produce a cooked British breakfast has been reduced by 70% through improved efficiency (Source: Plastow, 2007).

The use of appropriate breeds and breeding strategies may help to minimise the impact of greenhouse gas emissions, ammonia, nitrates and phosphates on the environment; for example by ensuring that essential nutrients such as carbon, nitrogen and phosphorus are converted as efficiently as possible into useful livestock products, rather than being lost to the environment. Ruminant FAnGR can also utilise forage and fodder which is not digestible by humans (e.g. grasses, clovers, heather, sedges, etc.) and therefore does not necessarily compete with humans for its feed requirements.

Selective breeding reduces greenhouse gas emissions

Illustrating the relevance of FAnGR to contemporary issues, selective breeding of farm livestock has made a major contribution to reducing greenhouse gas emissions per kg product over the last few decades. These benefits largely arise as a result of breeding for improved productivity (growth rate, egg production, milk yield etc) which is associated with improved gross feed conversion efficiency. This in turn reduces emissions per unit product. Estimated % reductions in methane, ammonia and nitrous oxide production, and overall reduction in global warming potential, from a Defra-funded study by the Genesis Faraday Partnership and Cranfield University, are shown in the table below. The larger reductions achieved in poultry, pigs and dairy cattle reflect the faster rates of genetic change that have been achieved in these livestock species.

Selective breeding reduces greenhouse gas emissions *(cont'd)*

Table 1: Estimated percentage changes in greenhouse gas emission per unit of livestock product as a result of genetic improvement 1988-2007

	CH_4	NH_3	N_2O	GWP_{100}
Layers	-30	-36	-29	-25
Broilers	-20	10	-23	-23
Pigs	-17	-18	-14	-15
Dairy	-25	-17	-30	-16
Beef	0	0	0	0
Sheep	-1	0	0	-1

Research in several UK research groups is underway to develop knowledge and tools to enable further reductions in emissions through selective breeding incorporating production and fitness traits. Results from studies at SRUC have shown that selective breeding can be used to further reduce GHG emissions from livestock systems while still improving economic performance and fitness traits.

Selective breeding reduces greenhouse gas emissions *(cont'd)*

Above: *SRUC 'GreenCow' facility for measuring greenhouse gas emissions from ruminants. Photographs supplied by Tony Waterhouse, SRUC*

4.5. Breeding strategies

Crossbreeding systems are used widely in most sectors of the livestock industry. Their role in the conservation of FAnGR is set out below.

Crossbreeding systems and their future prospects

Crossbreeding is the quickest way of utilising FAnGR sustainably but at the same time, if unregulated, it is the major threat to its conservation.

There are essentially four degrees of crossbreeding:

1. Stabilised crossbreeding systems.

Here, breeds are maintained as separate entities and are crossed to yield progeny which combine the merits of the parent breeds. For example, hardy hill ewes are crossed with rams of prolific breeds to produce hardy, fertile crossbreds. Males are sold for meat but females are then mated with rams of meat breeds to produce lambs for slaughter. This is the crossbreeding system traditional to UK sheep farming (G.E. Pollott & D.G. Stone, *The breeding structure of the British sheep industry 2003* http://archive.defra.gov.uk/evidence/economics/foodfarm/reports/documents/pollott2003.pdf.)

Crossbreeding systems and their future prospects *(cont'd)*

2. Introgression.

It may be desired to bring characteristics from one breed into another without changing the latter too radically. For example, by the 1970s British beef breeds were being outcompeted by larger-bodied, faster-growing Continental breeds. Bulls of Continental breeds or from overseas populations of British origin which had already undergone selection towards the desired type were mated with British herds, the crossbred progeny being then mated (backcrossed) with purebred British animals, successive backcrosses meaning the proportion of Continental genes was progressively reduced. A prime consideration was not to lose breed identity and local adaptations, and breed societies documented the process so that the percentage of the genotype attributable to the importation can be read from pedigree certificates. An example is the use of Maine Anjou cattle from France to develop a larger-bodied Beef Shorthorn in Britain.

3. Composite breeds.

This is introgression followed by selection for some desirable phenotype without regard to conforming to original breed type. An example is the development of Luing cattle from crosses between Highland and Beef Shorthorn followed by selection for a combination of performance characteristics coupled with genetically determined lack of horns. In pigs and poultry, production of composite breeds coexists with the maintenance of stabilised crossbreeding systems in highly complex breeding programmes which capitalise on the hybrid vigour (heterosis) which is often an outcome of matings between distinct genotypes.

4. Breed replacement.

This is introgression followed by selection for the phenotype of the breed which is being introduced. Crossbreds are backcrossed to the introduced breed. Also known as upgrading, this is the process whereby the traditional dairy breeds of the UK have been largely replaced by the Holstein-Friesian.

The relevance of crossbreeding to conservation of FAnGR is that in the interests of short-term economic advantage, breeds can easily be lost through their being subsumed into composite breeds, or by being upgraded. Many breeds that have been important in stabilised crossbreeding systems and specialised for that purpose, such as Wensleydale and Teeswater sheep, have fallen out of favour for that purpose and have had to find new uses. Other breeds have been heavily introgressed so, for example, non-introgressed Aberdeen Angus cattle are now very rare. However, FAnGR may well possess specific attributes which could be introgressed into mainstream breeds, such as maternal traits, hardiness, and aspects of meat and milk quality. Better characterisation of these will enable opportunities for their utilisation in crossbreeding systems to be identified.

4.6. Cultural and historic use

Some of our breeds fulfil an important social, cultural and historic role over and above their direct contribution to the UK economy. Our native breeds have had an historic role in helping to shape the countryside and in defining the regions where particular breeds have strong roots. In recent years there has been increasing interest in the relationship between livestock and landscape, where livestock are seen as a component of the landscape rather than just a means to maintain or restore landscapes. This is perhaps most marked where particular breeds have cultural significance, such as Herdwick sheep in the Lake District, or native pony breeds on their respective moors and commons. For example, for many people a visit to the New Forest would not be complete without the sight of New Forest Ponies. The ponies have been in the New Forest since at least medieval times and their grazing has shaped the look of the Forest today.

Cotswold Sheep

The Cotswold breed of sheep is synonymous with the hills which share their name. In fact the rolling bare hills or wolds were covered in wattle enclosures or cots in which the sheep were gathered. Hence the wolds of the sheep cots or the Cotswolds. Churches of the Cotswolds were built by the medieval wool merchants whose enormous wealth resulted from the export trade to Europe of the long and lustrous Cotswold fleeces. The sheep are represented alongside images of these merchants in brass memorials, stone carvings and stained glass windows. By the 13th and 14th centuries Cotswolds were kept in very large numbers and flocks of many thousands existed (over 10,000 sheep owned by Gloucester Abbey and 8,000 by Winchcombe Abbey). Their wool was renowned throughout Europe and ordered by breed name in documents dating back to 1319. Not only did the merchants grow rich, but there were heavy taxes collected. Since the 14th Century the Lord Chancellor's seat in the House of Lords has been the 'Woolsack'. This was originally made from a bale of Cotswold wool as a symbol of the enormous importance of the wool trade, which at its zenith accounted for half the nation's annual income.

No one would question the need to conserve and maintain these beautiful churches and ancient traditions, but by the 1970s the population of Cotswold sheep, the heirs of the original breed and visible reminders of this heritage, had fallen to just a few hundred ewes and faced imminent extinction. Wool was not fashionable or valued and the sheep were too big and slow growing to compete with imported lamb. In the 1970s a small group of farmers and breeders began a concerted effort to ensure their survival. The Cotswold Sheep Society linked up with local woollen mills and began a cooperative venture to collect the fleeces and manufacture modern products using traditional materials and skills. They established a local trade for their meat, which can now be purchased in local butchers shops though the region, and they are included in a number of conservation grazing projects. The current interest in locally sourced, traditional products has helped the breed's dramatic revival in recent years, and their fleeces are once again being used in the restoration of historic tapestries and fabrics, originally made with the wool of their ancestors.

Figure 13: Cotswold ewe and lamb

Supplied by Cotswold Farm Park

4.7. Education and comparative research

Our FAnGR have an important educational role – for example in helping children to understand where their food comes from as the case study below on the role of farm parks and city farms demonstrates.

Education and Recreation

Members of the UK's largely urban population are often unaware of the sources of the food presented in supermarkets and other outlets. This is especially true of children who may have had little opportunity to encounter farm animals or crops, or even experience the wider countryside. The National Curriculum includes topics on food and farming, but to bring this to life a visit to a farm park, city farm or open farm is an invaluable experience. These centres often keep native breeds at risk both for their intrinsic interest, such as varied colours, horns and sizes, and also for their historical and cultural links to particular regions.

Figure 14: Herd of Hereford Traditional cattle at Sandwell Park Farm, Sandwell, West Midlands.

Education and Recreation *(cont'd)*

Figure 15: Staff member at Tatton Park Farm, Cheshire with Tamworth sow and some of her litter.

Both photographs supplied by Linda Trotman

Farm parks may be privately owned, such as the well-known Cotswold Farm Park that is regularly featured on BBC Television's Countryfile programme, or they may be operated by local authorities, sometimes in conjunction with a historic house or with a country park (e.g. Croxteth Hall in Liverpool, Sandwell in Birmingham and Temple Newsam in Leeds). City farms, such as Gorse Hill City Farm (Leicester), Heeley City Farm (Sheffield) and Bill Quay Community Farm (Gateshead), tend to be smaller in area but are important resources for local communities, providing volunteering opportunities as well as educational facilities that may be within walking distance of local schools.

Some schools have taken on the challenge of keeping their own livestock. Woodchurch High School, in Birkenhead, started with a few ex-battery hens but has now developed breeding groups of Cream Legbar and Dorking chickens, Golden Guernsey goats and North Ronaldsay sheep. The school has started three Key Stage 4 courses related to environmental and land-based studies and animal care, and on recently achieving Academy status was awarded a Rural Dimension Specialism. The animals are used throughout the curriculum e.g. in English essays comparing battery hens' and free range hens' lives, calculating pen sizes in mathematics, and using the sheep as models in a sculpture workshop. The RBST has entrusted some of the rarest lines of sheep owned by the Trust to schools and colleges e.g. Leicester Longwool at Warriner School and Norfolk Horn at Easton College.

Education and Recreation *(cont'd)*

Figure 16: North Ronaldsay sheep at Woodchurch High School, Birkenhead.

Supplied by Woodchurch High School

The National Trust recently adopted an idea suggested by Jon Alexander, who saw the need to reconnect people with their food supply. The idea became the MyFarm project, in which members of the public could, collectively, decide the farming policies of the National Trust's Wimpole estate. At the beginning of 2012 there were approximately 3,500 'Wimpole farmers', with 70% coming from urban postcodes. Examples of the decisions taken by the Wimpole farmers were to start a flock of Oxford Down sheep, a commercial but at risk native breed, and that a new Irish Moiled bull should be purchased.

All of the farm parks and city farms mentioned above have RBST 'approved' status. Currently there are 15 RBST Approved Conservation Farm Parks and 3 Approved City Farms. As well as providing educational activities and informing the public about livestock farming they run successful breeding programmes for many of the UK's rarest breeds, often liaising directly with the RBST. In return, RBST has been active in the fight to keep these important facilities open when threatened with closure, as has been the case for, amongst others, Palacerigg Country Park in Cumbernauld, Bill Quay Community Farm and Doonies Farm in Aberdeen.

Education and Recreation *(cont'd)*

A recent initiative between the RBST and Bicton College in Devon saw the college become the first RBST College. Bicton has recently secured funding from the Skills Funding Agency of £2.88 million for a new animal husbandry school, which will provide excellent facilities for courses in animal care, husbandry and conservation and related enterprise activities. In agreement with RBST, Bicton will introduce rare breeds into the curriculum; these include Devon and Cornwall Longwool and Dorset Horn sheep and Berkshire and Oxford Sandy and Black pigs. There will also be four breeds of rare poultry including Cream Legbar.

Figure 17: Devon and Cornwall Longwool sheep at Bicton College, Devon.

Supplied by Richard Broad / RBST

The charity Farming and Countryside Education (FACE and FACE Wales) provides educational materials, promotes farm visits, helps teachers and supports farmers who are considering opening their farms for school visits. Another charity, Linking Environment and Farming (LEAF), has also done much to encourage understanding of food and farming through its Open Farm Sunday project that has been running since 2006. In the first six years nearly 1 million people have visited farms throughout the UK, and LEAF is piloting Open Farm School Days in 2013. Agri-environment schemes such as the Higher Level Scheme of Environmental Stewardship also contribute by rewarding farmers who allow educational access to their land.

Chapter 5: Analysing latest progress

This chapter summarises action taken by Defra and other stakeholders to improve our evidence base and to progress activities and policies relevant to FAnGR.

FAnGR co-ordination

Defra works with other organisations with an interest in FAnGR, including the main NGOs that work on the conservation of rare or heritage farm animal breeds and the Devolved Administrations. Defra provides the UK National Focal Point for FAnGR, which represents the UK at the FAO Intergovernmental Commission on Genetic Resources for Food and Agriculture. Defra is also a member of the European Regional Focal Point for animal genetic resources. The UK National Co-ordinator supplies information on farm animal breeds to the FAO Domestic Animal Diversity Information System (DAD-IS) and the European Farm Animal Biodiversity Information System (EFABIS), drawing on information from NGOs and breed societies.

The UK Government supports a number of key international agreements to encourage the conservation and sustainable use of FAnGR. Significant progress has been made to strengthen action in relation to FAnGR, including through the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity 2011-2020 and the European Biodiversity Strategy to 2020. More details of these initiatives are set out in Chapter 6.

Advice and expertise

The UK's FAnGR Committee is an expert scientific committee which provides advice to Defra and the Devolved Administrations on all issues relating to FAnGR. Its membership includes geneticists, industry leaders, representatives from livestock breeding companies and conservation organisations. The Committee in its current form was established in 2011 and replaced the National Standing Committee on FAnGR.

Further information, including membership of the Committee and its terms of reference, is available at: http://www.defra.gov.uk/fangr/about/

Research & Development

The EU funds a range of scientific research which is relevant to FAnGR. This includes the EU-funded GLOBALDIV programme (2007-2011) which took forward work related to the characterization of FAnGR and reviewed the main drivers of biodiversity loss and strategies for FAnGR conservation (http://www.globaldiv.eu/) and NEXTGEN (http://nextgen.epfl.ch/), which launched in April 2011 and is considering the next generation of methods that can help to preserve farm animal biodiversity.

Defra also funds research which is specifically relevant to the conservation and sustainable use of FAnGR, outlined below:

- Molecular characterisation studies – to identify gaps in knowledge and suggest new approaches[12].

12 (http://randd.defra.gov.uk/Document.aspx?Document=IF0180_8608_FRP.doc)

- Climate change – exploring how the use of research in animal genomics and breeding can help to reduce nitrogen and methane emissions from livestock and food chains[13].
- Nutrient efficiency – a range of work has been commissioned to research the lifecycle nutrient efficiency of different breeds and investigate how to incorporate different nutrient efficiency traits within breeding programmes. Examples include:
  - examining the scope for including environmental objectives in ruminant livestock breeding goals[14];
  - reviewing breed and within-breed genetic differences in nutrient utilisation[15];
  - investigating the role of genomic selection in beef and sheep breeding and the need for a ruminant Genetic Improvement Network to help achieve environmentally sustainable breeding of ruminants[16].
- Conservation – a project to develop a co-ordinated strategy for *in situ* and *ex situ* conservation of UK FAnGR has recently been commissioned by Defra. This will document and evaluate current UK practices and develop guidance for future conservation strategies and breeding programmes. It is due to be completed in spring 2013.
- Breed authentication – investigating the development of a DNA-based tool to authenticate traditional-breed meat products in the UK. This project can help to evaluate the authenticity and traceability of a product to provide reassurance to consumers and protect the interests of traditional meat producers in the UK[17].

Characterisation and evaluation

Identifying the major biological/agricultural characteristics of breeds and strains is key to helping us to identify what our genetic resources have to offer. Work on characterisation can support the development of genetic resources which can help farmers make efficiency gains, and also adapt to changing diseases, environmental conditions and consumer demands.

For breeds at risk, characterisation and evaluation are important for identifying particular adaptations that may make a breed more useful or justify its conservation on grounds of genetic distinctiveness. Characterisation of livestock breeds involves description of their phenotype, genotype, environment/agricultural system in which they are typically kept, and their geographical distribution. A key element of characterisation of livestock is a description of their demography, because their breeding is under human control. The information gathered in these processes needs to be collated, standardised and made available in databases and skills need to be maintained in the evaluation of these data.

13 (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=16594&FromSearch=Y&Publisher=1&SearchText=IF0182&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description)
14 (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=16595&FromSearch=Y&Publisher=1&SearchText=IF0183&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description)
15 (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=16595&FromSearch=Y&Publisher=1&SearchText=IF0183&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description)
16 (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=15846&FromSearch=Y&Publisher=1&SearchText=IF0149&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description)
17 (http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17588&FromSearch=Y&Publisher=1&SearchText=verification&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description; http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17961&FromSearch=Y&Publisher=1&SearchText=Extension%20of%20the%20method%20to%20verify%20meat%20&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description)

Characterisation and evaluation *(cont'd)*

Defra and other UK funding bodies already fund the evaluation and development of mainstream and some at risk FAnGR through their research programmes. Ongoing work and some of the outstanding challenges and questions are dealt with below.

- **Phenotypic characterisation**

Characterisation of mainstream breeds is possible, based on comprehensive performance recording systems. These systems enable breeds, families and individuals with particular commercial attributes to be identified and genetic variation within these breeds to be exploited. New approaches are making this exploitation more efficient, both for the production traits (for example milk yield, carcase composition) that have been of longstanding interest, but also for newly important traits that are less accessible to recording and selection procedures. The latter traits include those of relevance to disease resistance, animal welfare, and mitigation of climate change.

In breeds at risk, scientific characterisation of the traditionally important production traits has not advanced greatly, though the specialised systems of which many are components, such as conservation grazing, are becoming well characterised at the systems level.

- **Genotypic characterisation**

Understanding of the molecular mechanisms of traits controlled by many genes, such as milk yield in cows and feed conversion ratio in poultry, has not been necessary for the great advances that have been made in development of these phenotypes. The underpinning science has been quantitative, rather than molecular, genetics. However, advances in molecular genetics, and especially the availability of genotyping for many thousands of single nucleotide polymorphisms (SNPs), together with the efficient breeding structures and rich phenotypic data available, are enabling new breeding strategies, such as genomic selection. This uses both phenotypic records and genomic information to produce more accurate predictions of breeding worth.

Paradoxically, the study of genes that perform no function (because they do not code for any physical product) is of great value in the characterisation of FAnGR. As these accumulate mutations at known rates, the degree to which breeds diverge in respect of these mutations can reveal how long it is since they diverged from a common stock. Work here has, however, focused less on the specifics of UK breed history than on topics of international and multidisciplinary interest such as domestication and the early development of livestock husbandry. Accessible work in breeds at risk was outlined by Review of Molecular Characterisation Studies Relating to UK Farm Animal Genetic Resources (see Research & Development above).

- **Geographical characterisation**

In contrast, the cultural environment of livestock has become a subject of research and formal reviews of the geographical affinities of breeds (particularly of sheep) are now available (reference: *The Sheep Trust:* Geographical Isolation of Commercially Farmed Native Sheep Breeds in the UK – evidence of endemism as a risk factor to their genetic resources). This work showed how geographical endemism, which first evoked widespread concern in the case of Herdwick sheep during the Foot and Mouth outbreak in 2001, is an issue in many other breeds, and is helping to confirm the importance of livestock breeds in the human geography of the UK.

Characterisation and evaluation *(cont'd)*

- **Demographic characterisation**

The population structure of a breed is a prime determinant of genetic processes in the breed, governing the spread of a favourable gene or the loss of (perhaps unappreciated, though potentially valuable) genetic variation. Pedigree records enable these processes to be monitored and predicted, a statistic of fundamental importance being the rate of increase of inbreeding. Loss of genetic variation is inevitable in a closed population, but it is clear that if the rate of this loss is restricted, the consequences need not be severe, in a realistic timescale.

Inbreeding must be considered in all livestock breeding programmes because the improvement resulting from the use of selected animals can be negated by the reduced performance that usually results from increased inbreeding.

Government policy and regulation

The domestic and international policy framework for FAnGR is described in Chapter 5, along with information on updated UK zootechnical legislation.

Key policies and activities

The following key activities have been taken forward since the publication of the UK National Action Plan for FAnGR:

- Based on international best practice, the FAnGR Committee has developed clear guidelines on breed definitions, including what qualifies as a breed, what is considered native and what is meant by feral. These have been used to develop the formal UK Inventory of Breeds;
- A principle of exotic disease control legislation is that certain categories of animals may be considered for sparing from culling, provided that disease control is not compromised. Animals may potentially be exempt for purposes related to conservation of species or genetic resources. Based on the expert advice of the FAnGR Committee a list of UK breeds considered to be at particular risk in the event of an outbreak of exotic disease was approved and published by Defra in July 2012 as the UK Breeds at Risk list (UK BAR);
- The FAnGR Committee has carried out a comprehensive review of breeds that are present in the UK and determined which of these may qualify as native genetic resources. This is used to establish eligibility for support under EU Rural Development programmes;
- Work has been done to help raise awareness of the importance of FAnGR, including through the UK FAnGR website (http://www.defra.gov.uk/fangr/) and a regular newsletter;
- A suite of biodiversity indicators has been developed to assess how the UK is addressing its key international obligations and to understand whether or not progress is being made. This includes an indicator on genetic resources for food and agriculture which currently focuses on trends in genetic diversity in native sheep breeds and native cattle breeds. It is proposed that this indicator will also include trends in genetic diversity in UK native equine, goat, pig and poultry breeds in due course.

Further work is required in a number of key areas. There remains an urgent need to improve the harmonisation, collection and use of electronic data on livestock breeds to draw together and facilitate sharing of important information on FAnGR and enable national obligations on monitoring to be fulfilled. Activity during 2012 to compile an up-to-date National Inventory of FAnGR has been an important step forwards. The FAnGR Committee and Defra will now establish an improved, automated, effective and cost-effective central database to support monitoring on a more regular basis, without adding extra burdens to the breeders and breed societies who provide the core information on animal genetic resources within the UK.

While progress has been made on "mainstreaming" FAnGR issues in wider UK policy-making, more remains to be done. This is especially relevant to Target 13 of the Convention on Biological Diversity (CBD) Strategic Plan for 2011 – 2020, agreed in Nagoya. There is also scope to improve co-ordination and co-operation with other industry stakeholder groups. It will also be important to ensure that FAnGR conservation is incorporated into Rural Development Programme measures available in the UK for the 2014-2020 period.

Action by others

Recording information in herd, flock and stud books

Individual breed societies, producer groups and some NGOs are responsible for maintaining herd, flock and studbooks and for recording key genetic information. The recording of information has advanced considerably in recent years and most breed societies now hold records in electronic format. However, there is scope to improve systems and information for some hill breeds of sheep and in the poultry sector. Developments in animal identification, especially electronic identification systems (now compulsory for sheep), will help to provide a greater level of information in future.

Accurate information resources are important for disease prevention and control. In relation specifically to FAnGR such information can also help with:

- pedigree registration and accurate recording systems, including birth notifications;
- management of breeding programmes and the efficient use of DNA analysis techniques;
- advertising and sale of breeding animals with transparent breeding history records;
- marketing of differentiated (e.g. by breed name) animal products for instance, through accreditation and assurance schemes;
- monitoring and management of within-breed, and within-population, genetic diversity;
- obtaining funding or other forms of support from EU and national programmes (for example, Rural Development Programmes).

Performance recording, genetic evaluation and genetic improvement programmes

UK performance recording, genetic evaluation and genetic improvement programmes involve many partners, including performance recording organisations, levy boards, breed societies and breeder organisations, dairy cattle, pig and poultry breeding companies, and the national equine centre. Some private groups, NGOs and individuals also carry out performance recording. Genetic evaluations are performed by breeding companies, Edinburgh Genetic Evaluation Services (EGENES) for dairy cattle, beef cattle and sheep, on behalf of UK levy boards, and ABRI (Agricultural Business Research Unit, Australia) for many beef cattle breeds.

In **dairy cattle**, organised genetic improvement programmes are in place for the Holstein, Friesian, Ayrshire, Jersey and Guernsey breeds. Dairy cattle evaluations are conducted across breed, which means that all pure and most crossbred cattle have predicted breeding values.

Genetic improvement programmes are in place for many **beef breeds** and are managed indirectly by individual breeders, co-operatives, and breed societies through their input to their chosen performance recording and genetic evaluation service provider.

Genetic improvement of sheep breeds is also managed indirectly by individual breeders, co-operatives, and breed societies, mainly through a single performance recording service provider and its genetic evaluation service provider. A relatively low proportion of most breeds are engaged in performance recording. The majority of this is done under the auspices of Signet, with a mix of breeder-recorded and technician-recorded (e.g. ultrasonic scanning results) data. Most genetic evaluations are undertaken by EGENES on behalf of Signet or breeder groups (e.g. BASCO, which is a web-enabled database founded by three breed societies). Co-operatives (including sire referencing schemes) have an important role.

Genetic improvement programmes are in place for the intensive sector of the **pig and poultry** industries and are managed by international breeding companies. Since 2002 the British Pig Association has introduced a new form of pedigree analysis using the Geneped programme developed by Grassroots and RBST. This has also been used for sheep, goat and equine breeds by RBST. As well as monitoring inbreeding and effective population size, the programme allows the identification of animals that are least related to the general population. This information can be used in novel conservation breeding programmes to ensure that genetic diversity is maintained within breeds and is a valuable addition to the conservation programmes based on named lines.

Modern genetic technologies have led to the development of tools which may help breeders of two British native **pony breeds** eradicate a fatal inherited disease in foals. Foal Immunodeficiency Syndrome (FIS) is an inherited recessive disease affecting Fell and Dales ponies and crosses of these ponies, which usually means affected animals die or are put down before they are 16 weeks old. The sequencing of the horse genome and the use of modern DNA technologies has allowed the development of a test which can be used to identify carriers, which will help breeders to avoid FIS in their foals and help in the conservation of these pony breeds.

The actions needed to deliver further progress are discussed in Chapter 7.

Chapter 6: Long term policy and regulatory framework for future conservation and sustainable use of UK FAnGR

The ongoing conservation and sustainable use of diverse genetic resources will contribute to Defra's goals of supporting the farming industry, protecting biodiversity and encouraging sustainable food production. Genetic resources are important for maintaining an efficient and sustainable farming industry and supporting the development of varieties and breeds to cope with new circumstances and demands.

This chapter provides an overview of the international and domestic policy framework for UK FAnGR and the obligations and commitments that we will need to meet. In order to meet these commitments our key objectives are to:

- produce a new UK Country Report on FAnGR, including an Inventory of all farm animal breeds resident in the UK;
- develop an improved monitoring system for FAnGR so that we can identify trends and possible risks to our genetic resources and more effectively deliver on our commitments to monitor, characterise, develop and conserve our FAnGR;
- raise awareness of the importance of FAnGR with the public, scientific community, breeders, consumers and the food industry;
- support relevant scientific research; and
- support FAnGR through other UK policies and programmes.

6.1. The international policy framework

Conservation and sustainable use of FAnGR is a widely supported international objective and will contribute to efforts to achieve poverty reduction and global food security. The UK is committed to take action to conserve FAnGR through a range of international agreements, which are outlined below.

The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) provides for the conservation and sustainable use of biological diversity, including benefits sharing, and research and training. The UK is a Party to the Convention, which also aims to mainstream agricultural biodiversity within core Government policies.

In Nagoya in October 2010, the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity adopted a *Strategic Plan for Biodiversity 2011-2020*. The Plan includes 20 targets, known as the Aichi Biodiversity Targets. Aichi Target 13 is particularly relevant to FAnGR: "*By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity*."

The 10th Conference of the Parties also agreed a new Nagoya Protocol on Access and Benefit Sharing. By promoting the use of genetic resources and associated traditional knowledge, and by strengthening the opportunities for fair and equitable sharing of benefits from their use, the Protocol aims to create incentives to conserve biological diversity, sustainably use its components, and further enhance the contribution of biological diversity to sustainable development and human well-being.

The Global Plan of Action for Animal Genetic Resources (GPA)

The United Nations Food and Agriculture Organisation (FAO) convened an International Technical Conference on Animal Genetic Resources for Food and Agriculture in Interlaken, Switzerland, in 2007. As a result of that conference, the first ever Global Plan of Action for Animal Genetic Resources was adopted by 109 country delegations including the UK in September 2007. The GPA has 23 Strategic Priorities aimed at combating the erosion of animal genetic diversity and using animal genetic resources sustainably. The GPA also recognises the need to survey, monitor, characterise, sustainably use, develop and conserve animal genetic resources more effectively.

6.2. The European policy framework

European Regional Focal Point (ERFP)

The UK supports the work of the European Regional Focal Point for Animal Genetic Resources (ERFP) in driving forward collaborative actions in support of conservation activities across Europe and implementing the FAO's Global Plan of Action for Animal Genetic Resources in Europe. A limited budget is provided by donor countries, including the UK. The ERFP is taking forward a range of collaborative projects covering information sharing, technical cooperation, training and research.

The EU Biodiversity Strategy to 2020

In 2011, the European Commission adopted *The EU Biodiversity Strategy to 2020* which aims to halt the loss of biodiversity and ecosystem services in the EU. The Strategy has six priority targets, and 20 actions to help Europe reach its goal. The Strategy also supports the CBD commitments made in Nagoya in 2010. In particular, Action 10 of the Strategy says that: '*The Commission and Member States will encourage the uptake of agri-environmental measures to support genetic diversity in agriculture and explore the scope for developing a strategy for the conservation of genetic diversity*.'

In April 2012, the European Parliament adopted a formal Resolution on the Strategy. The Resolution highlights ongoing biodiversity loss as a danger not only for wild species and habitats but also for the genetic diversity of farmed species.

Common Agricultural Policy

The EU's Common Agricultural Policy (CAP) is the framework under which European Union farmers operate. It covers a wide range of farming, environmental and rural development activities as well as controlling EU agricultural markets. Within the CAP, Rural Development policy aims to stimulate economic, social and environmental development in the countryside. Rural Development legislation will continue to have a key role to play in delivering actions on the ground to protect and sustainably manage FAnGR.

Under EU Rural Development rules, grants can be paid for the conservation of genetic resources. In England, the Higher Level Stewardship Scheme supports conservation grazing involving native breeds at risk. This supports the management of habitats for nature conservation and provides an incentive to farmers to conserve and use rare native breeds that might otherwise be lost. As the scheme applies only to grazing animals, it does not cover other native breeds at risk such as pigs and poultry. In England, there are currently over 1,180 agri-environment scheme agreements in place which support conservation grazing by native breeds at risk. Similar schemes exist in Wales (Glastir, which supports cattle, sheep and equines); Scotland (the Scotland Rural Priorities scheme,

which supports eight breeds of Scottish origin); and Northern Ireland (the Northern Ireland Countryside Management Scheme, which supports Irish Moiled cattle). The current list of eligible UK native breeds at risk is available at: http://www.defra.gov.uk/fangr/2011/03/21/breeds-at-risk/.

The EU budget is organised under 7-year programmes and the current programming period runs from 2007-2013. Following the publication of the Commission's legislative proposals on the future CAP in October 2011, negotiations are underway on CAP reform for the 2014-2020 period. The proposed new Rural Development Regulation has six priorities. These include fostering knowledge transfer and innovation in agriculture, enhancing competitiveness of all types of agriculture, the sustainable management of natural resources, and enhancing ecosystems dependent on agriculture – including by restoring and preserving biodiversity.

Zootechnical legislation

The purpose of EU zootechnical legislation is to facilitate trade in pedigree breeding animals, and their semen, ova and embryos between Member States, to preserve breeds throughout the European Union, and to give a legal right of entry in an equivalent herd or flock book for the same breed in another EU Member State. Under the legislation, Member States must recognise breed societies that deal in pedigree animals if they meet certain conditions. The most important of these is that they must have a herd or flock book into which each pedigree animal is entered. Recognised breed societies must accept similar animals into their herd or flock books when imported from other Member States. While there is no obligation on breed societies to seek official recognition, animals entered into the herd or flock book of an organisation which is not approved could be refused entry into herd or flock books in other Member States.

The UK National Co-ordinator for FAnGR and the FAnGR expert Committee have a continuing role in monitoring zootechnical legislation to assess its impact on FAnGR. New Zootechnical Regulations in England came into force on 30 November 2012 covering purebred breeding cattle, sheep and goats, pigs and hybrid pigs. A recast of EU Zootechnical legislation is expected in 2013.

6.3. The domestic policy framework

The following section sets out some of the main UK policy issues and other developments affecting FAnGR since the publication of the UK FAnGR National Action Plan.

Disease control

Outbreaks of disease and the introduction of control measures can have a major impact on breeding programmes and the viability of breeds unless there are specific exemptions for FAnGR that are considered to be at risk of extinction. The 2001 FMD epidemic led to huge losses for some breeds, particularly sheep breeds. European Animal Health Law sets out measures aimed at preventing and limiting the spread of exotic diseases and the UK Government has recently published an updated list of breeds that are considered to be at risk in the event of an exotic disease outbreak and may potentially be exempt from precautionary culling if certain conditions are met. Details of the relevant breeds and the criteria used to consider inclusion on the list are based on recommendations from the FAnGR expert Committee. The list will be reviewed regularly and is available at: http://www.defra.gov.uk/animal-diseases/controls/culling-exemptions/

Natural Environment

In June 2011, the UK Government published its Natural Environment White Paper setting out a vision for the natural environment in England over the next 50 years and the practical actions that are needed to deliver progress. The White Paper includes commitments to implement the Nagoya agreements, including Aichi Target 13 which has particular relevance for FAnGR. It also renews the UK's commitment to the Convention on Biological Diversity and the importance of taking effective and urgent action to halt the loss of biodiversity.

Biodiversity

The England Biodiversity Strategy, *Biodiversity 2020: A strategy for England's wildlife and ecosystem services*, was published in August 2011 and contains explicit commitments to the conservation of farm animal biodiversity (Outcome 3: '*Conserving and enhancing biodiversity is not just an issue for wild species. It also applies to cultivated plants and farmed animals as well as to their wild relatives... There are also over two hundred native breeds of farm animals which are often associated with traditional land management required to conserve important habitats. The great genetic diversity which these provide can make an important contribution to the ecosystem provisioning service of food security by offering genes that are important for future... livestock breeding*.')

The strategy also commits the Government to the conservation of agricultural genetic diversity as a "Priority Action" including: raising awareness of existing genetic diversity within farmed animals and its importance for food security; encouraging responsible management and conservation of genetic diversity resource by relevant stakeholders; incorporating sustainable maintenance of genetic diversity into relevant policies and programmes (including incentive measures and protective arrangements); updating the UK's Inventory of FAnGR; and establishing efficient identification and monitoring systems for genetic diversity, including maintaining *ex situ* collections.

The biodiversity strategies being prepared in Scotland, Wales and Northern Ireland should also recognise the importance of FAnGR.

Biodiversity indicators

The UK is committed to developing and making use of indicators to monitor progress in meeting international goals and targets. The current set of UK biodiversity indicators measures the genetic diversity of the UK's FAnGR by examining changes in the "effective population size" of UK native breeds of cattle and sheep. Effective population is measured by assessing the number of pedigree breeding females and males contributing genes to the next generation of animals. For example, there may be a large number of pedigree breeding females in a breed but if only a small number of males are used, the "effective population size" is low. A low effective population size signifies a greater likelihood of in-breeding and risks the loss of genetic diversity. This approach was developed with the assistance of the FAnGR expert Committee and it is proposed to cover all UK major species of FAnGR as soon as possible.

Food security

In January 2011, the Government's Chief Scientific Adviser published the Foresight report on The Future of Food and Farming: Challenges and Choices for Global Sustainability. This identifies the scale of the challenge if the world is to feed its population sustainably in future and is described in greater detail in Chapter 2. In response to the report, the Government has published a Foresight Action Plan that includes taking forward work on the conservation, characterisation and sustainable use of FAnGR and restates our commitment to meeting the Nagoya Aichi targets.

Chapter 7: Moving forwards

There are many inter-related “drivers” that will affect the fortunes of our FAnGR further into the future, including market, demographic, climatic, resource scarcity, policy and technological drivers.

7.1. Longer term trends affecting FAnGR

To a large extent, market forces have driven the increasing specialisation of farm livestock breeds in the industrialised world over the last few decades. In many countries and supply chains, the relative value of primary livestock products has fallen steadily over the last few decades. This has driven producers to seek ever greater efficiencies in production, including through selection for higher yields. As a result, high yielding, more efficient breeds and crosses now dominate in most temperate production systems. These biologically more efficient breeds (and breeding company lines) also produce less pollution per unit of food produced.

This trend towards a small number of dominant mainstream breeds poses three types of threat to our FAnGR. Firstly, it reduces the opportunity for many, less productive breeds, to be sustained by rewards from the market alone – though some have achieved success in specialist markets. This, in turn, means that greater support is needed for these breeds from other routes, if they are to be maintained *in situ*. Secondly, if the focus of selection in specialised breeds is dominated by production efficiency traits, there may be additional risks to the health and welfare of animals of these breeds. These threats can be mitigated by broadening selection goals to include key health, welfare and fitness-related traits, as has happened in many species and countries already. Thirdly, even in globally-popular breeds, “effective population sizes” can be quite small, so global popularity alone is no assurance of the future “genetic health” of a breed.

The well-established trend of specialised breeds dominating the market is expected to continue in the short to medium term (5-15 years), albeit with continued attention to broader and more balanced breeding goals. Hence, an important role for the FAnGR Committee over this timeframe will be to continue to monitor and advise on the protection of breeds displaced by this ongoing trend towards specialised breeds, and on the fitness and genetic health of specialised mainstream breeds. The FAnGR Committee will also seek to develop policy that enables and supports niche marketing and removes barriers to the development of breeds within the UK for its own markets and export.

The impacts of global population growth on market demand for livestock products are already being seen and this is likely to intensify. Also, while it is impossible to link individual climatic events to global climate change, recent patterns of warming and the increasing frequency of extreme events all fit with the predictions associated with global climate change. Continuing climate change is predicted to dramatically alter the agricultural production capability of different countries. Many northern hemisphere countries – including the UK – may see favourable changes in production conditions. However there are major uncertainties in the scale of change and the localised impact because of the uncertainties in the details of the scientific models and in the global response in mitigating this threat. Despite these uncertainties it is already clear that climate change brings new disease threats, to which at risk FAnGR may be especially vulnerable because of their low numbers or geographical concentration. However, some FAnGR may have particular adaptations which mean that they are less vulnerable to these threats and other environmental stressors that may emerge. Exploitation of genetic resistance ought to be explored as a key element of our response to these emerging challenges.

Scarcity of some of the key resources for agriculture, including energy, water and some minerals, will create additional challenges. These demographic, climatic and resource-related drivers are likely to become increasingly important over the next few decades. As mentioned in Chapter 1, protecting, characterising, sustainably using and further developing our FAnGR, and the systems in which they are used, will be vital in rising to the challenges of feeding a dramatically growing global human population. Similarly, it is possible that our FAnGR, and production systems, will need to be further developed to adapt to climate change. The Committee has a role here in advising on risks to FAnGR from any of these factors, on further protection measures, and on the need for new research and technical support to ensure that the UK's FAnGR responds effectively to these challenges.

The existence of the FAnGR Committee, its predecessors, and their actions, are a direct response to UK Government and international policies – either directly relating to FAnGR, to protecting biodiversity including FAnGR, or to providing protection to avoid unintended consequences of other policies e.g. relating to animal health. Each of these drivers is of continuing and possibly growing importance. Particular UK domestic needs are to ensure the "mainstreaming" of measures to protect and sustainably use FAnGR, and to ensure that farmed biodiversity is fully recognised and addressed in all biodiversity strategies.

7.2. Scientific and technological challenges

There will continue to be growth of scientific knowledge and many new technologies that will offer both opportunities and threats to the conservation and sustainable use of our FAnGR. These will include:

1. **Developments in reproductive technologies,** including improved technologies for sex ratio control, *in vitro* fertilisation, improvements in the efficiency of livestock cloning, the potential for manipulation and selection of cells *in vitro*. If these technologies become applicable, and publicly acceptable, on a wide scale, their use could intensify some concerns around breed specialisation, but equally proper use could alleviate some of these concerns e.g. via widespread use of robust genotypes, well adapted to new production systems or resistant to new diseases . Also, these techniques could offer new opportunities for efficient conservation and recovery of FAnGR populations at risk. Livestock cloning is already being undertaken in North and South America, particularly for the dissemination of very high genetic merit bulls and for the conservation of these individual genomes by generation of a clone. The Committee will keep such strategies under review and offer advice as appropriate.

2. **Advances in, and wider uptake of, genomic selection and related techniques** potentially offer faster genetic gain in mainstream breeds, but especially offer potential advantages in selection for "hard to measure" traits, many of which contribute to robustness, and to reduce the impact of selection on the rates of inbreeding. Trait measurement on sufficiently large numbers of animals to "train" genomic selection will however remain the major cost barrier to its uptake for novel traits, and, without further improvements in the technology, its uptake in smaller populations. For this reason, genomic selection has the potential to accelerate the pace of differentiation in performance between mainstream and other breeds. It is already having a significant impact on the generation interval of Holstein dairy cattle by allowing the identification and use of superior young bulls long before the availability of progeny test proofs from performance recording of a bull's daughters.

3. **Advances in statistical genetics techniques** will help in both selection and in genetic resource management. Of particular interest in some species is the potential for group selection. This is selecting for a population of animals that perform well in groups, rather than focussing all selection pressure on individual animal performance when this might be at the cost of other animals in the population e.g. aggressive behaviour at feeding.

4. **Biobanking and related cryopreservation technologies.** New techniques for conserving biological material and information, and recreating viable populations from this material, offer major opportunities for cost effective conservation of more FAnGR. There will be issues in the long term about whether there will be the capacity and stability to permanently store DNA information in a non-biological format.

5. **GM livestock and genome editing.** New molecular biology tools allow genomes to be edited to bring about genetic changes. These tools can work at a very fine scale (such as a change to a single amino acid in a protein) and do not leave marker genes or other evidence of modification as has been the case with previous genetic modification technologies. Such changes can be indistinguishable from a naturally occurring mutation. These tools open up new opportunities for the transfer of variants within species – for example it might be feasible to engineer the polled (hornless) mutation in Holstein dairy cattle to improve animal welfare without the loss of performance that would come from introducing this variation via crossbreeding. It might also be feasible to edit an animal in the process of cloning – such as to introduce the polled mutation into elite mainstream bulls. There would be a time delay caused by the process, but the impact on progress would still be considerably less than via crossbreeding. All such strategies would need to utilise existing selection technology to avoid excessive rates of inbreeding in the course of introgression.

7.3. The way forward

Taking account of these challenges and further areas of work highlighted earlier in this report, the following actions are proposed:

Awareness raising

1. This Report provides an opportunity to share information on FAnGR issues with those with an interest in using, developing and protecting our FAnGR. As a next step, the FAnGR Committee, with Defra and the Devolved Administrations expect to hold workshops with UK stakeholders to further raise awareness.

Data sharing

2. The information provided in the UK Inventory should provide a baseline for further, more regular monitoring and reporting on indicators for genetic diversity. The Inventory should be updated at 3-yearly intervals as a minimum and will be used to update European and UN-FAO reporting systems.

3. We will establish an improved automated, effective and cost-effective central database to support more regular monitoring of UK FAnGR, including trends and potential threats.

4. Poultry data has been highlighted as a gap in this report. We will explore approaches to improve the data we can collect on poultry species.

5. We will progress further work to identify all *ex situ* FAnGR collections (private and public) across the UK.

Co-ordination

6. We will look to improve co-ordination and co-operation with our industry stakeholder groups and NGOs.

7. Contributions to relevant European and international work will be made through the UK National Co-ordinator for FAnGR.

8. We will carry out a review of the FAnGR Committee, to be completed by Autumn 2013.

"Mainstreaming" FAnGR

9. We will continue to look for opportunities to "mainstream" FAnGR issues across UK Government policies and programmes. In the short term, this will include keeping in touch with developments on CAP reform and ensuring that FAnGR conservation is incorporated within the new Rural Development Programme measures, the new EU Animal Health Law, the expected recast of EU Zootechnical legislation and ensuring that FAnGR is recognised as a core part of biodiversity, ecosystems and the UK's natural capital and is included as such in all biodiversity strategies and actions.

Research

10. We will look for opportunities for the importance of FAnGR to be recognised within the UK's agri-tech strategy, which is currently being developed and should enable the UK to meet food and environmental challenges while also making a significant contribution to economic growth. Diverse genetic resources should have a role here in helping us to maintain productivity, increase its sustainability and respond to new pressures.

11. We will consider lessons from research at national, European and worldwide levels as a basis for further priority setting and work. As well as research directly focused on FAnGR issues, this will also include wider research, including for example further work on animal product identification and traceability.

Appendix 1: FAnGR Committee breed definitions and criteria for breeds "at risk" in the UK

Definitions for use in the UK National Breed Inventory

The following definitions have been used by Defra and the FAnGR expert Committee for the UK National Breed Inventory. They were developed through a series of detailed deliberations over the course of more than two years, taking into consideration other definitions that were available. Definitions have been refined to ensure that they are practical, reasonable and proportionate for our UK circumstances.

Definition of a breed for the purpose of the UK National Breed Inventory

A livestock **breed**, in the UK context, is an interbreeding population of husbanded or formerly husbanded domesticated animals of consistent genotype and phenotype with a recognised history and administrative framework.

Eligibility of a "breed" for inclusion in the UK National Breed Inventory

To be included in the UK National Breed Inventory a breed should satisfy both of the following conditions:

- It fulfils, or potentially fulfils, a role in the rural economy. This condition may be satisfied by evidence that the breed has been, at some time in the past, viable in numbers that exceed criteria for being at risk by UN FAO standards.
- Less than 10% of the aggregate genetic contributions to the population over the last 4 generations are derived from other resources distinct from foreign herd books recognised as representing the same breed.

Definition of a "native breed"

For a breed to be considered **native**, the breed should satisfy all of the following criteria:

- The breed satisfies the criteria for inclusion in the UK National Breed Inventory described above.
- Breed history documents the breed origin within the UK (including from an amalgamation of native breeds) and the UK has formed the primary environment for the development of the breed.
- Breed history documents its presence in the UK in its current adapted form for a qualifying period of at least 40 years or 6 generations whichever is the longer period of time.
- Less than 10% of the aggregate genetic contributions to the population over the qualifying period are derived from other resources distinct from foreign herd books recognised as representing the same breed.
- A minimum of 80% of the genetic contributions from any generation of ancestors within the qualifying period must come from ancestors that were (i) registered in the breed's herd book and (ii) born in the UK. An exception to this may be granted as part of an approved conservation scheme. Henceforward, all conservation schemes that may threaten native status should be notified to Defra and the Devolved Administrations through the Expert Committee for prior approval.

Definition of "feral"

The following series of tests should be used to define **feral** FAnGR in the UK National Breed Inventory:

- the breed itself satisfies the criteria for inclusion in the UK National Breed Inventory as defined above; and

Definitions for use in the UK National Breed Inventory *(cont'd)*

- the breed is not subject to routine handling of any kind; and
- more than 90% of the population have been born to feral parents, over two generations.

Definition of "exotic breed globally at risk"

An **exotic breed globally at risk** satisfies the following conditions:

- the breed does not qualify as a UK native breed; and
- the breed is considered to be "at risk" worldwide, according to UN FAO definitions for numerically scarce breeds.

Criteria for breeds "at risk" in the UK

The UK Government has produced two lists of breeds considered to be at risk in the UK, which are based on whether a breed is scarce in terms of actual numbers, measured using the number of pedigree breeding females. These lists and their criteria are explained in greater detail below.

a) **UK Native Breeds at Risk (UK NBAR).** All UK native breeds that are eligible for support under agri-environment schemes through EU rural development programme legislation are included within the lists of eligible Native Breeds at Risk in the UK. There are separate lists of such eligible breeds for agri-environment schemes in England, Scotland, Wales and Northern Ireland. Under these schemes (Higher Level Stewardship in England, Glastir in Wales, the Scotland Rural Priorities Scheme and the Northern Ireland Countryside Management Scheme) a grazing supplement may be paid for suitable grazing with native breeds at risk. The native breeds at risk thresholds for agri-environment schemes are [less than] 7,500 registered purebred breeding females for cattle, 10,000 for sheep and goats, 5,000 for equines, 15,000 for pigs, and 25,000 for poultry. There are [199] UK Native breeds on the most recent UK NBAR list which was published in July 2012. The current list of UK Native Breeds at Risk for use in UK Rural Development Programmes is available at: [http://www.defra.gov.uk/fangr/breeds-at-risk-register/]; and

b) **UK Breeds at Risk (UK BAR).** These breeds are potentially at particular risk in the event of outbreaks of exotic disease in the UK and may be considered for sparing from culling, provided that disease control is not compromised. The population thresholds for a Native Breed to be included on this list are less than 3,000 registered purebred breeding females for cattle, sheep, goats and equines, 1,500 for pigs, and 1,000 for poultry. These threshold figures are further increased by 20% for any breed where fewer than 80% of the registered purebred females are bred with registered purebred males of the same breed. There are also a number of breeds that have been identified as being at especial risk due their geographic concentration within the UK. There are [179] UK Native Breeds on the most recent UK Breeds at Risk list, which was most recently published on 4 July 2012 and is available at: http://www.defra.gov.uk/animal-diseases/controls/culling-exemptions/.

Non-governmental information on rare breeds in the UK: In the charitable sector, the Rare Breeds Survival Trust regularly publishes a list of rare breeds in its Watchlist and this is available at: https://www.rbst.org.uk/rare-breeds-watchlist

Appendix 2: UK National Inventory of Breeds (major species)

Ideally, numbers of breeding females in a breed are obtained by an audited census. In practice, most of the smaller breed societies seldom have the resources to conduct a comprehensive census. However, the number of breeding females can be estimated by multiplying numbers of females registered each year by a species-specific multiplier. The FAnGR Committee recommended that the following multipliers be used: 3.52 for cattle, 2.4 for sheep, 2.7 for pigs and 5.2 for goats. In order to ensure that breeds at risk are captured, these multipliers apply a lower 99% confidence level to the proposed multipliers set out at: http://www.defra.gov.uk/fangr/files/hall-anm110811.pdf.

Census data are usually only included if the FAnGR Committee has verified that a comprehensive survey has been undertaken. Where full census data are not confirmed but data on the number of pedigree females registered over a three year period has been provided, the multipliers described above have been used in the Inventory to estimate numerical sizes of breeds. In a small number of identified cases, census information has been included without confirmation that a full census has been undertaken. This information is only included where other data, such as the pedigree female registrations over three years, has not been made available.

2002 figures have been included where these are available. Some 2002 figures were incorrectly transposed in the 2002 Country Report and the correct transposition of those figures is included in this table. It is important to note that in many cases direct comparisons between 2002 and 2012 data cannot be made, particularly where additional information has been made available. It is the 2012 data that will be used as a baseline for future monitoring. Comparisons between 2002 and 2012 data are therefore only discussed in the body of this report where it is appropriate to do so.

Data on pedigree registered breeding females in 2012 is provided for 70% of the breeds listed in the Inventory below. In most cases, data has been produced on the basis of information provided by breed societies and organisations. This is indicated by a “P”,“C” or “C*” in the Inventory. Other data sources are indicated as “O” and further explanation on these sources, as well as the other abbreviations, is provided in a key at the end of this Appendix.

In addition to the *in situ* Inventory set out below, an initial exercise has been carried out to identify *ex situ* collections. In the time available it has not been possible to contact all possible holdings of *ex situ* collections and further, more comprehensive work will be needed in this area in future. The *ex situ* information that has been collected so far will be published on the FAnGR website (http://www.defra.gov.uk/fangr/).

Cattle

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Aberdeen-Angus	8,377	P	29,486	11,500		N	ZR
Aberdeen-Angus (Original Population)	41	P	144	<150		N	BAR, NBAR, ZR
Abondance						E	EGBAR
Ancient Cattle of Wales (Coloured Welsh Cattle)	26	P	92			N*	BID, GC?
Angler Rotvieh				40		E	EGBAR
Ankole				15		E	EGBAR
Armoricaine				25		E	EGBAR
Aubrac				50		E	EGBAR
Ayrshire	3,200	P	11,264	7,000		N	ZR
Baltata Romaneasca						E	EGBAR
Bazadaise	159	P	560	300		E	EGBAR
Beef Shorthorn	2,047	P	7,207	582		N	NBAR, ZR
Beefalo						E	
Belted Dutch						E	
Belted Galloway	1,000	P	3,520	1,400		N	BAR, NBAR, ZR
Bison				45		E	
Blonde D'Aquitaine / British Blonde	1,093	P	3,847	8,500		E	ZR, GC?, BID
Blue Albion		Oa	163	95		Formerly native	BID
Brahman				35		E	
Bretonne Pie Noire				10		E	EGBAR
Belgian Blue / British Blue	1,071	P	3,769	10,000		E	ZR, BID
British Friesian including British Friesian (Original)	2,415	P	8,501	12,000		N	ZR
British Friesian (Original)		O	1,924			N	BAR, NBAR, ZR
British White	422	P	1,485	1,368		N	BAR, NBAR, ZR
Brown Swiss	1,077	P	3,791	1,200		E	ZR
Charolais / British Charolais	3,737	P	13,153	15,000		E	ZR, BID

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Chianina				75		E	
Chillingham	9	P	31	17		N	BAR, NBAR, GC
Dairy Shorthorn (Original Population)	15	Ob	53			N	BAR, NBAR, ZR
Dairy Shorthorn (including Northern Dairy Shorthorn)	2,559	P	9,009	3,500		N	ZR
Danish Red				4		E	
Devon (Red Ruby Devon)	2,224	P	7,827	1,534		N	ZR, NBAR, GC?
Dexter (UK)	1,807	P	6,361	3,000		N	NBAR, ZR
East Finnish Brown						E	EGBAR
Estonian Red						E	EGBAR
Fleckvieh						E	
Frisona Espagnola						E	EGBAR
Galloway (including White Galloway)	1,112	P	3,914	3,500		N	BAR, NBAR, ZR, GC?
Gasconne	36	P	128	25		E	EGBAR
Gayal						E	EGBAR
Gelbvieh				350		E	
Gloucester	126	P	442	389		N	BAR, NBAR
Groningen Blaarkop				30		E	EGBAR
Guernsey	1,169	P	4,116	4,500		N	NBAR, ZR
Guernsey (Island)		O	1,724	1,569		N	BAR, NBAR, GC?
Heck		Oc	11			E	EGBAR
Hereford	3,466	P	12,199	6,500		N	ZR
Hereford Traditional	252	P	888	350		N	BAR, NBAR, ZR, GC?
Highland	1,728	P	6,081	2,500		N	NBAR, ZR
Holstein Friesian (includes Holstein, Holstein Friesian, Red and White Friesian)	210,698	P	741,658	>1,000,000		E	ZR
Hungarian Steppe						E	EGBAR
Irish Moiled	166	P	584	225		N	BAR, NBAR, GC?

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Jersey	8,686	P	30,576	11,000		N	ZR
Jersey (Island)		O	3,098	4,588		N	BAR, NBAR
Kerry	4	P	13 (UK)	90 (UK)		E (Native in ROI)	EGBAR
Lakenvelder						E	EGBAR
Limousin / British Limousin	10,712	P	37,706	17,000		E	ZR, BID
Lincoln Red	710	P	2,499	1,521		N	BAR, NBAR, ZR
Lincoln Red (Original)	92	P	325	<150		N	BAR, NBAR, ZR
Longhorn	1,638	P	5,766	1,500		N	NBAR, ZR
Lowline		O	<50	n/a		E	
Luing		C	7,194	1,700		N	NBAR, ZR
Maine Anjou				90		E	
Malkekorthorn						E	EGBAR
Marchigiana				70		E	
Meuse-Rhine-Issel				2,800		E	ZR
Miniature Zebu						E	EGBAR
Montbeliarde				1,300		E	ZR
Murray Grey	118	P	415	600		E	ZR
Normande		Od	140	120		E	EGBAR
Northern Dairy Shorthorn (100% pure bred)	3	Oe	11	25		N	BAR, NBAR, ZR
Norwegian Red				10		E	
Parthenais				70		E	EGBAR
Piemontese	32	P	111	350		E	EGBAR, ZR
Pinzgauer				5		E	EGBAR
Red Poll	921	P	3,242	814		N	BAR, NBAR, ZR, GC?
Reggiana						E	EGBAR
Romagnola				45		E	EGBAR, ZR
Rotbunt/Rotbunte						E	EGBAR
Salers	587	P	2,067	2,500		E	

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Shetland	157	P	554	300		N	BAR, NBAR, ZR
Simmental / British Simmental	4,147	P	14,599	8,900		E	ZR, GC?, BID
South Devon	3,338	P	11,750	11,500		N	ZR
Speckle Park						E	BID
Stabiliser	3,837	P	13,506			E	
Sussex	1,010	P	3,556	2,000		N	NBAR, ZR, GC?
Swedish Red & White				50		E	
Swiss Grey				7		E	EGBAR
Swona (feral)						E	BID
Tarantaise / Tarantaise-Tarina						E	EGBAR
Tyrone Black						E	EGBAR
Valdostana Nera						E	EGBAR
Vaynol	4	C	22	32		N	BAR, NBAR, GC
Wagyu						E	EGBAR
Water Buffalo						E	
Welsh Black	2,240	P	7,884	9,000		N	ZR, GC?
White Park	257	P	906	525		N	BAR, NBAR, ZR
Whitebred Shorthorn	44	P	154	120		N	BAR, NBAR, ZR, GC?
Yak						E	
Zebu						E	

Sheep

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Arapawa (Island)						E	EGBAR
Avranchin						E	EGBAR
Badger Face Welsh (Torddu and Torwen)	2,023	P	4,855	3,500		N	NBAR, BAR, GC?
Balwen		O	964	2,000		N	NBAR, BAR
Beltex	3,699	P	8,878	2,000		E	ZR
Berrichon du Cher						E	EGBAR, ZR
Beulah Speckled Face	8,103	P	19,447			N	NBAR
Blackface (Scottish)						N	ZR, GC?
Black Welsh Mountain		O	1,159	7,200		N	NBAR, BAR, ZR, GC?
Bleu Du Maine	228	P	547	6,000		E	EGBAR, ZR
Blue Texel	415	P	996			E	BID
Bluefaced Leicester	6,514	P	15,634	13,189		N	
Border Leicester	451	P	1,082	3,500		N	NBAR, BAR, ZR
Boreray	85	P	204	93		N	NBAR, BAR, ZR
Brecknock Hill Cheviot		O	20,000			N	BAR(GC)
British Milksheep	31	P	74	1,232		E	ZR, BID
Cambridge	126	P	302	800		N	NBAR, BAR
Castlemilk Moorit	224	P	538	688		N	NBAR, BAR, ZR
Charmoise	100	P	240			E	EGBAR
Charollais / British Charollais	8,717	P	20,921	22,500		E	BID
Clun Forest		O	2,971	4,886		N	NBAR, BAR
Colbred			Believed extinct			E	
Corriedale						E	
Cotentin						E	EGBAR
Cotswold	381	P	914	712		N	NBAR, BAR, ZR, GC?

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Dalesbred	1,598	P	3,835	37,500		N	BAR(GC)
Derbyshire Gritstone		O	2,000	2,250		N	NBAR, BAR
Devon and Cornwall Longwool	320	O	772	2,750		N	NBAR, BAR, GC
Devon Closewool	821	P	1,970	4,340		N	NBAR, BAR, ZR, GC
Dorper	167	P	401			E	EGBAR
Dorset Down	338	P	811	2,034		N	NBAR, BAR, ZR, GC?
Dorset Horn	391	P	938	2,386		N	NBAR, BAR
Drysdale						E	EGBAR
Easy Care		C*	150,000			E	BID
Epynt Hardy Speckled	1,653		3,967				BID, GC?
Est a Laine Merino						E	
Exlana	2,100	P	5,040			E	BID, GC?
Exmoor Horn	3,025	P	7,260	20,000		N	NBAR, ZR, BAR(GC)
Finnsheep						E	EGBAR
Friesland / B ritish Friesland				360		E	BID, EGBAR, ZR
Galway	45	P	108	150		E (Native in ROI)	EGBAR
Gotland	109	P	262	450		E	EGBAR
Greyface Dartmoor	552	P	1,325	1,685		N	NBAR, BAR
Hampshire Down	1,308	P	3,139	4,050		N	NBAR, ZR
Hartline						E	
Hebridean	1,868	P	4,483	2,298		N	NBAR
Herdwick		Of	8,000	45,000		N	NBAR, BAR(GC)
Hill Radnor		O	1,200	1,539		N	NBAR, BAR
Icelandic / British Icelandic	47	P	113	300		E	EGBAR, BID
Ile De France	100	P	240	500		E	EGBAR, GC?
INRA 401			Believed extinct			E	

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Jacob	2,349	P	5,638			N	NBAR, ZR
Kerry Hill	1,283	P	3,079	2,550		N	NBAR, BAR
Lacaune						E	EGBAR
Leicester Longwool	196	P	470	420		N	NBAR, BAR, GC?
Lincoln Longwool		O	991	1,345		N	NBAR, BAR, ZR, GC?
Llandovery Whiteface Hill		O	8,000			N	NBAR, GC?
Llanwenog	804	P	1,930	1,944		N	NBAR, BAR, ZR, GC?
Lleyn	34,795	P	83,508	129,643		N	
Lonk	1,020	P	2,448	3,500		N	NBAR, BAR, GC
Manx Loaghtan	362	P	869	1,253		N	NBAR, BAR, ZR
Meatlinc				1,000		E	BID
Merino (Saxon)						E	EGBAR
Merino (Tasmanian)						E	EGBAR
Norfolk Horn	427	P	1,025	1,061		N	NBAR, BAR, ZR
North Country Cheviot				86,000		N	ZR
North Ronaldsay/Orkney	164	P	394	666		N	NBAR, BAR, ZR
Oldenburg / British Oldenburg						E	EGBAR, BID
Ouessant						E	EGBAR
Oxford Down[18]	419	P	1,006	1,529		N	NBAR, BAR, ZR
Poll Dorset	4,607	P	11,057	21,470		N*	
Polwarth						E	EGBAR, ZR
Portland	334	P	802	1,339		N	NBAR, BAR, ZR
Romney		O	2,900			N	NBAR, BAR, GC

18 The Oxford Down Sheep Breeders' Association report that their own census in November 2011 recorded 1,324 pedigree registered breeding females and an equivalent census in November 2001 recorded 1,072 pedigree registered breeding females.

Breed General						Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002		Breed Origin	Breed status in the UK
Rouge de l'Est/British Rouge	444	P	1,066			E	ZR, BID
Rough Fell		O	14,807	12,000		N	ZR, BAR(GC)
Roussin	300	P	720	400		E	EGBAR, GC?
Ryeland (including Coloured Ryeland)	1,194	P	2,866	3,000		N	NBAR, BAR, ZR
Shetland Mainland	1,671	P	4,010	2,500		N	NBAR, BAR
Shetland Island		C*	9,532			N	BAR(GC)
Shropshire	950	P	2,280	1,453		N	NBAR, BAR, ZR
Soay	476	P	1,142	1,107		N	NBAR, BAR, ZR
South Country Cheviot				43,000 (as Cheviot)		N	BAR(GC)
Southdown	1,432	P	3,437	1600		N	NBAR, BAR, ZR
South Wales Mountain (Nelson type)	4,800	P	11,520			N	NBAR, BAR(GC)
Suffolk	9,273	P	22,255	56,600		N	ZR
Swaledale	67,875	P	162,900	750,000		N	ZR
Teeswater	273	P	655	429		N	NBAR, BAR
Texel / British Texel[19]	21,513	P	51,631	115,000		E	BID
Vendeen / British Vendeen	174	P	418	620		E	EGBAR, BID
Welsh Hill Speckled Face		O	2,700			N	NBAR, BAR, GC
Welsh Mountain				250,000		N	
Wensleydale	413	P	991	1,624		N	NBAR, BAR
White Face Dartmoor	615	P	1,476	2,094		N	NBAR, BAR, GC
Whitefaced Woodland	206	P	494	656		N	NBAR, BAR, ZR
Wiltshire Horn	2,720	P	6,528	3,000		N	NBAR, ZR
Zwartbles				1,406		E	EGBAR

19 The Texel Society have reported 70,903 pedigree registered breeding females as of November 2011. They also advised that the 2002 figure of 115,000 females was likely to be an overestimate due to under reporting of culls at this time.

Goats

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Alpine / British Alpine	94	P	483		E	BID, EGBAR
Anglo Nubian	247	P	1,275		E	BID
Angora / British Angora	8	P	40		E	ZR, BID
Arapawa / British Arapawa	30	P	155		E	EGBAR, GC?, BID
Bagot	54	P	277	80	N	NBAR, BAR
Boer / British Boer	345	P	1,782		E	BID
British Goat					E	BID
British Guernsey	35	P	182		E	BID
British Saanen	180	P	927		E	BID
British Toggenburg	152	P	784		E	BID
Cashmere			0		E	
Cheviot (Feral)		O	63		N	NBAR, BAR
English Goat					E	BID
Golden Guernsey	185	P	955	700	N	NBAR, BAR
Kalahari Red Boer					E	EGBAR
Nubian					E	EGBAR
Pygmy	358	P	1,849		E	EGBAR
Saanen	40	P	205		N	NBAR, BAR
Toggenburg	47	P	243		N	NBAR, BAR

Pigs

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
ACMC (Breeds: ACMC Meidam ACMC Volante ACMC Vantage FC ACMC Vantage EC ACMC Vantage MQ)	n/a (commercial)		n/a (commercial)			ZR
Berkshire	325	C	680	391	N	NBAR, BAR, ZR
British Landrace	347	C	693	5,538	N	NBAR, BAR, ZR
British Lop	221	C	450	162	N	NBAR, BAR
British Saddleback	674	C	882	414	N	NBAR, BAR, ZR
Duroc / British Duroc	49	C	92	1,203	E	ZR, BID
Gloucestershire Old Spots	853	C	1,627	628	N	NBAR, BAR, ZR
Hampshire	30	C	50	21	E	ZR
JSR Genetics (Breeds: JSR Genepacker 1 Dam Line Large White JSR Genepacker 2 Dam Line Landrace JSR Genepacker 4 Dam Line 12x JSR Geneconverter 500 JSR Geneconverter 600 JSR Geneconverter 700)	n/a (commercial)		n/a (commercial)			ZR
Kune-Kune	660	P	1,782		E	EGBAR
Large Black	192	C	362	377	N	NBAR, BAR, ZR
Large White	532	C	619	6,432	N	NBAR, BAR, ZR
Mangalitza	116	C	115		E	EGBAR, ZR
Middle White	230	C	391	233	N	NBAR, BAR, ZR
Oxford Sandy & Black	372	C	684	129	N	NBAR, BAR, ZR
PIC UK (Breeds: L02 PIC L03 PIC L08 PIC L14 PIC L15 PIC L27 PIC L62 PIC L65 PIC)	n/a (commercial)		n/a (commercial)			ZR
Pietrain	75	C	71	363	E	

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Rattlerow Seghers (Breeds: Rattlerow Large White 36 Rattlerow Landrace 12 Rattlerow Duroc 46 Rattlerow MaxiLean HC)	n/a (commercial)		n/a (commercial)			ZR
Tamworth	268	C	502	214	N	NBAR, BAR, ZR
Welsh	385	C	793	548	N	NBAR, BAR, ZR

Equines

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Alpine					E	
American Miniature Horse	9				E	EGBAR, ZR
American Quarter Horse	60				E	ZR
American Saddlebred	2				E	EGBAR, ZR
Andalucian					E	EGBAR
Anglo-Arab					E	BID
Anglo European	750				E	ZR
Appaloosa / British Appaloosa	153	C*	72		E	ZR, BID
Arab Horse	536				E	ZR
Ardennes					E	EGBAR
Bavarian Warmblood					E	EGBAR
British Falabella					E	ZR, BID
British Percheron, Percheron	8	O	46		N	NBAR, BAR, ZR
British Piebald					E	ZR, BID
British Riding Pony	306				E	ZR, BID
British Show Horse					E	BID

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
British Skewbald					E	ZR, BID
British Spotted Pony, Spotted Pony	189				E	ZR, BID
Camargue / British Camargue	1				E	ZR, GC?, BID
Caspian Horse	3			250	E	EGBAR, ZR
Cleveland Bay Horse	22	O	133	300	N	NBAR, BAR, ZR
Clydesdale Horse	143	O	468	500	N	NBAR, BAR, ZR, GC?
Coloured Horse & Pony	108				E	ZR
Connemara Pony / British Connemara Pony	87				E (Native in ROI)	EGBAR, ZR, BID
Dales Pony	77	O	266	850	N	NBAR, BAR, ZR, GC?
Dartmoor Hill Pony	226	C*	1,018		E	BID, GC?
Dartmoor Pony	96	O	646	330	N	NBAR, BAR, ZR
Donkey	3				E	ZR
Eriskay Pony	7	O	27	150	N	NBAR, BAR, ZR
Exmoor Pony	113	O	456	575	N	NBAR, BAR, ZR, GC?
Falabella					E	EGBAR
Fell Pony	173	O	836	400	N	NBAR, BAR, ZR, GC?
Fjord Horse	32	C*	116		E	EGBAR, ZR
Friesian Horse	13				E	EGBAR, ZR
Hackney Horse	35	O	152		N	NBAR, BAR, ZR
Hackney Pony		O	76		N	NBAR, BAR
Haflinger	21				E	EGBAR, ZR
Hanoverian						EGBAR
Highland Pony	182	O	722	658	N	NBAR, BAR, ZR
Hispano-Arabe					E	EGBAR, ZR, GC?
Icelandic Horse	14				E	EGBAR, ZR

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Irish Draught	46			120	E (Native in ROI)	EGBAR, ZR
Kerry Bog Pony					E (Native in ROI)	EGBAR
Knabstrupper Horse					E	EGBAR
Konik Pony					E	EGBAR
Lipizzaner	10				E	EGBAR, ZR
Lusitano	234				E	EGBAR, ZR
Miniature Horse	86				E	ZR
Miniature Mediterranean Donkey	105				E	EGBAR
Morgan					E	EGBAR, ZR
New Forest Pony	500	O	2,508		N	NBAR, BAR, ZR, GC?
Palomino	31				E	ZR
Poitou Donkey					E	EGBAR
Russian					E	EGBAR
Selle Francais Horse					E	EGBAR, ZR
Shetland Pony	1,294				N	ZR
Shire Horse		O	760	1,800	N	NBAR, BAR, ZR
Spanish Horse	88				E	EGBAR , ZR
Sport Horse	107				E	ZR
Sport Pony					E	ZR
Spotted					E	ZR
Standardbred Trotting Horse	228				E	EGBAR, ZR
Suffolk	21	O	76	69	N	NBAR, BAR, ZR
Tennessee					E	
Tersk					E	EGBAR
Thoroughbred	2,499	C*	9,317		N	ZR
Traditional Gypsy Cob	45					ZR
Trakehner	26				E	EGBAR, ZR

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Warmblood/British Warmblood					E	ZR, BID
Welsh					E	
Welsh Cob (Section D)	1,224	O			N	ZR
Welsh Mountain (Section A semi-feral)		O	650	<900	N	NBAR, BAR, ZR
Welsh Mountain Pony (Section A)	1,536	O	1		N	ZR
Welsh Pony (Section B)	454	O			N	ZR
Welsh Pony of Cob Type (Section C)	532	O			N	ZR

Camelids

Breed General					Breed Status	
Breed Name	Average females registered for 3 years	Source of pedigree registered breeding female numbers 2012	Pedigree registered breeding females 2012	Pedigree registered breeding females 2002	Breed Origin	Breed status in the UK
Alpaca	1,715	Og	15,529	3,225	E	
Llama	79				E	
Camels	0				E	
Guanacos	0				E	

Poultry

As information on poultry breeds is available in *Poultry in the United Kingdom* (November 2010) http://www.defra.gov.uk/publications/files/pb13451-uk-poultry-faw-101209.pdf, it is not reproduced here. We will, however, explore approaches to improve the data we can collect on poultry species in future.

Key to abbreviations used in the Inventory

BAR Breeds included on the UK Breeds at Risk (BAR) list and potentially exempt from precautionary culling in the event of an exotic disease outbreak. Where population data provided in this Inventory indicates the breed may no longer meet BAR criteria, status will be reviewed.

BAR(GC)	Breeds included on the UK BAR list solely due to status as a geographically-concentrated breed.
BID	Possible candidate for BREED IN DEVELOPMENT status – 3.3.4 of the main report provides further information.
C	CENSUS. Data indicates a full census of the breed has been undertaken.
C*	Census information has been provided but it has not been possible to verify that a fully comprehensive census has taken place. Census data is included here because other data, such as the three year average of pedigree female registrations, has not been provided.
E	EXOTIC and other NON-NATIVE BREEDS in the UK (including potential UK resident BREEDS IN DEVELOPMENT)
EGBAR	An exotic breed that is at risk globally according to FAO "at risk" criteria. [Further work is required to confirm the list of EGBAR breeds.]
GC	GEOGRAPHICALLY-CONCENTRATED. Where this is followed by "?" further work is needed to confirm geographically-concentrated status.
N	NATIVE. For full definition, see Appendix 1.
N*	Proposed native breed, subject to Committee recommendation.
NBAR	Breeds included on the UK Native Breeds at Risk list and eligible for UK Rural Development Programme agri-environment schemes. Where population data provided in this Inventory indicates the breed may no longer meet NBAR criteria, status will be reviewed.
O	OTHER ESTIMATE. Unless indicated otherwise, this is based on estimates provided to the FAnGR Committee during preparation of the UK Native Breeds at Risk list, which was published in July 2012.
Oa	Estimate from British Cattle Movement Service (BCMS) figures.
Ob	The "original" population of Dairy Shorthorn is taken from a preliminary survey (RBST 2012 unpublished) which suggests that of the estimated 9009 Shorthorn breeding females, 60 of these have no trace of overseas Shorthorn or other breeds in their pedigree.
Oc	Partial estimate from Edinburgh Zoo.
Od	Estimate from keepers.
Oe	The "original" population of Northern Dairy Shorthorn is taken from RBST survey data on the number of Northern Dairy Shorthorn breeding females with no trace of overseas Shorthorn or other breeds in their pedigree.
Of	Estimate provided by Herdwick Sheep Breed Society on the basis of their 2012 census.
Og	Information from British Alpaca Society (BAS)
"original" population	A full definition of "original" population is provided by RBST at: https://www.rbst.org.uk/watchlist-criteria.pdf
P	PREDICTED. This is calculated by using the average number of breeding females registered for 3 years and multiplying by the appropriate "species multiplier" (3.52 for cattle, 2.4 for sheep, 2.7 for pigs and 5.2 for goats)
ZR	Registered under EU Zootechnical legislation.

Appendix 3: Minor and other species

The minor and other species included below are included in this report because of their role in UK agriculture and in relation to potential disease outbreaks. Brief information is provided below and it is hoped that these species can be considered in greater depth in future. Bees and aquatic resources are excluded from the report because they are not within the current remit of the FAnGR Committee. However, these species have been included in the UK Species Inventory[20] list of Farm Animal species and breeds and it will be important to consider whether these should be covered in future FAnGR Country Reports.

Bison (*Bison* species)

There are two wild species of bison, American Bison (*Bison bison*) and European Bison (*B. bonasus*), both of which are physically present in the UK. They have at times been classified as belonging to the same genus as domestic cattle and the American Bison has been used to produce hybrids such as the Beefalo in agriculture.

Buffalo (*Bubalus arni*/*B. bubalus*)

Domesticated Water Buffalo are now being farmed in the UK to some extent and in several different breeds. This species is of major importance in many parts of the world.

Herds of buffalo have been established in the UK in the past decade and there are now a very small number of farmers manufacturing buffalo mozzarella in the UK.

Ratites

Of the four distinct groups of ratites the Ostrich (*Struthio camelus*) and the Rheas (*Rhea americana* and *R. pennata*) are farmed in the UK.

There has been an attempt to establish Ostrich farming in the UK for specialist meat production but this has not been very successful to date.

Camelids

All six camelids are present in the UK, some in considerable numbers. The Dromedary (*Camelus dromedarius*), Bactrian (*Camelus bactrianus*), Llama (*Lama glama*) and Alpaca (*L. pacos*) are all genuinely domesticated, but the Guanaco (*L. guanicoe*) and Vicugna (*L. vicugna*) are considered wild species.

The two main species of South American camelids kept on farms in the UK are llamas and alpacas. Llamas are relatively uncommon and are usually kept in small groups as companion animals and for trekking. Alpacas are much smaller and are bred for fibre production. There are two breeds, the tight fleeced huacaya and the long fleeced suri. They are both found in a range of natural colours from white, fawn, brown and grey to black. There are in the region of 40,000 registered alpacas in the UK in just over 1,000 herds. There is a burgeoning alpaca fibre industry and a vibrant export trade supplying pedigree breeding stock to farmers in Europe. Camelids are also used as a deterrent to foxes for the protection of other farm animals, particularly outdoor poultry.

20 For further information on the UK Species Inventory see http://www.nhm.ac.uk/research-curation/scientific-resources/biodiversity/uk-biodiversity/uk-species/index.html

Deer

There are no real domestic breeds of deer, but several species are “farmed”, particularly Red Deer (*Cervus elaphus*) and to a much lesser extent Reindeer (*Rangifer tarandus*).

Members of the British Deer Farming Association are involved in the breeding, rearing and marketing of farmed deer. Their products are routinely available on supermarket shelves.

Rabbit (*Oryctolagus cuniculus*)

Although the majority of the many breeds of rabbit are fancy breeds that do not necessarily contribute to farming, there are a very few specific breeds and hybrids of rabbits farmed for meat in the UK.

Wild boar (*Sus scrofa*)

Wild boar are farmed in the UK for the limited production of gourmet meat.

Guinea Fowl (*Numida meleagris*)

This is a farmed species kept in several different domestic varieties.

Pheasants (*Phasianus species*)

There is considerable farming of covert Pheasants for shooting in the UK, with all these being derived from wild *Phasianus* species, mostly *P. colchicus*, but some input of *P. versicolor*. None of the other 50+ species of pheasant can be described either as farmed or domesticated, except of course *Gallus gallus* which is one of the main domesticated species and covered elsewhere in this report and in *Poultry in the United Kingdom* (2010).

Quail (*Coturnix* species)

There is now quite a substantial breeding of domesticated Quail, derived largely from the Japanese Quail (*Coturnix japonica*) used mainly for eggs, but also for meat. There are also many wild species of quail, but these are kept by aviculturalists, not farmed.

Partridge

The situation in partridges is broadly similar to that of pheasants described above. There are two principal species (Grey Partridge (*Perdix perdix*) and Red-legged Partridge (*Alectoris rufa*)) kept for the game shooting industry.

Duck (non domestic)

Any farming of duck for shooting in the same way as the pheasants and partridges is probably confined to Mallard (*Anas platyrhynchos*).

Appendix 4: Glossary of terms, further information and acknowledgements

Glossary of terms

CAP – Common Agricultural Policy

CBD – Convention on Biological Diversity

DAD-IS – Domestic Animal Diversity Information System, the FAO's system for recording data on breeds

EFABIS – European Farm Animal Biodiversity Information System

ERFP – European Regional Focal Point for FAnGR

EU – European Union

FAnGR – Farm Animal Genetic Resources

FMD – Foot and Mouth Disease

GRFA – Genetic Resources for Food and Agriculture

In situ / *ex situ* **FAnGR** – breed populations where animals are maintained in protected areas or in their normal production environments are known as *in situ* FAnGR. FAnGR involving the storage of genetic material are known as *ex situ* FAnGR. *Ex situ* FAnGR can include live animals that are not kept on farms, for example those that are kept in zoos.

Major species – the main farm animal species that are covered in this report. These include cattle, sheep, pigs, goats, horses, ponies and poultry.

Minor species – other farm animal species that have a minor role in UK agriculture and are covered briefly in Appendix 3.

Multiplier – the number which, when multiplied by the number of female registrations in a year, gives an estimate of the total number of registered females in the breed. Each species has a different multiplier. A full definition is given in http://www.defra.gov.uk/fangr/files/hall-anm110811.pdf

NAP – National Action Plan on Farm Animal Genetic Resources (Defra, 2006)

NGO – Non-Governmental Organisation

RBST – Rare Breeds Survival Trust, the UK's only charity dedicated solely to conserving all Britain's native farm livestock

UK BAR – the UK Breeds at Risk list: a list of UK native breeds that may potentially be exempt from culling in the event of an outbreak of exotic disease. A full definition is provided at Appendix 1.

UK NBAR – the UK Native Breeds at Risk list: a list of UK native breeds eligible for support under agri-environment schemes through EU rural development programme legislation. A full definition is provided at Appendix 1.

UN-FAO – Food and Agriculture Organization of the United Nations

Further key information

Agriculture in the UK 2011: http://www.defra.gov.uk/statistics/files/defra-stats-foodfarm-crosscutting-auk-auk2011-120709.pdf

Biodiversity 2020: A strategy for England's wildlife and ecosystem services: http://www.defra.gov.uk/publications/files/pb13583-biodiversity-strategy-2020-111111.pdf

The breeding structure of the British sheep industry 2003: http://archive.defra.gov.uk/evidence/economics/foodfarm/reports/documents/pollott2003.pdf

The Convention of Biological Diversity *Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets:* https://www.cbd.int/sp/

The EU Biodiversity Strategy to 2020: http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm

FAnGR Committee: http://www.defra.gov.uk/fangr/

Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration: ftp://ftp.fao.org/docrep/fao/010/a1404e/a1404e00.pdf

Poultry in the United Kingdom: http://www.defra.gov.uk/publications/2011/04/08/pb13451-poultry-in-the-uk/

The State of the World's Animal Genetic Resources for Food and Agriculture: http://www.fao.org/docrep/010/a1250e/a1250e00.htm

UK National Action Plan on Farm Animal Genetic Resources: http://www.defra.gov.uk/publications/2011/05/10/pb12190-fangr-action-plan/

UK Country Report on Farm Animal Genetic Resources 2002: http://www.defra.gov.uk/publications/2011/05/10/pb7959-farm-animal-genetic-resources-2002/

For any further information about this report, please contact the FAnGR Secretariat by email at fangr@gsi.gov.uk.

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