Federal Ministry of
Food, Agriculture
and Consumer Protection

Animal Genetic Resources in Germany

National Programme for Conservation and Sustainable Use
Recent Activities and Achievements

Fallow deer

Foreword

Dear Readers,

The dynamics of our agricultural production have brought us considerable wealth in the past 50 years. Most important for this development was the foundation laid by the diversity of our natural resources – the agricultural biodiversity. This includes conservation of animal genetic resources and their further development. As a part of our common heritage, we do have the obligation to maintain these resources for future generations.

The National Programme on Animal Genetic Resources deals with the special needs of conservation and sustainable use of our farm animals. The Programme forms part of the global efforts to maintain this natural "raw material". In Germany, there is a large diversity of farm animal breeds – from horse to rabbit. Altogether, Germany's gene pool of farm animals, which fall under the Animal Breeding Act, consists of almost 300 breeds, 63 of which are indigenous breeds and quite a few of these are threatened by extinction.

The conservation of these breeds is a contribution to food security because each breed preserves a variety of genetic characteristics and thus contributes to the conservation of the full scope of the gene pool. With these resources in store, animal breeding can respond to changing consumer demands, modern animal husbandry and new environmental challenges. Last but not least, it enables farm animals to adapt to harsh geographical environments, less developed regions or under less favourable climatic conditions in rural areas.

The National Programme provides the political framework in which the user, breeder, breeding associations, scientists, politicians and administrative officers can make their contribution and take common responsibility for agricultural biodiversity the future.

Horst Seehofer
Federal Minister of Food,
Agriculture and Consumer Protection

Schwarzwaelder Kaltblut

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Summary and Conclusions

The "National Programme for Conservation and Sustainable Use" was initiated by the working group of the German Society for Animal Production *(Deutsche Gesellschaft fuer Zuechtungskunde, DGFZ)* following the call of the Food and Agriculture Organisation of the United Nations (FAO) for National Reports on the Status of Animal Genetic Resources. The Programme, as presented in chapter 3, was agreed between all parties involved and finally approved by the Conference of Agricultural Ministers *(Agrarministerkonferenz, AMK)* in 2003.
The following is an update on what has been achieved so far in preserving Germany's animal genetic resources, namely the many breeds at risk of extinction.

Chapter 2 provides background information on the historical development of animal genetic resources in Germany and its relevance in modern animal production. This is complemented by a brief overview of the legal framework.

Chapter 3 contains the National Programme. The version as issued in 2003 remains unchanged but for updated names and figures.

Finally, in **chapter 4** we summarise the main activities and achievements in the priority areas of the National Programme since 2003.

The brochure aims to offer an introduction to the subject, focused on the situation of animal genetic resources in Germany. For further reading there is a choice of literature listed in chapter 5.3. It is, though, not exhaustive, given the ongoing vast abundance of research.

The outline of current conservation measures for animal genetic resources in Germany clearly shows that despite numerous activities, there is still considerable need for optimisation in many areas. However, the request from the FAO to develop a National Programme for Animal Genetic Resources in Germany as a contribution to its Report on the State of the World's Animal Genetic Resources provided a welcome opportunity to develop ideas and put them into action.

A stately ram of the goat breed Thueringer Wald Ziege

Agricultural landscape

1 Introduction

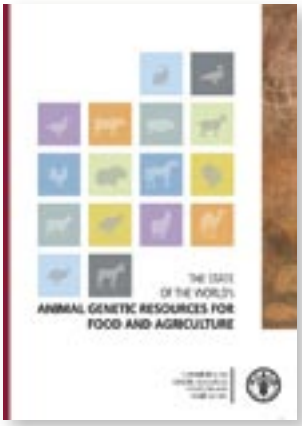
Biodiversity as described by ecologists as the "totality of genes, species, and ecosystems of a region" describes most circumstances and presents a unified view of the traditional three levels at which biodiversity has been identified:

- genetic diversity – diversity of genes within a species. There is a genetic variability among the populations and the individuals of the same species.
- species diversity – diversity among species in an ecosystem. "Biodiversity hotspots" are excellent examples of species diversity.
- ecosystem diversity – diversity at a higher level of organisation, the variety of ecosystems on Earth.

Agricultural biodiversity includes all components of biological diversity relevant to food and agriculture, the components of biological diversity i.e. the variety of animals, plants and micro-organisms which are necessary to sustain the key functions of the agro-ecosystem, its structure and processes.

Two major changes in agriculture have upset its biodiversity equilibrium. One is the intensification of production and the other is the under-utilisation of land. Specialisation, concentration and intensification of agricultural production during the last decades are known to potentially threaten biodiversity conservation. Many species have a direct interdependence with agriculture (i.e. many bird species nest and feed on farmland). However, it is difficult to isolate the effects of changes in land use from others such as urbanisation and the progression of infrastructure in rural areas.

Sound agricultural management practices can have a substantial positive impact on the conservation of the wild flora and fauna, as well as on the socio-economic situation of rural areas. Traditional farming contributes to safeguarding certain natural or semi-natural habitats. Land abandonment and cessation of traditional farmland management, on the other hand, may pose a threat to its biodiversity.
As early as in 1990, the Council of the Food and Agriculture Organisation of the United Nations (FAO) recommended the development of a global strategy for sustainable use of animal genetic resources.
The Intergovernmental Technical Working Group on Animal Genetic Resources (ITWG-AnGR) commended FAO the preparation of a Report on Animal Genetic Resources, the so-called „State of the World's Animal



The State of the World's Animal Genetic Resources Report

Genetic Resources" (SoW-AnGR), based on national reports. FAO began assisting the development of national reports by guidelines and workshops for national co-ordinators in 2000, the deadline for the development of the national reports was 2005. Against this background, the Federal Ministry of Food, Agriculture and Consumer Protection *(Bundesministerium fuer Ernaehrung, Landwirtschaft und Verbraucherschutz, BMELV)* together with the responsible authorities in the *Laender** appointed a National Committee on Animal Genetic Resources (*Fachbeirat Tiergenetische Ressourcen, FBR TGR*): The Council consisted of representatives from the Committee on the Conservation of Farm Animal Genetic Diversity of the German Society for Animal Production *(Deutsche Gesellschaft fuer Zuechtungskunde, DGfZ)*. Its first task was to draft Germany's contribution to the SoW-AnGR report, which contained the National Programme for Conservation and Sustainable Use of Animal Genetic Resources as its main component, as presented in chapter 3.

The State of the World Report was finally published during the Interlaken Conference in 2007. Delegates from 109 countries also adopted a "Global Plan of Action for Animal Genetic Resources" based on the Strategic Priorities for Action, which were prepared together with the SoW-AnGR. The Global Plan reflects national, regional and international priorities for action and is the first internationally agreed framework to halt the erosion of livestock diversity and support the sustainable use, development and conservation of animal genetic resources. The finalisation of The State of the World's Animal Genetic Resources for Food and Agriculture and the International Technical Conference on Animal Genetic Resources for Food and Agriculture in September in Interlaken, Switzerland, make 2007 an important year for intergovernmental policy-making in the area of animal genetic resources. It is expected that governments will be encouraged by their results to increase their efforts with respect to the sustainable conservation of animal genetic resources.

*In this document Germany's 16 federal states are referred to as "Laender".

Deutsches Schwarzbuntes Niederungsrind

2 Framework for Animal Genetic Resources in Germany

2.1 Definitions

Animal Genetic Resources
The Convention on Biological Diversity (CBD) defines genetic resources as “any material of plant, animal, microbial or other origin containing functional units of heredity”. For the purposes of this paper, animal genetic resources are understood to be “material from farm and food-producing animals (farm animals)”.

Population
In animal breeding, a population is more or less defined as a closed mating community, i.e. groups of animals that regularly contribute to a common gene pool. The members of one (breeding) population are thus more closely related than members of different populations. Breeding lines and even inbred lines are special populations which provide the genetic resources for commercial breeding programmes. Breeding lines can show marginal genetic variability, something that happens by default in inbred lines.

Breeds
In contrast to populations, breeds are not exclusively genetically but also geographically, regionally, morphologically and otherwise defined animal groups of one species. Breeds can be part of one population (subpopulations) or a mixture of multiple populations (synthetic or pure breeds) used in breeding activities. In the context of conserving (animal) genetic resources, genetically related breeds must be regarded as one.

Braunvieh alter Zuchtrichtung

Landraces (local breeds, regional breeds)
These are breeds with small population sizes or animal groups found in specific regions or ecological niches. They are often the remainder of a former larger local breed which, due to prevailing environmental conditions or less efficient breeding programmes, have fallen behind in performance compared to intensively bred farm animals. Lagging behind in performance was the prime reason why many of those breeds are endangered now, and with them vital alleles potentially needed for adaptation and survival in extreme geographical and climatic conditions, and in conditions of extensive farming. Loss of a landrace‘s alleles would mean loss of the quality characteristics in their products, characteristics that might be missing in products from high performance breeds. These breeds thus deserve particular attention in programmes designed to conserve animal genetic resources.

Indigenous breeds
According to the new Animal Breeding Act a breed is defined as „indigenous“ if the original herd-book was established in Germany and has been maintained ever since. A breed can be acknowledged as „indigenous“ by the responsible authorities, if the herd-book was not established in Germany but the only herd-book for the breed is maintained in Germany and a breeding programme is carried out or a herd-book has been maintained since 1949 in Germany and a separate breeding programme is carried out.

Effective population size (N_e)
N_e is a term used in population genetics and defined as the “total number of male and female breeding animals in an idealised population that is expected to have the same rate of inbreeding and associated allele loss as the breeding population under study”. An idealised population with a gender ratio of 1 : 1, no selection and random mating shows only random fluctuation of family size. These idealised conditions are usually not found in farm animal populations, and their effective population size is therefore often considerably smaller than the actual number of breeding animals suggests, and thus the rate of inbreeding is higher. N_e therefore serves as a parameter for the comparison of different populations in terms of their endangerment due to gene loss.

- *In situ* conservation
  According to the CBD, this means "the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties".

- *Ex situ* conservation
  The CBD defines *ex situ* conservation as "the conservation of components of biological diversity outside their natural habitats". Except for the keeping of small animal groups in zoos and domestic animal parks, this means cryoconservation of embryos, gametes, cell cultures and DNA in appropriate gene banks under laboratory conditions.

To clarify these definitions, we would add that appropriate management of farm animals outside their region of origin is considered "*in situ*", not "*ex situ*". The continuous expansion of Pinzgauer cattle – originally a dual purpose breed from the Alps – as beef cattle in the North-German plains, for example, does not fall in the range of "*ex situ* management".

Sustainable use
In terms of genetic diversity in farm animal breeding, sustainable use is defined by the CBD as "the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations". As genetic diversity encompasses both genetic variability within and between populations and breeds, this definition calls not only for the conservation of endangered breeds, but also for the management of genetic variability within presumably larger production populations as part of a sustainable management programme.

Shepherd with a flock of Heidschnucken sheep

2.2 Historical Developments

Draft horses working with plough

While organised farm animal breeding associations have existed for more than 100 years, targeted and efficient production-based selection has been applied for the last 50 years only – a result of the growth in wealth since World War II. Advancements in biotechnology with artificial insemination (AI) and embryo transfer (ET), and in animal breeding with data processing, index selection, commercial cross- and hybrid-breeding have led to a rapid improvement of the commercially significant characteristics milk, meat and egg production in intensively managed breeding populations of cattle, pigs and poultry. Breeding is now focussed on a few economically important performance traits of high market value, e.g. meat proportion, milk volume, egg numbers, while many of the characteristics that concern farmers, such as health, fertility or longevity, carry less weight. The latter, so-called functional traits may well be more deeply rooted within the old landraces. This market-driven trend has led to an intensive production of a few, sometimes globally used high-output breeds, for example Holstein cattle, a number of meat pig breeds, Leghorn hens and a few broiler lines.
At the same time, many of the less productive landraces have lost their importance. As a consequence, their population size continues to decrease and they become endangered. The loss of these endangered landraces comes along not only with the risk that important alleles disappear, but also that stringent selection and global use of ever fewer sires lead to an increase in inbreeding within high-output populations. This in turn means ongoing reduction and potential loss of genetic diversity and of alleles that currently are not thought useful in achieving breeding objectives. It is feared that the use of molecular biotechnology, especially with marker assisted selection, will accelerate this trend.

Changes in agricultural production and in industrial product processing render formerly important farm animal breeds obsolete, which results in their declining numbers and therefore the risk of their extinction. For example, as a result of the technical progress in agriculture and forestry, many of the draught horse breeds (particularly heavy horses and heavy warmblood horses) have already disappeared. With regard to the skills under saddle, the remaining warmblood horses are bred more and more uniformly around the world. Another example: due to the widespread use of cotton and synthetic yarns in the textile industry, wool and fur sheep have lost much of their importance.

This trend is intensified by the concentration of demand, which forces producers to offer the expanding consumer industry uniform products of strictly defined quality at falling prices. In an increasingly globalised market, small amounts of regional niche products do not have a chance. The products and thus the producers and their farm animals can only stand their ground if they open specialised markets where the particular characteristics of local products with a higher unit price are appreciated accordingly. This requires not only self-production, but also direct marketing. Thus, the traditional breeding structures of farmers, i.e. breeding associations, are put at risk by globally active breeding companies, which now become the rule for hybrid poultry and pig breeding. It can be expected that this trend will continue with the globalisation of the markets for the animal species mentioned above: trends in this direction are evident in horse breeding, too, despite unfavourable organisational structures. At present, only sheep, goat and cattle are bred along traditional paths in Germany.
The trend outlined in contemporary industrial societies leads unintentionally to more farm animal breeds being at risk of extinction. The potentially irreversible loss of alleles associated with extinction reduces genetic diversity. For this reason, the conservation of endangered breeds “as the genetic resources of the future” has become a social liability.

The use of limited public funds and fundraising from private sponsors for this task requires that, on the one hand, the social importance of the local breeds is pointed out irrespective of their present day market value and that, on the other hand, cost-effective, sustainable and reliable conservation methods are developed and recommended.

Table 1: Herd-book Cattle in Germany – Trends in number of Herd-book Cows (1951 – 2006)

Breed Name	Year					
	1951	1960	1970	1980	1989	2006
Braunvieh alter Zuchtrichtung	29,725	24,617	66,997	107,204	174,205	143,917
Charolais					4,602	8,681
Deutsche Angus					1,717	8,108
Deutsche Holstein Rotbunt	86,593	125,157	124,010	129,382	167,809	142,900
Deutsche Holstein Schwarzbunt incl. Deutsches Schwarzbuntes Niederungsrind	319,898	421,111	393,047	493,346	719,221	1,475,624
Deutsches Rotvieh / Rotes Hoehenvieh	5,173	5,556	3,150	2,191	2,761	701
Deutsches Shorthorn	1,292	36	35	2	10	273
Fleckvieh	133,444	175,254	200,150	311,020	589,173	642,448
Galloway					2,055	4,733
Gelbvieh	13,885	15,268	12,048	12,004	24,318	4,603
Hinterwaelder	688	872	437	288	616	627
Jersey		477	5,574	1,576	2,688	1,881
Limousin					1,055	9,594
Murnau-Werdenfelser	1,182	478	688	57	86	125
Pinzgauer	2,991	1,761	1,666	240	348	830
Rotvieh alter Angler Zuchtrichtung	16,641	17,277	15,822	13,782	12,537	13,054
Scottish Highland					804	3,190
Vorderwaelder	2,430	4,649	3,571	3,172	6,093	4,050
total	**613,942**	**792,513**	**827,195**	**1,074,264**	**1,710,098**	**2,465,339**

Table 2: Herd-book Cattle in Germany – Percentage of Herd-book Cows (1951 – 2006)

Breed Name figures in %	Year					
	1951	1960	1970	1980	1989	2006
Braunvieh alter Zuchtrichtung	4.8	3.1	8.1	10.0	10.19	5.84
Charolais					0.27	0.35
Deutsche Angus					0.10	0.33
Deutsche Holstein Rotbunt	14.1	15.8	15.0	12.0	9.81	5.80
Deutsche Holstein Schwarzbunt inkl. Deutsches Schwarzbuntes Niederungsrind	52.1	53.1	47.5	45.9	42.06	59.85
Deutsche Shorthorn	0.2					0.01
Deutsches Rotvieh / Rotes Hoehenvieh	0.8	0.7	0.4	0.2	0.16	0.03
Fleckvieh	21.7	22.1	24.2	29.0	34.45	26.06
Galloway					0.12	0.19
Gelbvieh	2.3	1.9	1.5	1.1	1.42	0.19
Hinterwaelder	0.1	0.1	0.1	0.0	0.04	0.03
Jersey					0.16	0.08
Limousin					0.06	0.39
Murnau-Werdenfelser	0.2	0.1	0.1	0.0	0.01	0.01
Pinzgauer	0.5	0.2	0.2	0.0	0.02	0.03
Rotvieh alter Angler Zuchtrichtung	2.7	2.2	1.9	1.3	0.73	0.53
Scottish Highland					0.05	0.13
Vorderwaelder	0.4	0.6	0.4	0.3	0.36	0.16
other		0.1	0.7	0.1		
total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 3: Breeding Pigs in Germany – Percentage of registered herd-book animals (1950 – 2006)

Breed Name figures in %	Year					
	1950	1960	1970	1980	1990	2006
Angler Sattelschwein	12.5	5.1	0.5	0.2	0.1	0.2
Berkshire	1.1					
Buntes Bentheimer					0.3	0.6
Cornwall	1.5					
Deutsche Landrasse	68.1	86.5	93.8	75.0	51.1	66.4
Deutsche Landrasse B				10.0	2.5	
Deutsches Large White	7.1	2.5	1.7	2.0	9.6	19.2
Duroc					0.3	0.3
Hampshire					0.9	
Pietrain			3.6	12.8	34.7	12.7
Rotbunte Husumer		0.1	0.2			0.1
Schwaebisch Haellisches Schwein	8.0	4.8	0.1		0.5	0.5
Weideschwein	1.7	0.5	0.1			
total	**100.0**	**99.5**	**100.0**	**100.0**	**100.0**	**100.0**

2.3 The Significance of Animal Genetic Resources

The **economic value** of animal genetic resources is defined by their actual and potential value.

The **actual economic** value consists of the contribution of animal genetic resources to the agricultural value chain and to the pre- (e.g. breeding programmes) and post-production sectors (e.g. processing industry, trade). Small endangered breeds have an actual value if they contribute specific characteristics to present-day breeding programmes, e.g. disease resistances like the trypanotolerance in African N'Dama cattle, improved claw integrity and endoparasite resistance in some landrace sheep breeds, quality characteristics like the intramuscular fat content in Duroc pigs or specific suitability for cross breeding like the Hampshire to produce fertile sires. The characteristics of landraces can be important for regional niche programmes, too, as is shown e.g. in the successful marketing of Heidschnucken and Rhoen sheep in local gastronomy and in the use of the Schwaebisch Haellische pig in the quality meat co-operative of the same name.

The **potential economic** value of animal genetic resources, on the other hand, is their genetic diversity itself, which one day may be used to allow for product diversification, should e.g. product standards, environmental conditions and management methods change. It is expected that with advanced application of molecular biotechnology in farm animal breeding, useful genes that determine product quality, animal vitality and disease resistance will be found in adapted landraces, making them valuable for future breeding programmes.

Great ecological and considerable **economic value** is attributed to farm animals used in nature protection and landscape management. This often involves landraces that have adapted to the prevailing environmental conditions, in particular many sheep breeds such as the Skudde, Heidschnucke and Bergschaf sheep which are kept on dikes, heaths, moors and mountainous terrain, but also cattle breeds like Hinterwaelder, Rotes Hoehenvieh and other adapted beef cattle breeds. Ongoing globalisation of farm animal breeding programmes will result in breeds having to adapt to a variety of different environmental and production conditions. Animal production in marginal areas, extensification programmes and less-developed regions call for animals that differ geneti-

Good combination of intramuscular fat content of Duroc with the lean carcass of Pietrain

cally from the dominating populations in intensive production systems in Germany, and are rather bred from well-adapted landraces.
Breeding and husbandry of poultry, rabbits and other species used in agriculture also have to be considered from this aspect.

In organic farming, new and sustainable methods to use old breeds in production can be developed. At present, organic farming, too, is dominated by high-performance breeds. By using genetic resources from highly endangered local breeds, some farmers seek to maintain healthy animal stocks because it is assumed that old breeds can cope with the conditions in organic agriculture better than high-performance breeds and thus have a clear advantage. Unfortunately, the many benefits of endangered breeds are often enough outweighed by their low performance, which makes them unsuitable even in organic farming. Therefore, performance under the conditions in organic farming has to be improved based on the genetic material from endangered old breeds.

Farm animal breeds that have evolved over time and most traditional livestock management systems can be regarded as **cultural and historical achievement** of our forefathers. They have therefore to be valued as "cultural heritage of humankind" and have to be saved from disappearing for education and demonstration purposes. In our society focused on leisure time and tourism, this becomes more important in less economically developed regions where the display of historical landscapes, old methods of farming and handicrafts and past lifestyles in natural history museums, domestic animal parks and museum villages attract visitors and tourists.

Pinzgauer cattle

2.4 Legal and Political Framework

There is no specific policy area or legislation to rule the conservation and use of genetic resources for food, agriculture, forestry and fishery. Animal genetic resources are by and large affected through legislation on e.g. European and national animal breeding and welfare, common market structures, subsidies and other areas of agricultural and trade policy.
As far as research is concerned, policy in this area is important in terms of basic knowledge on genetic resources and methods for their conservation and utilisation.
Most important for animal genetic resources from Germany are also environmental and nature protection policies.

Most of the genetic resources currently used in agriculture come from developing countries. Given the global distribution of farm animal breeds and the great wealth of genetic resources of developing countries, economic co-operation, development and balancing interests with the countries of origin of animal genetic resources will play a role in the future.

2.4.1 International

In order to set up internationally binding Treaties and Conventions for the protection of the environment, the United Nations (UN) chose to hold a "UN Conference on Environment and Development" (UNCED) in 1992, otherwise known as the " Earth Summit" or "Rio Conference". The conference resulted in five important "documents":

- Rio Declaration on Environment and Development
- The Forest Principles
- The Convention on Climate Change
- The Convention on Biological Diversity
- Agenda 21.

The opening ceremony of the ITC in Interlaken

The most significant regulatory framework for the conservation and use of genetic resources is the "Convention on Biological Diversity" (CBD). With its ratification in 1992, more than 170 signatory states – including Germany – have committed themselves to the conservation and sustainable use of biodiversity in their sovereign territory by developing national strategies, programmes and plans to integrate the convention's aims into their sectoral policies. A working programme for agricultural biodiversity was agreed at the Conference of the Parties (COP) in 2000. Agenda 21, too, is of great political significance, though not a legally binding instrument. It provides a framework for sustainability which has to be filled in by the signatory nations from government level (National Plan) down to local authorities (Local Agenda 21).

In December 1992, the United Nations (UN) General Assembly established the "United Nations Commission on Sustainable Development" (CSD) to ensure effective follow-up of the UNCED, i.e. to review the progress in the implementation of Agenda 21 and the Rio Declaration on Environment and Development.

The Food and Agriculture Organization of the United Nations (FAO) plays another important role in implementing Agenda 21. In 1983, the FAO established a Commission on Plant Genetic Resources, the mandate of which was expanded in 1995 to include farm animals, and that was renamed "Commission on Genetic Resources for Food and Agriculture" (CGRFA). In May 1997 at last, the Commission established a subsidiary Intergovernmental Technical Working Group on Animal Genetic Resources (ITWG-AnGR) to address issues relevant for the conservation and sustainable use of animal genetic resources for food and agriculture and to advise the CGRFA on the development and implementation of the "Global Strategy for the Management of Farm Animal Genetic Resources".

The Food and Agriculture Organization of the United Nations

As recommended by CGRFA in 1999, the country-driven report on the State of the World's Animal Genetic Resources was finally published at the 1st International Technical Conference on Animal Genetic Resources, which took place in September 2007 in Interlaken (Switzerland). It is a major step forward in the global management of animal genetic resources.

As recommended to the CGRFA by ITWG-AnGR at its fourth session in December 2006, the "Global Plan of Action for Animal Genetic Resources" as a planning framework for the CGRFA, FAO and others to advance the management of AnGR was the main outcome of the Conference. Delegates from 109 countries adopted the Global Plan, which is the first internationally agreed framework to halt the erosion of livestock diversity and support the sustainable use, development and conservation of animal genetic resources.

European Community regulates Animal Breeding

2.4.2 Europe

A pan European initiative, SEBI2010 (Streamlining European 2010 Biodiversity Indicators), was launched in 2004. Its aim is to develop a European set of biodiversity indicators to assess and inform about progress towards the European 2010 targets, i.e. to achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on earth.

Against this background the EU Commission adopted the "Biodiversity Action Plan for Agriculture" in 2001 with the following priorities:

- the promotion and support of environmentally-friendly farming practices and systems that serve biodiversity directly or indirectly;
- the support of sustainable farming activities in areas rich in biodiversity;
- the maintenance and enhancement of good ecological infrastructures and
- the promotion of actions to conserve local or threatened livestock breeds or plant varieties.

All these priorities are supported by research, training and education actions. Biodiversity conservation greatly depends on the sufficient and targeted application of measures within the CAP, notably compensatory allowances for less favoured areas and agrienvironmental measures.

Following a mandate from the Council and the European Parliament, in 2004, the Agriculture Directorate General (DG) drew up a report on the implementation of this action plan in consultation with all interested parties, represented in an ad hoc working group.

Furthermore, the Council adopted a Community programme under Council Regulation (EC) No. 870/2004 on "Establishing a Community programme on the conservation, characterisation, collection and utilisation of genetic resources in agriculture" covering the period from 2004 to 2006. The programme promoted genetic diversity, the exchange of information and co-ordination in the field of international undertakings regarding genetic resources. Several projects have since been supported by means of a total budget of EUR 10 million allocated to this programme.

Council Regulation (EEC) 2078/92 on "Agricultural production methods compatible with the requirements of the protection of the environment and the maintenance of the countryside" introduced co-financing by the EU for the conservation of endangered farm animal breeds by the *Laender*. This was continued by the Agenda 2000, which was laid down in Council Regulation (EC) No. 1257/99 on "Support for rural development from the European Agricultural Guidance and Guarantee Fund (EAGGF)", now replaced by Council Regulation (EC) No. 1698/2005 on "Support for rural development by the European Agricultural Fund for Rural Development (EAFRD)".

Apart from that, European zootechnics legislation on the recognition of breeding organisations, entering in herd-books, pedigree certificates, performance testing, genetic evaluation and acceptance for breeding deals with animal genetic resources. If one or more officially recognised breeding organisations or associations already exist, the authorities of the concerning Member State may refuse to recognise a new breeding organisation or association if it endangers the preservation of the breed in respect.

2.4.3 Germany

Breeding of horses, cattle, pigs, sheep and goats in Germany is ruled by the Animal Breeding Act and its rules of application. The Breeding Act focuses on the implementation and documentation of breeding animals, and rules the type and scope of performance testing and recording in compulsory breeding programmes. In addition, the Animal Breeding Act contains provisions on the implementation and use of biotechnology in artificial insemination and embryo transfer. The Animal Breeding Act rules the approval of breeding associations, breeding companies, insemination centres and embryo transfer institutes along with the approval of their breeding programmes, herd-book regulations (herd-book recording) and their area of activity. Responsibility for the implementation of the Breeding Act lies with the *Laender*. Breeding organisations are approved and monitored by the authorities responsible for animal breeding in the *Laender*.

The Breeding Act was amended in 2006 and came into force at the beginning of 2007. It now rules the conservation of genetic diversity as one major objective. In this context, the Breeding Act includes a definition of indigenous breeds and directions for the establishment of monitoring, subsequent *in situ* conservation programmes and cryoconservation measures, which underlines the importance of animal genetic resources in German animal breeding. Since animal breeding is governed by the legislation of the *Laender*, the latter are now revising the corresponding rules of application incl. the financing of the corresponding measures.

The breeding of endangered farm animals often forms part of the agro-environment programmes of the *Laender* and in most cases are co-financed by the EU, according to Council Regulation (EC) No. 1698/2005. Those subsidies for the conservation of endangered species and breeds, however, are subject to the Community Guidelines for state aid in the agriculture sector. Support measures within the framework of the conservation activities implemented by the *Laender* without co-financing are still bound to EC regulations (for measures of the *Laender* see table II (annex)).

2.5 Farm Animal Breeding in Germany

2.5.1 Geography and demographics

The Federal Republic of Germany is situated in Central Europe and has a land mass of 357,022 km². Germany reflects the landscapes of Western, Central and Eastern Europe. Its western coastline meets the North Sea and its eastern coastline the Baltic Sea. Germany can be divided into the North German Lowland, the Central German low mountain ranges, Southern Germany and the Alpine Foreland of Bavaria.
The Federal Republic of Germany has a population of some 82 million, which amounts to approximately 230 inhabitants / km². Population development has remained static over the last years.

2.5.2 Structure of agriculture in Germany

In 2005 there were approximately 366,000 farms of more than 2 ha utilised agricultural area (UAA). The number of farms has declined since 2001 by more than 10%. The farms with more than 2 ha UAA manage approximately 17.0 million ha UAA, 11.4 million ha thereof in the former Federal Territory and 5.6 million ha UAA in the *New Laender*. Constant UAA in combination with declining numbers of farms resulted in an increase in UAA per farm, which in 2005 rose to 46.5 ha on average – farms in the former Federal Territory coming up to 34 ha, whereas those in the *New Laender* had 202 ha on average. Regional examination shows a North-South-divide both in the East and the West.
In Germany, the limit of growth regarding farm size is increasing: in the early 1980s, 30 ha marked the minimum size above which the number of farms increased, in 2005 it was 75 ha. The greatest gain was registered for farms in the size range of 200 to 500 ha, whereas the number of farms with more than 1,000 ha fell slightly.

There are different legal forms of farms in Germany. Individual enterprises remain the dominant form and are usually family-run farms. In 2005, they made up 94% of all farms and farmed around 69% of the total UAA. However, private companies become more important: about one eighth of the land (13.5%) is farmed by around 18,800 companies, which make up 4.0% of all farms. 5,300 legal entities under private or public law farmed almost one fifth (17.6%) of Germany's total UAA, in the *New Laender* they cover well over 50% of the total UAA.

In the former Federal Territory, the proportion of land owners decreased due to structural changes. While the proportion of leased land remains at a stable 53.5%, there is an increasing number of farms expanding by leasing additional land. In the *New Laender*, the proportion of leased land has been declining since 2003. With appr. 213,000 ha UAA, ever more farmers own the land they till, which is a result of the privatising activities of the land use and management corporation of Germany (*Bodenverwertungs- und -verwaltungs GmbH*). However, with 81.2%, the average proportion of leased land is higher in the *New Laender* than in Germany as a whole (62.6%).

Agricultural landscape

In 2005, approximately 1.26 million people were employed full-time or part-time in the agricultural sector, including 300,000 non-permanent (mostly seasonal) workers. The number of persons permanently employed in the agricultural sector fell to 960,000, thus continuing the long-term trend.

Retrieving hay bales

Approximately 61% of all farm workers are family members. Their number declined faster in comparison to hired employees in total, which can be put down to the developments in the former Federal Territory. In the *New Laender*, the number of jobs in the agricultural sector remains constant, but the fraction of hired employees is growing, too.

2.5.3 Agricultural markets

Germany's most important vegetable products are grain, oil-seed, potatoes, fruits, vegetables and wine grapes.
The most important animal products are cow's milk, beef, veal, pork, poultry and eggs.

Table 4: Agricultural Products in Germany and Sales Volume (source: Agricultural Report of BMELV, 2006)

Product	Production (2005) in million to	Self-Sufficiency in %
Milk	28.45	108 (fresh milk)
Beef and Veal	1.15	121
Pork	4.29	97
Poultry	1.20	82
Eggs	0.79	73

Table 5: Agricultural Production (source: Statistical Annual Report on Food, Agriculture and Forestry, 2006)

Product	in million EURO	Share in %
Vegetable Products	13,113	40.5
Cattle incl. calves	3,181	9.8
Pigs	6,118	18.9
Poultry	1,117	3.5
Sheep	167	0.5
other animals	162	0.5
Milk	7,939	24.5
Eggs	535	1.7
other animal products	21	0.1
Animal Products total	**19,240**	**59.5**
Vegetable + Animal Total	**32,353**	**100.0**

Table 6: Animal Stocks in Germany (source: TGRDEU, 2006)

Animal Species	Total Animals	Female Herd-book Animals
Horses	500,400	> 110,000
cattle total	12,688,600	2,472,839
Dairy cows (> 2 years)	4,070,300	2,419,177
Suckler cows (> 2 years)	662,600	53,662
Pigs	27,103,000	38,581
Sheep	2,444,400	92,100
Goats	180,000	13,862

2.5.4 Food Consumption

Some 186 billion EURO were spent on food, drinks and stimulants in Germany in 2006, which highlights the size of the market (source: Federal Statistical Office (*Statistisches Bundesamt*)).

Compared to total consumer spending of private households, expenditure on foodstuffs and stimulants has shown a steady downward trend. It fell from 18.5% in 1998 to 12% in 2005 (source: German Farmers' Association *(Deutscher Bauernverband, DBV)*. It is not alone the fact that overall foodstuff consumption is no longer growing that accounts for this trend. It is also the result of the enormous growth in productivity of the agricultural sector and the food industries and of intense price competition in the retail foodstuffs market. Germany has the lowest expenditure on foods, drinks and stimulants in consumer spending of all EU Member States.

The average household in Germany spent around € 272 per month on food, drink and stimulants (source: Federal Statistical Office, 2006): around 18.6% on bread and cereal products, 11.9% on potatoes and vegetables, 10.1% on fruits, 24% on meat and meat products, 16.2% on dairy products and eggs and 3.4% on fish and fish products.

The total of meat consumption has changed only little in the past decade, but there has been a considerable shift in which type of meat is consumed. While per capita consumption of beef dropped, demand for pork and even more so for poultry increased considerably. As regards dairy products, per capita consumption of full-fat milk fell significantly since 1991, while sales of dairy products, particularly yoghurt, increased on a similar scale. Cheese consumption, too, increased significantly in the past decade.

Eggs – one of the most important animal products

Yoghurt – a dairy product

Consumers' purchasing behaviour, consumption of and expenditure on foodstuffs in Germany have changed considerably over the years. Today, the main criterion for the selection of foodstuffs is the price, which ranges even before freshness, quality and taste. However, factors like health value, type and place of production and convenience aspects gain in importance for many consumers. In addition, the fraction of consumers who buy organic foodstuffs is growing steadily, last but not least "promoted" by epizootics like BSE (bovine spongioform encephalopathy), Scrapie or swine fever.

2.5.5 The Structure of Animal Breeding in Germany

Most of the breeding associations in Germany and many insemination centres, too, have the legal form of voluntary association or co-operative. Some insemination centres and embryo transfer institutes are private companies or limited companies and can also be special purpose associations.

Breeding associations alone are authorised to carry out pure-breeding programmes. Breeding companies are a special form of breeding organisations under the Animal Breeding Act in Germany. These private companies may only operate cross-breeding programmes. In Germany, the only breeding companies approved under the Animal Breeding Act are for pig breeding. That is to say, with respect to animal genetic resources, that only breeding associations can keep an officially approved herd-book and thus operate a breeding programme for a specific breed. Though some breeding associations are authorised to operate in more than one *Land* or nation-wide, the area of activity of a breeding organisation is generally confined to a specific region. This may have the unwanted effect that several breeding organisations in different *Laender* keep a herd-book for one and the same breed. Sometimes more than one herd-book is kept for the same breed by different breeding organisations within the same *Land*, even.

Breeding associations whose area of activity is restricted to only one *Land* are common in sheep, horse or beef cattle breeding. Breeding associations approved according to the Breeding Act can naturally deal with more than one breed, though they have to keep a separate herd-book for each breed.
Most of the approved breeding associations affiliate with regional, federal or umbrella breed associations. The umbrella associations, however, are not approved breeding associations under the Animal Breeding Act. Rather, they act according to the interests of their members. The umbrella breed organisations co-ordinate the breeding programmes nationwide. In many cases, their recommendations are incorporated into the constitution and herd-book regulations of the affiliated breeding associations.
The following table provides an overview of the number of approved breeding associations and the number of breeds registered in herd-books.

Germany's animal breeding organisations

Table 7: Number of Breeding Associations and Breeds

Species	Number of breeding associations (incl. breeding companies) (2006)	Number of breeds registered with the breeding associations (2006)	Number of breeds thereof important in production systems (2006)
Horse	35	94	*
Cattle	33	42	7
Pig	21	15	3
Sheep	17	59	*
Goat	14	26	2

* Data for horse and sheep not available.

Stratification in breeding organisation is a question of species:
More than 50% of cattle are registered with breeding associations, more than 80% are used in artificial insemination and more than 80% of milk cows are tested in milk recording.

Around 95% of young sows sold by breeding companies or breeding associations are hybrid or crossbred. Less than 6% of the ewes are herd-book animals. Traditional pig breeding in herd-book organisations is being replaced by hybrid breeding in companies of global commercial influence.

Poultry breeding is structured differently. On the one hand, there are the commercial poultry breeders, a really small number of globally active breeding companies that use a few internal breeding lines to produce high performance "products", i.e. laying and fattening hybrids with company-specific tradenames. On the other hand, there are numerous poultry breeding associations which engage (often as amateurs) in breeding and conservation of old commercial poultry and exotic fowl breeds. The majority of these breeding associations are organised in the Federation of German Poultry Breeders *(Bundesverband Deutscher Rassegefluegelzuechter e.V., BDRG)*.

The structure of rabbit breeding is much the same, with a few international hybrid breeding companies dealing in rabbits for fattening and the numerous local breeding associations that are represented by the National Association of German Rabbit Breeders *(Zentralverband Deutscher Rasse-Kaninchenzuechter e.V., ZDRK)*.

Angora rabbit

Brown layer

The SoW-Report on Animal Genetic Resources includes wildlife species, too. Some of these are used in game farming, while other huntable animals contribute also to food security. Section 4.1.4 of this document gives some information on game utilisation in Germany. Given the lack of key requirements for conservation activities, however, the National Programme does not specify any activities in this area.

The importance of endangered farm animal breeds

Table I (annex) gives an overview about Germany's number of farm animals. The table contains figures on the total stock of breeding and production animals for each species in Germany compared to the numbers of breeding animals registered in herd-books. The figures highlight the significance of the species of cattle and pig, and reflects the dense organisational structure in cattle breeding.

A herd of Hinterwaelder cattle in the Black Forest

With regard to the number of breeds and the relative importance of endangered breeds, sheep breeding can be classified as the most diversified kind. The situation is similar with goat breeding. In horse breeding, the mere number of breeds is the most striking figure.

For many decades, in fact since the idea of conservation and promotion of endangered farm animal breeds first emerged, the discussion on when a breed is deemed at risk of extinction has been controversial. The main problem is that sinking population sizes come along with an increasing probability of loss of alleles. This means that it is impossible to define a critical value which determines the "natural" starting point of a conservation programme for populations at risk – no matter how helpful such a figure would be for deciding on government aid.

Bearing in mind that the loss of alleles with unknown functions by random drift in populations kept as animal genetic resources has to be minimised, the overall aim should be to minimise the rate of inbreeding. This can be achieved by maximising the so-called effective population size (N_e).

3 National Programme for the Conservation and Sustainable Use of Animal Genetic Resources

The Co-ordination Group of the DGfZ put forward the recommendation for the "National Programme for the Conservation and Sustainable Use of Animal Genetic Resources". The National Programme was agreed between the Federal Government, the *Laender* and other participants and was approved by the Conference of Agriculture Ministers (*Agrarministerkonferenz, AMK*) on 21st March 2003. It serves as a guideline for close co-operation between all parties.
The actions of the National Programme as detailed in the following currently focus on horses, cattle, pigs, sheep, goats, rabbits, hens, geese, ducks, turkeys and pigeons.
Game contributing to food security or wild relatives of farm animals and game kept for game-farming will be considered when the Programme will be revised in future.

3.1 Objectives

The objectives of the National Programme are:

- long term *in situ* and *ex situ* conservation of the diversity of animal genetic resources in scientifically sound and cost-effective breeding programmes;
- enhancing attractiveness of animal genetic resources for sustainable animal production systems by means of description, evaluation, documentation and breeding tests;
- contributing to the conservation and use of agricultural grassland ecosystems and supporting the utilisation of animal genetic resources in nature and landscape protection areas;
- supporting all actions concerning the conservation of animal genetic resources and establishing a transparent system of competence and responsibilities between the Federal Government and the *Laender*, NGOs and private sponsors;
- promoting co-operation at national, European and international level and exploiting the resulting synergies.

Portrait of Coburger Fuchsschaf

Angler Sattelschwein piglet

3.2 Measures for the Conservation of Sustainable Use of Animal Genetic Resources

The most important actions for the establishment of a back-up system for animal genetic resources are the use of *in situ* conservation and cryoconservation. Depending on the population size, the process includes three steps:

- monitoring of large, non-endangered production populations,
- semen / embryo cryoconservation programmes for populations which fall below the first critical value;
- *in situ* conservation of populations which fall below the second critical value.

The first step aims at monitoring both the variability within populations and stock sizes.
The second step aims at initiating cryoconservation measures as long as enough animals are still available. Cryoconservation is suitable as back-up for conservation breeding programmes in the first place, but also for safeguarding the alleles of a population from extinction.

The third step involves live conservation, its main objective being the conservation of a population with sufficient numbers for sustainable use, e.g. in niche production. The measures of this step require identification of individual animals involved in the programme, including their complete ancestry, whereas in cryoconservation this is only required from sires that were chosen as donors.

Strupphuhn

3.2.1 In Situ Conservation Depending on Endangerment Status

Sustainable *in situ* conservation (on-farm management) of farm animal populations requires herd-book management. This involves the identification, tagging and registration of farm animals in herd-books or at least in a database together with the documentation of their ancestry. These measures are subject to the Animal Breeding Act enforced by the authorities of the concerning *Laender* and are routine procedures of approved breeding programmes with regional herd-books or breed registries.

Similar registration is required for conservation programmes for species not dealt with in the Animal Breeding Act. However, this implies considerable effort on the part of poultry and rabbit breeders, which the amateur organisations are not capable of.

Monitoring Population Size and Determination of Endangerment Status

Inventory of farm animal breeds kept in Germany, though at present not including data on individual animals yet, is carried out by the Information and Coordination Centre for Biological Diversity (IBV) and published in the Central Documentation on Animal Genetic Resources in Germany (*Zentrale Dokumentation Tiergenetischer Ressourcen in Deutschland, TGRDEU*). The National Programme, however, concentrates on the monitoring of population data and the endangerment status of the indigenous breeds only. The effective population size (N_e) is considered the key criterion for assessing the endangerment status of a specific breed because it is closely related to increase inbreeding and thus to loss of alleles.
Details of how the effective population size is calculated and of the difficulties involved are summarised in the annex (Chapter 5.2).

As far as the National Programme is concerned, only accurately identified and tagged breeding animals from breeders who register their breeding animals in up-to-date, consistent herd-books or breed registries are taken into consideration for the conservation of animal genetic resources. This allows for the continu-

Gelbvieh cattle at the Central Agricultural Fair

ous monitoring of small populations – just like commercially dominant production populations – and the implementation of breeding programmes targeted for conservation. Accurate calculation of effective population size and rate of inbreeding (DF) for each generation helps determining the most appropriate conservation strategy. The great advantage of this procedure is that the same software can be used to routinely examine all registered breeding populations (including large production populations), to calculate the effective population size and the annual rate of inbreeding, and thus to routinely identify population trends. Decisions on measures for the conservation of genetic diversity in Germany are thus based on the effective population size as the critical value.
As long as pedigree data is not available in TGRDEU, the determination of the endangerment status based on the effective population size, which is calculated by means of the number of male and female animals only, is just an approximation. In addition to the orientation values given in table 8, a margin of safety should be set for small populations. This has been taken into account in the classification of the following three endangerment categories.

These categories serve as preliminary values for monitoring. As soon as the National Programme is implemented and the necessary data on family structures is available, it will be adjusted to accurately calculate the effective population sizes (with low critical values).

Table 8: Endangerment Categories

Risk Category	Criterion	Description
1a) Conservation Population (CP)	$N_e \leq 200$	Highly endangered population for which immediate conservation measures are needed to stabilise the effective population size and to minimise further genetic loss.
1b) Phenotypic Conservation Population (PCP)	$N_e \leq 50$	Within the conservation population, most breeds with $N_e < 50$ have only a slight chance of becoming an independent live population again in the long run. Their existing genetic stock should thus be secured by means of cryoconservation. They could then be integrated into larger related populations. Live conservation of such breeds, particularly of their phenotype, can nevertheless be relevant due to their cultural and historical value. This is why some (a total of twelve) populations have been especially identified as PCP in table 9.
2) Monitoring Population (MP)	$200 < N_e \leq 1{,}000$	Endangered population which should be monitored and for which a semen cryoconservation programme should be initiated as soon as the number of adult male animals falls below 100.
3) Non-Endangered Population (NE)	$N_e > 1{,}000$	Non-endangered population in which N_e should be regularly calculated and the trend documented.

Table 9 gives an overview over the number of German farm animal breeds in the CP (including PCP) resp. MP endangerment category in 2006, classified according to the effective population size estimated as explained above and sorted by animal species. This table is updated annually and is the basis for decisions on appropriate conservation measures.

For populations in the first risk category, other objectives and standards have to be applied. These are only kept for phenotypic conservation (category PCP) because they are mainly conserved for phenotypic demonstration. Many examples for phenotypic conservation can be found in the breeding of zoo animals and also in amateur breeding, e.g. the back-breeding of the aurochs, the ancestor of our domesticated cattle, which became extinct in 1627, today known as Heck cattle. The different requirements in the management of farm animals for the conservation of cultural goods (identification, ancestry, amateur breeding etc.) call for different methods of conservation and different support programmes. Apart from sponsorship systems like those introduced by the GEH, fundraising in the sectors of culture, tourism and regional development also offers a range of opportunities.

Non-endangered populations of the third risk category (NE), basically all large production populations, have to be monitored with respect to the genetic variability within breeds, which should not decrease as rapidly as has been noticed in highly efficient selection programmes (e.g. Holstein cattle).
Conservation measures mainly aim at the categories conservation and monitoring population. Regional lines or subpopulations of a specific breed that are genealogically closely related (heavy horses and saddleback pigs, for example) should be merged into one population (breed group).

With the above mentioned restrictions in mind, there are 63 indigenous farm animal breeds of the five large animal species in Germany, 35 of which belong to category CP (including phenotypic conservation populations) and 17 to MP.

Table 9: Number of German Farm Animal Breeds and Breed Groups in the CP (including PCP) and MP Endangerment Categories

Animal Species	CP (PCP – included)	MP	Total
Horse	9 (6)	3	12
Cattle	15 (4)	0	15
Sheep	7 (2)	12	19
Goat	1 (0)	2	3
Pig	3 (2)	0	3
total	**35 (14)**	**17**	**52**

According to the figures from 2006, the National Programme needs to deal with conservation programmes for 35 conservation populations.
The situation of poultry kept for agricultural production differs from the situation with large animals. The parent stocks of hybrid breeding programmes are owned by a few multinational breeding companies. There is no information published on the effective population size of these lines. Though the BDRG conducted a privately initiated census for fancy poultry breeds kept by amateurs, the information is flawed by numerous uncertainties. Monitoring of poultry breeds must therefore be organised with government support and in close co-operation with the amateur poultry breeders or their umbrella organisation respectively.

Developing Conservation Programmes

For the benefit of effective conservation breeding programmes and the most cost-effective use of public funds, current population structures must be analysed with the aim of bringing together, across boundaries and *Laender*-wide, genetically related breeds registered with different breeding associations in order to get a general idea of the number of conservation programmes needed. In some cases, though, genetic distance estimation is still needed to verify the situation. It needs for example to be decided whether North and South German heavy horses from the Rhineland can be joined to form a large and less endangered monitoring population. The funds currently provided by seven *Laender* could then be put to far better use in a joint conservation programme.

The situation with sheep is less straightforward. Plans for suitable conservation programmes do not make any sense unless e.g. the relationship between Bergschaf and Waldschaf sheep and between the various Heidschnucken sheep breeds is determined with the help of genetic distance estimation. Similar investigations could help to find close relations for breeds classified as cultural goods, such as the Alt-Wuerttemberger and Rottaler horse breeds, Murnau-Werdenfelser cattle as well as the Geschecktes Bergschaf and Steinschaf sheep breeds, which presumably have relatives among the larger, thus less endangered populations.

In the poultry sector, the structures and traditions of amateur poultry breeding have to be linked with conservation measures. Appropriate measures like intangible support and bonus payments can entice amateurs, smallholders and part-time farmers to keep herd-books and thus support conservation breeding activities.

From the commercial poultry breeders' point of view, there is no need to integrate fancy poultry breeds that are no longer used commercially to breed farm animals adapted to changing management conditions into their breeding programmes. On the other hand, there is a need to breed lines for new production systems, particularly free range management. To assess whether non-commercial poultry breeds possess the desired traits for special breeding programmes, information on their characteristics and their performance is required. One of the first and essential requirements prior to conservation measures for genetic resources in the poultry sector is the description of the existing range of breeds. The aim is to identify those breeds with potential or actual merit in agriculture which are the first choice for conservation measures, and to exclude duplicates or breeds predestined for amateur breeding. For this purpose, criteria on the basis of the evolution of the breeds, the characterisation of and information on the relationship with other breeds (genetic distance estimation) have to be developed. The next stage involves examining the characteristics of selected breeds in performance testing centres under production conditions, e.g. organic farming and alternative management systems. Criteria for performance testing which take the system-specific conditions into account, e.g. those of organic farming and alternative management systems, are not at hand yet.

Assuming that a National Programme covers the breeds presented in table IV (annex), the biggest problem in planning effective conservation programmes is the fragmentation of endangered breeds in as many as 14 regional subpopulations, each with its own independent herd-book. It is for this reason necessary to ensure that a centralised herd-book for endangered populations or at least a common statistical routine to combine individual animal data of all regional subpopulations is established.

Portrait of a Lachshuhn

The main objective of an effective conservation programme is to minimise the rate of inbreeding per generation. This implies the use of the largest possible number of unrelated sires in the largest possible number of matings. Thus, with 25 sires, a rate of inbreeding of 0.5% (DF) per generation can be achieved and, after 20 generations, an average inbreeding coefficient (F20) of below 10%. With only 10 sires, the figures are 1% per generation and F20 of 20%. With the use of more than 25 sires throughout, matings between siblings and half-siblings can be avoided. Furthermore, it is recommended that the generation interval in conservation programmes should be as long as possible. This is, in terms of fertility, health and longevity, an advantage for the selection of dams for mating too, because it is possible to carry out pure-bred matings and conserve the population with dams that have shown these characteristics over a number of litters.

Therefore, it is one of the primary tasks of the National Programme to ensure that, by means of adequate financial support, at least 25 sires per population, ideally unrelated, are kept for the live conservation of CPs. Additionally, the sires should preferably be mated with as many dams of the same breed as possible to conserve the existing family structure of the CP in future generations.
Of the 35 CP (incl. PCP) shown in table IV (annex), 19 breeds have less than 25 sires which are – probably even closely – related, which means that centrally managed matings are even more urgent. Regarding the implementation of conservation programmes, it is also important to consider whether targeted artificial insemination (AI) (as in horses, cattle and pigs) or natural insemination dominates (as in sheep and goats). If 20 AI sires are available to all breeders, the conservation programme will be steady in the long run. If natural serving predominates, it is recommended to use 30 to 40 sires, a number which only half of the CPs have at their disposal. Therefore, the support for conservation programmes must first of all provide the (often hardly used) sires and then facilitate a small number of planned pure-bred matings to produce breedable offspring. Experience has shown that for small populations the keeping of sires for natural service should be preferred because it guarantees a higher number of sires than is the case with artificial insemination.

Integration into Sustainable Production Programmes or Establishment of New Methods of Utilisation

One option to prevent breeds from extinction is to use endangered breeds for the production of marketable, competitive products. A good example is the scheme run by the “Quality Meat Production Association of Schwaebisch Haellisches Pork” (*Qualitaetsfleisch-Erzeugergemeinschaft Schwaebisch-Hall*). They use the indigenous saddleback pig breed as the dam-line for a self-marketed commercial crossbreed. The saddleback pig supplies the raw material for popular quality meat products, which is labelled and marketed as a regional product. Less structured marketing systems for regional specialities exist for example for Heidschnucken and Rhoen sheep. Further opportunities are needed to promote new marketing chains for products from endangered farm animal breeds, e.g. by means of appropriate start-up financing.

Cost-effective management of endangered breeds can also be achieved by following new paths of utilisation. For this reason, the use of endangered horse, cattle, sheep and goat breeds in landscape management and in regional tourism campaigns should be promoted. In publicly funded nature and landscape protection schemes and in leisure parks, endangered indigenous farm animal breeds should be given priority and be promoted through the provision of public funds. What should not be forgotten in this context is the reason why most breeds became endangered: compared to other breeds, they were no longer profitable, or their specific production traits were no longer in demand. The come-back to economic use is often complicated by the fact that those breeds have not been subject to targeted breeding for many years and have been cut off the breeding progress. Therefore, the development of a new utilisation is a challenge that may not necessarily be successful with every breed.

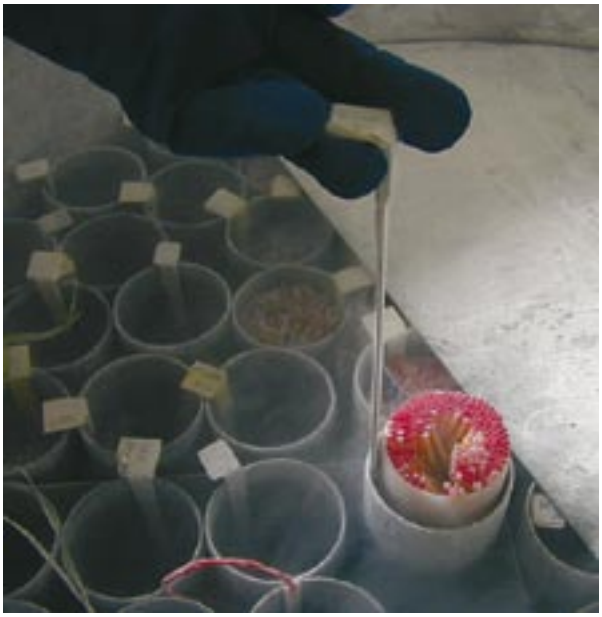
What certainly is needed is support for research programmes that promote the integration of endangered farm animal breeds into competitive production programmes, e.g. by developing new products and sales promotion.

3.2.2 Ex Situ Methods (Cryoconservation)

Current practice in *ex situ* conservation is largely limited to cryoconservation of semen, which is feasible for all farm animal species, and to cryoconservation of oocytes and embryos from ruminants. In future, preservation of somatic cell lines and extracted DNA has to be taken into consideration because practicable technologies might be available to breed animals from this material. At present, the National Programme deals with the methods for cryoconservation of gametes and embryos only.

Cryoconservation of semen and other organic material is possible for all poultry species used in agricultural production, too. However, additional effort has to be made because, in order to achieve good fertilisation results, the cocks have to be kept in insemination centres. Premises could be made available in publicly run institutes like the FLI or the Department of Animal Sciences at the Humboldt University in Berlin. Though only a limited number of breeds can be tested, it seems appropriate to store frozen semen from cocks during the testing phase.

The advantage of cryoconservation is that – in contrast to live conservation – it is an extremely cost-effective way of literally freezing the genetic status of a population over time and without interim drift loss. Also, it is possible to introduce cryo material into declining live populations. And with the utilisation of embryos, populations already extinct can be revived – with the genetic status they had at the time they were frozen. A further significant benefit of cryoconservation, given appropriate storage procedures, is its absolute safety in terms of risks caused by disease, which is always a threat to small live populations at times of (international) epidemics. On the other hand, cryo material can also bear a hygienic risk if it still contains pathogens from diseases that have been eradicated from current live populations, e.g. IBR / IPV (Infectious Bovine Rhinotracheitis / Infectious Pustular Vulvovaginitis) in cattle. This is why precise documentation of the hygiene status of cryo material at the time of storage is vital.



Straws with cattle semen for cryoconservation

Piglets of the old pig breed Schwaebisch Haellisches Schwein

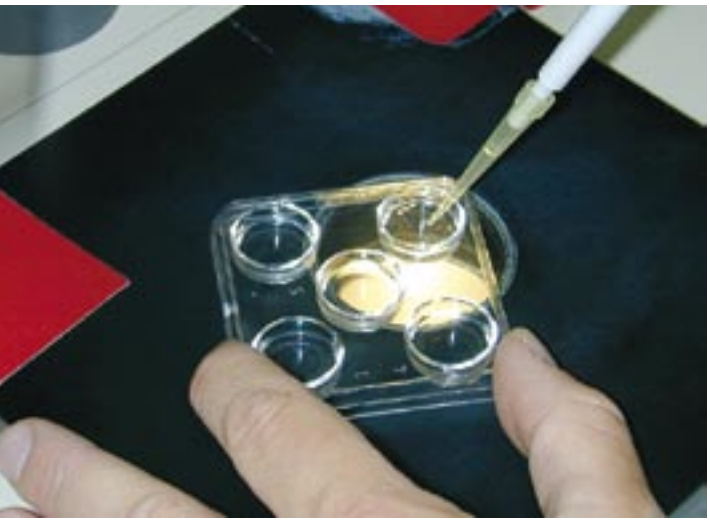
One of the disadvantages of storing frozen material is that it cannot be used for demonstration purposes like live animals. At least theoretically, populations which have been frozen for a long time and are integrated into today's advanced production environment might have adaptation problems, though no such problems have been heard of so far in practice.
It follows that cryoconservation is suited for long-term storage as a "back-up copy" of endangered live populations and consequently plays an important role in *in situ* conservation programmes, too.

Cryoconservation is therefore one of the main objectives of the National Programme because it is the first conservation measure to be taken for populations that have been classified as endangered.

For populations with an effective population size of $N_e < 50$, it is actually the only conservation measure available, which has to be set in motion immediately. For those – often very small – populations, too, the acquisition and storage of frozen embryos is recommended because the risk of extinction as a live population is greater, and the revival of a pure-bred population with frozen semen only, via back-crossing, is extremely difficult.

Systematic cryoconservation measures must be implemented for MPs as soon as the number of sires falls below 100. As a standard, it is recommended that at least 100 samples from 25 preferably unrelated sires (i.e. 2,500 samples per breed) are taken. If one of these populations falls into CP status, the cryogenic semen store provides a back-up copy to enable the implementation of a live conservation programme. In the early stages of the National Programme, a sperm bank for all CPs must be established – unless they can be taken over from existing reserves (see table III, annex).

Given its key role in the National Programme and its current largely unsatisfactory organisation (see Section 3.6.4), cryoconservation in Germany needs revision, the focus being on a nationwide model. This could be achieved by means of start-up funding from the Federal Government for the establishment of a central organisation – in the form of a central cryoconservation register –, the operation and utilisation of which would be under the aegis of the different bodies of the National Programme. The register would initially include all usable and available cryo material as listed in table III (annex) completed with identification data. All cryo material acquired will be routinely registered under the National Programme in order to ensure its availability even if decentralised storage continues. Ideally, cryo material would be stored jointly in a few (for hygienic safety reasons at least two) uniformly managed locations, but cost-effective solutions are needed. Storage locations in a federal research institute (e.g. FLI), in institutes of the *Laender* like the Institute for the Reproduction of Farm Animals *(Institut fuer Fortpflanzung landwirtschaftlicher Nutztiere e. V., Schoenow)* or in commercial insemination centres would serve the purpose. Storage in institutes of the *Laender* would also simplify matters in terms of distribution of the running costs between the responsible authorities.



Handling embryos for cryoconservation

The legal framework for the establishment of a central cryoconservation register and its following routine operation have also to be integrated into national legislation on the conservation of animal genetic resources, which would apply for all *Laender*.

3.2.3 Requirements for the Implementation of a National Programme

In the Federal Republic of Germany, as compared to countries where animal breeding is centralised, the conservation of animal genetic resources needs to be agreed between the Federal Government and the *Laender*. In this context it is essential to allocate funds made available for this purpose by the EU, the Federal Government and the *Laender* in such a way that the greatest possible outcome for genetic diversity in farm animal species according to the latest technical standards is achieved. This includes:

Joint Herd-books for Conservation Breeding Programmes at Breed Level

First of all, all the data necessary for the establishment of a conservation programme needs to be routinely collected from the breeding organisations of the *Laender* to establish joint herd-books for each breed.
Ideally, all animals of an endangered breed will be listed in a joint herd-book, which contains the usual identification and pedigree details for each animal together with the relevant data for conservation breeding.

Deutsches Schwarzbuntes Niederungsrind grazing

The existing herd-book system can be continued for breeds that are kept in one *Land* only (e.g. Vorderwaelder, Hinterwaelder and Deutsches Shorthorn cattle, Brillenschaf and Bergschaf sheep). If the majority of an endangered breed is registered with one organisation (e.g. Deutsches Schwarzbuntes Niederungsrind, Gelbvieh cattle and Heidschnucke sheep or Bunte Bentheimer pig), this organisation should keep the central herd-book and incorporate the remaining fractions of the breed from other breeding organisations. For all other endangered breeds which are scattered and listed in different herd-books, the breeding organisations and *Laender* authorities involved have to reach a mutual agreement. Here, to continue local support for farmers, provisions for regionally registered associations have to be made in case joint nationwide herd-books are put in place.

For poultry and rabbits, which are not covered by the Animal Breeding Act, suitable organisational structures must be found or established so that central animal breeding registries can be set up and maintained. These structures have to be in accordance with the aims of the National Programme so that routine data transfer to the central database is guaranteed. For poultry, both the BDRG herd-book and breeds listed in conservation breeding registries provide a good point of reference. However, the proportion of the animals listed in herd-books compared with the total number is not satisfactory, and the completion of herd-books must be pushed forward.

Monitoring Inbreeding and Effective Population Size

Information on the risk status of the individual breeds has to be available in due time at the IBV. Collection of data at breed level from the herd-books of breeding organisations is a prerequisite for the routine calculation of inbreeding and the effective population size, at least for MP and CP. According to the National Programme, the IBV needs to receive the results directly in order to guarantee that conservation programmes and measures are put in place accordingly. In conservation breeding these parameters will be used for monitoring and controlling the breeding programme.

In vitro fertilisation

Action Plan for Disease Control for Animal Genetic Resources

Existing legislation on animal genetic resources lacks special arrangements for disease and hygiene measures in the event of an outbreak of epidemics, like e.g. foot and mouth disease. These epidemics threaten the existence of all *in situ* conservation programmes and can also have serious consequences for cryogenic stores. For populations which are conserved with great effort and expense under the National Programme, an action plan involving disease control for animal genetic resources is obligatory. In the event of epidemics, exemptions from prevailing veterinary and civil law sanctions (especially immediate culling orders) have to be put into force to prevent the complete loss of valuable and possibly unique genetic resources. Special attention should be paid to safeguarding genetic diversity when breeding for disease resistance, e.g. the breeding of Scrapie-resistant sheep.

Against this background, a representative breeding nucleus of a maximum of 200 animals ("irrecoverable animal genetic resource") will have to be identified in breeding programmes for endangered populations (CP, MP). Updating this nucleus must then be an integral part of the breeding programme. In the event of epidemics, it has to be possible to identify and track down nucleus animals immediately and unmistakably. For these animals, special veterinary regulations at farm and regional level apply. They are applicable to farms or farmers and breeding animals, both by way of precaution as well as during and after an epidemic.

Furthermore, the undefined health and welfare status of breeds from amateur breeders pose a significant problem as regards their integration into commercial breeding programmes. Particularly in commercial poultry breeding, the health status of the animals is of such great importance that breeding stocks are kept free of infectious diseases. Amateur breeders can of course not keep such a high standard. Thus, veterinary diagnosis of animals in conservation programmes is indispensable.

3.3 Organisational Measures for Co-ordination and Information

To integrate the numerous institutions involved in the National Programme – like Federal and *Laender* administrations, approved animal breeding organisations and non-governmental organisations –the following two central institutions are needed under the National Programme:

3.3.1 National Committee on Animal Genetic Resources at the DGfZ

The National Committee is the central panel under the National Programme consisting of senior animal breeding consultants from Federal and *Laender* administrations and breeding organisations, from interested non-governmental organisations and scientists. It provides expert advice on the support of conservation programmes for animal genetic resources. Its most important responsibility is the co-ordination of support measures for conservation projects across the *Laender*. This would gain further importance if in future, in addition to the funds for keeping individual animals, state aid at either EU or national level is made available for the implementation of conservation breeding programmes, too. The Council's key tool in evaluating funding strategies and preparing its recommendations is the IBV. The chairperson and the members of the Council are appointed by the DGfZ following proposals by the senior animal breeding consultants from the Federal and *Laender* administrations.

3.3.2 Information and Co-ordination Centre for Biological Diversity (IBV)

The centre point for the management of animal genetic resources is the TGRDEU database of IBV. Based on the existing structure, its current area of responsibility has nevertheless to be considerably expanded. One new objective is the documentation of conservation measures. More important though: while at present only animal numbers per breed have to be reported to the TGRDEU database, the IBV will have to monitor the population parameters such as inbreeding and effective population size in future. The parameters will be calculated using the herd-book data at breed level. Where possible, breeding value estimation centres or herd-book services, for example, should calculate the parameters since data at breed level is already available.
Where this is not possible, IBV should take over the responsibility. The technical and organisational requirements for taking over the necessary data have to be developed. In any case, the IBV will contact the breeding organisations and support them in the implementation of monitoring and conservation breeding programmes. Through the responsible bodies, the IBV will also routinely document all measures of *in situ* and cryoconservation as a basis for monitoring conservation programmes for endangered farm animal breeds. The IBV will keep the national cryoconservation register. Its documentation task thus goes beyond the current function of reporting to the cross-national databases of the European Association for Animal Production (EAAP) and the FAO. Under the auspices of the National Committee, the IBV will become the central data and methodology archive under the National Programme and, in agreement with the BMELV, assume the task of a National Focal Point under the FAO's Global Plan of Action for Farm Animal Genetic Resources. Once the National Programme has been implemented, a candidate from IBV will be nominated as National Co-ordinator of the National Focal Point.

3.3.3 National Focal Point and National Co-ordinator for Animal Genetic Resources

The National Focal Point is responsible for the functions as defined in FAO's Global Plan of Action for Farm Animal Genetic Resources.

The National Co-ordinator is the contact for and coordinator of international and cross-national issues and the link to both the European and the Global Focal Point.

3.4 Research Requirements

Optimising management, information and utilisation activities involving animal genetic resources requires the provision of research capacities. Within the remit of BMELV, the FLI with its institute for animal breeding and the Research Institute for the Biology of Farm Animals *(Forschungsinstitut fuer die Biologie landwirtschaftlicher Nutztiere, FBN)* have the necessary means. There are also numerous *Laender*-specific institutes, which conduct applied research into various topics of the National Programme.
In future, research has to focus on methods for the identification, classification and assessment of genetic resources, e.g. the expansion of population genetics and biotechnologies for *in situ* and *ex situ* conservation.

Considerable research into the integration of endangered populations in sustainable animal production, landscape management and nature protection programmes is needed. Since this usually falls in the range of applied rather than basic research, it is not funded by institutions such as the German Research Foundation (*Deutsche Forschungsgemeinschaft e.V., DFG*). Therefore, funding for such projects must be provided under the National Programme.

One relatively new research area is the economic assessment of strategies for the conservation of genetic diversity, as explored by Weitzmann (1992 and 1993). Simianer et al (2002a) and Simianer (2002b) applied these theories to data of 26 African cattle breeds and compared various strategies for optimised allocation of limited funds to conserve the greatest possible diversity in that breed range. They list the following research priorities for the implementation of this approach in current conservation programmes:

- the identification of base parameters to set up reliable functions between conservation efforts and yield for genetic diversity;
- relative economic weighting of within-breed diversity, current production value and special performance of the endangered breeds;
- expansion of the analysis approach to consider diversity within and between breeds likewise.

Bentheimer Landschaf sheep

3.5 Recommendations for International Co-operation

3.5.1 Research Co-operation

Given that some of the farm animal breeds classified as endangered in Germany can be found in European neighbouring countries as well, co-operation at European level appears useful – especially as the European Union is one of the biggest public investors in programmes for the conservation of genetic diversity. European research projects have largely focused on the definition of genetic distance between farm animal breeds and the further development of biotechnological conservation processes. In pig breeding, for example, the European Pig Biodiversity Project aimed to identify the relationship between all significant Western European pig breeds based on microsatellite standards. Similar international and EU-funded projects on cattle, hens and rabbits were also conducted. In the project "Characterisation and Conservation of Pig Genetic Resources in Europe" (EAAP Publication 104, 2001), semen portions from more than 20 endangered pig breeds in four Western European countries were taken and stored, including the pig breeds Angler Sattelschwein and Bunte Bentheimer (pig) from Germany. In the project " Development of Strategy and Application of Molecular Tools to Assess Biodiversity in Chicken Genetic Resources (AVIANDIV)", 52 breeds of chicken, including commercial breed lines for laying and fattening, were analysed using 25 microsatellite loci in order to quantify the relationship between and the variability within the populations in question. Similar investigations are needed especially for sheep and horses in order to join the large number of related breeds in effective cross-border conservation programmes.

Braunvieh alter Zuchtrichtung in harness

Modern farm

3.5.2 Co-operation in Conservation Activities

The EAAP database and DAD-IS provide information on which neighbouring countries in Europe have the greatest potential in terms of joint research projects. For the successful and targeted use of the information, the databases need to be updated on a regular basis. The conservation of the cattle breed "Rotes Hoehenvieh", for example, requires co-operation with many Eastern European countries. Suitable cold-blooded horse breeds are kept in Poland, Belgium and France, and saddleback pigs are kept in the Czech Republic, France, Poland, Romania and England. All of these countries have research institutes that focus on the conservation of genetic resources and with which German researchers could plan joint projects with European co-operation.

3.5.3 Data Network and Data Exchange

The TGRDEU database maintained by IBV is also a key tool for an international network of information systems on animal genetic resources. Through the National Focal Point, data is made available for the FAO's global database DAD-IS and, at European level, for EAAP's database. Linking all existing databases requires the development of IT-compatible interfaces at institutional, national and international level.
Since regional and international information networks are being developed in other contexts, too, particularly the CBD's Clearing House Mechanism (CHM) and the Global Biodiversity Information Facility (GBIF), it seems appropriate to develop suitable national structures based on TGRDEU.

3.5.4 Distribution of Costs and Benefits

Cryogenic stores and the conservation of animal genetic resources are cost-intensive. In order to generate synergy effects for *ex situ* conservation activities, co-ordination and exchange of sperm and embryo banks at European and international level with the aim of long-term conservation of animal genetic resources are recommendable. It is thus necessary, ideally at global level but at least EU-wide, to agree upon the conditions to access the sperm and embryo banks, taking into account the related international and European framework.

Preparing the State of the World's Animal Genetic Resources report and assessing the national contributions to it inspired new initiatives, which, for example, involve access and benefit sharing with regard to the use of animal genetic resources.

3.6 Summarised Presentation of Activities

The National Programme for Animal Genetic Resources can be taken as a guideline to develop activities and draft the organisational requirements needed for the conservation and utilisation of animal genetic resources. It is also an indispensable addendum to conventional farm animal breeding programmes. Once established, it should become good practice in farm animal breeding in Germany. This can only be achieved if animal breeding regulations and the availability of long-term funding are consolidated. The Federal Government and the *Laender* are thus called upon to establish the basis for this and to implement the plan.

Altsteirer chicken – fenced

Cold blood horses out on the pasture

3.6.1 Expanding the Infrastructure

3.6.1.1 National Committee on Animal Genetic Resources

The Committee is the central advisory and co-ordination panel under the National Programme for Animal Genetic Resources.

Organisation

- The Committee is organised as a working group of the DGfZ.
- Its twelve members represent the following institutions:
  - Federal administration
  - *Laender* administration
  - animal breeding organisations
  - private associations and institutions, NGOs
  - science.
- The chairman and the members of the National Committee are appointed for a 2-year term by the DGfZ upon recommendations by senior animal breeding consultants of the Federal and *Laender* administrations.
- The Committee agrees on rules of procedure and co-ordinates all key issues with the senior animal breeding consultants of the Federal and *Laender* administrations.
- The chairman is a non-voting member of BMELV's Advisory Board on Genetic Resources and participates in relevant meetings of the senior animal breeding consultants.
- The National Committee is funded by DGfZ's existing project budget provided by the Federal Government and the *Laender*.
- The Committee agrees its annual budget with the DGfZ.

Responsibilities

- The Committee issues statements on all subject-related issues concerning the conservation of animal genetic resources, and makes recommendations for scientific reports and statements. The Committee has to be consulted when key issues are concerned and given the opportunity to be heard by the Federal Government and the *Laender*.

- The Committee decides, based on the monitoring results, on the classification of breeds into endangerment categories and recommends appropriate conservation measures.

- The Council must be given the opportunity to state its position on measures to be taken once breeds have been classified as either MP or CP (cryoconservation for MP and conservation breeding programmes for CP).

3.6.1.2 Information and Co-ordination Centre for Biological Diversity

The Information and Co-ordination Centre is responsible for the central documentation and co-ordination of cross-regional conservation activities. It supports the Committee in its work.

Organisation

The function is performed by IBV at the Federal Agency for Agriculture and Food *(Bundesanstalt fuer Landwirtschaft und Ernaehrung, BLE*).

Responsibilities

- Documentation of farm animal breeds in Germany, specifically identification and updating stock numbers in a central database.

- Identification and monitoring of population parameters of genetic variability (effective population size, rate of inbreeding) for all breeds.

- Management of the national register of the cryogenic store.

- Documentation of all live and cryoconservation activities.

- Central archive for data and methods for the National Programme under the supervision of the National Committee (see 3.3.2).

- Expertise and organisational support for the National Committee.

- Reports to the databases of EAAP and FAO.

A flock of Coburger Fuchsschafe

- Co-ordination and support in the conservation of animal genetic resources in Germany, particularly:
  - close co-operation with breeding organisations on the implementation and use of methods in monitoring and conservation breeding programmes;
  - support of breeding organisations in calculating population genetics parameters;
  - calculation of parameters by means of combined herd-book data at breed level (subsidiary, if this task cannot be fulfilled by breeding organisations);
  - promotion and co-ordination of the management of animal genetic resources.

3.6.1.3 National Focal Point, National Co-ordinator for Animal Genetic Resources, International Co-operation

The National Focal Point is responsible for the tasks outlined in the FAO's Global Plan of Action for Animal Genetic Resources.

Organisation

- In agreement with BMELV, IBV assumes the technical responsibility for the tasks assigned to the National Focal Point under the FAO's Global Plan of Action for Animal Genetic Resources.
- National Co-ordinator is BMELV's senior animal breeding consultant, at least until the National Programme is implemented.
- Once the National Programme has been implemented, BMELV will appoint a National Co-ordinator assigned to the National Focal Point from the IBV in agreement with the *Laender*. The National Co-ordinator will agree all key and fundamental issues with the BMELV (see 3.3.3).
- The National Co-ordinator should be a member of the National Committee on Animal Genetic Resources.
- BMELV makes an annual national contribution to the funding of the European Regional Focal Point for Animal Genetic Resources (ERFP) via DGfZ's project budget and without co-financing by the *Laender*.

Calf of the cattle breed Deutsches Schwarzbuntes Niederungsrind

Responsibilities

- Serves as the point of contact and co-ordinator for international and cross-national issues and inquiries.
- Liaison to and co-ordination with ERFP and Global Focal Point.
- Participation in EU matters concerning animal genetic resources, particularly consultations of the Commission for Genetic Resources on Regulation 870/2004, EAFRD Regulation 1658/2005 and animal breeding.
- Participation in international expert meetings, particularly those of the FAO and the EAAP.

3.6.2 Implementation of Routine Monitoring

The National Programme stipulates that the principal activities are the use of *in situ* management and cryoconservation. This involves a three-phase process built on the most accurate estimation of the effective population size or the loss of alleles (inbreeding, drift, genetic variance) in the respective populations.

Targets

- All breeds, including large non-endangered populations (NE), will be subject to the monitoring process.
- As soon as the stock of a specific population falls below the first critical value (MP), a cryoconservation programme, at least with semen collection, will be initiated.

- If the population falls below the second critical value (CP), *in situ* conservation must be included into the conservation breeding programme.

Activities

- Calculation of population genetic parameters per population using recent methods to determine the effective population size and genetic variance with data of individual animals, taking into account the family structure.
- Compilation of the data and classification of the risk category.
- Implementation of measures appropriate for the respective endangerment category; need for action regarding the preparation, implementation and advancement of these measures.
- Advancement of the methodology for determining the status of endangerment in a specific population.
- Advancement and adaptation of the methodology for identifying and calculating significant parameters and indicators for small and large populations, including the development of adequate software applications.
- Creation of the necessary prerequisites allowing for identification / calculation of population parameters (breeding organisations, *Laender*, IBV); establishment of interfaces for data exchange.
- IBV will develop a plan specifying which organisation should report what data and when.

Glanrind cattle

- Advancement of the legal framework for the implementation of the agreed measures (Federal Government and *Laender*).
- Establishment / enhancement of herd-book structures for fancy poultry and rabbit breeds to lay the necessary foundation for monitoring.

Responsibilities

Advancement of the theoretical framework and building of the foundation for the implementation of the National Programme by Federal and *Laender* scientific institutes.
Developing the necessary information base for the calculation of the effective population size – where possible –, drawing on existing structures that already process individual animal data of each breed (e.g. breeding value estimation centres). If this is not possible, IBV will organise data collection and assessment.
Collection and transfer of data to IBV according to an agreed schedule.
Determination of the risk classification by the National Committee based on the criteria determined in the National Programme and recommendations for measures to be taken accordingly.
Laender and breeding organisations decide on and implement measures.

3.6.3 Live Conservation (in situ)

Targets

- Long term *in situ* conservation of populations with the aim to maintain the genetic variability of and the specific genetic characteristics in breeds.
- Conservation of the appearance (phenotype) of culturally and traditionally significant breeds (where necessary without conservation of independent genetic variability).
- Sustainable use of as many different breeds (*in situ*) as possible.

Activities

At least for each CP category breed

- Developing a breed-specific model for the use of the breed and for long-term protection of the related breeding programme, including animal husbandry.
- Implementation of an agreed nationwide conservation breeding programme to stabilise an adequate

Rhoenschaf

effective population size and to conserve specific genetic characteristics.

- Combination of all data on individual animals in one place for the purpose of monitoring the conservation breeding programmes.
- Providing technology, human resources and organisational support for nationwide co-ordinated conservation breeding programmes.
- Developing a breed-specific emergency plan in case of epidemics (see 3.2.1).

For phenotypic conservation breeding programmes:

- Implementation and notification of conservation measures / documenting to IBV and the National Committee.

Need for action regarding the preparation, implementation and advancement of these measures:

- Developing models for utilisation and support, e.g. regional marketing, use of landscape management, biosphere reserves, management in Ark Farms, domestic animal parks and zoological gardens. (However, without permanent funding the majority of the conservation populations cannot be maintained.)
- Integrating the activities of NGOs (umbrella breed associations, GEH, etc.).
- Developing guidelines for conservation breeding programmes with special breeding objectives (e.g. Scrapie resistance breeding, phenotypic conservation objectives, mixed populations).
- Reviewing the advancement of the legal framework and administrative regulations on conservation breeding programmes (Federal Government / *Laender*).
- Providing or improving the funding strategy for conservation breeding programmes for the development and introduction of utilisation concepts. Solving funding problems regarding cross-*Laender* conservation breeding programmes.

Responsibilities

The National Committee recommends the fundamental principles of breeding programmes.
Wherever possible, approved breeding organisations agree and implement breeding programmes.

3.6.4 Cryoconservation (ex situ)

A comprehensive model on objectives, organisation and implementation of a National Cryogenic Store is being developed. The following outlines the preliminary targets and activities.

Targets

- Unchanged conservation of the gene pool of specific populations in the long run.
- Support of live conservation programmes with frozen conserves.
- Emergency reserves against total loss in case of natural catastrophes.

Activities

- Establishment of cryogenic stores before a breed becomes endangered; implementation as soon as the numbers fall below a certain critical value.
- Establishment and organisation of cryogenic stores by breeding organisations and insemination centres / sperm banks.
- Storage of cryoconserves at insemination centres / sperm banks.
- Decision on existing and future cryogenic stores in agreement with the National Committee.

- Monitoring of stored material and expansion or reduction of stocks by the responsible organisations.

- Central identification and documentation of National Cryogenic Store by IBV.

Further action:

- Developing a national concept after inspection and identification of existing stocks (FLI, IBV, *Laender*, breeding organisations, insemination centres).
  - Replenishing existing stocks.
  - Structuring stocks (risk minimisation, cost distribution, responsibilities).
  - Establishing an information and documentation system (FLI, IBV).
  - Developing concepts for use and access (FLI).

- Developing a cryoconservation model for poultry and rabbits (FLI, ZDRK, BDRG, GEH).

- Advancement of methods for storage and reactivation of semen and embryos, and for the use of somatic cells for the cryoconservation of all animal species involved.

- Securing funding for cryoconservation, including acquisition, storage and management of incoming and outgoing material.

Decontamination area

- Monitoring the advancement of the legal framework regarding epizootics to ensure the future use of semen, embryos and oocytes in long-term storage.

Responsibilities

Federal Government and *Laender*.
Breeding and insemination organisations.

3.6.5 Preventive Measures in Case of Epizootic Diseases

During an outbreak of an epizootic disease, it is often necessary to trade off the overall aim to maintain acceptable disease and hygiene standards on the one hand and to conserve valuable animal stocks on the other. Regulations on animal health and welfare are thus indispensable, preventive measures being of special importance in this context. The following preliminary principles will need to be updated once EU legislation on vaccination is revised.

Targets

- Protection of irrecoverable animal genetic resources from unfavourable outcomes of epizootic diseases or taking of preventive measures to control them.

- Ways of considering nucleus herds of irrecoverable animal genetic resources during measures to fight an epizootic disease outbreak.

Activities

Farm-specific activities

- Where possible, stocks of irrecoverable animal genetic resources are to be kept in regions with low farm animal density.

- Decentralised management of stocks of irrecoverable animal genetic resources of a specific breed across several farms, supra-regional wherever possible.

- On farms with several breeds, irrecoverable animal genetic resources should be managed in separate epidemiological units.

German farm with animals

Extra farm activities

- Cryogenic store.
- Management of a continually updated inventory of irrecoverable animal genetic resources, which is accessible to the veterinary authorities during an epizootic disease outbreak.

Activities in the event of epizootic disease outbreak

- On farms which are not affected, an epidemiological unit of irrecoverable animal genetic resources will be isolated.

Further action needed:

- Advancement and finalisation of general action plans.
- Reviewing the amendment of regulation on animal welfare and hygiene.

Responsibility

Veterinary authorities and animal breeding administrations at Federal and *Laender* level.
Breeding organisations.
National Committee.
Municipal veterinary authorities.

3.6.6 Support Measures

Targets

- Continuation and improvement of activities to promote genetic resources (see *Laender*-specific activities in table II (annex)).
- Utilisation of existing funds which, up to now, have primarily been used for other purposes.
- Extending / creating new funding.
- Making payments available to non-farmers.

Activities

Improving the exploitation of existing measures, particularly according to Council Regulation (EC) No 1698/2005 “Support for rural development by the European Agricultural Fund for Rural Development (EAFRD)”

- National aid policy regarding animal genetic resources.
- Promoting breeding and conservation of rare breeds under the “Joint Task for the Improvement of Agricultural Structures and Coastal Protection”.

- Providing (financial) support for breeding organisations and non-farmers.
- Supporting cryoconservation (acquisition, storage and management).

Extension of existing funds that have previously not or rarely been used for this purpose

- Utilisation and development of utilisation of breeds in organic farming.
- Suckler cow bonuses for all endangered cattle breeds (EU legislation does not provide special bonuses for endangered breeds; however, dairy cattle breeds, including endangered breeds and breeds eligible as suckler cattle, are excluded.).
- Investment programmes, e.g. for cryoconservation, infrastructure for conservation programmes (herd-book systems).
- Regional promotion, e.g. marketing of products as regional specialities.
- Nature conservation programmes, e.g. use of rare local breeds for the maintenance of biosphere reserves.
- Model and research projects for the development, planning, implementation and management of conservation breeding programmes.

Development of new support measures

- Opportunities to support conservation breeding programmes and cryoconservation (*Laender*).
- Options to support the application of new models and programmes of utilisation (Federal Government / *Laender*).

Responsibilities

Federal Government, *Laender*, EU
Individuals (limited option) including foundations.

3.6.7 Research and Development

For the development and implementation of conservation activities and for the routine identification, calculation and assessment of the various population parameters, processes must be devised, implemented and tested in order to classify breeds into endangerment categories. Contributions to research and development are expected from the Federal Research Centres, *Laender* research institutes, the Leibniz Association, universities and others.

Target

Supporting and advising the Federal Government and the *Laender* regarding the establishment, implementation and advancement of activities under the National Programme.

Activities, Research Topics

- Evaluation and optimisation of existing utilisation and support models.
- Developing new models for the integration of endangered populations into sustainable animal production, landscape management and nature protection schemes.
- Identification, classification and assessment of genetic resources, e.g. implementation of genetic distance estimations to assess the endangerment status and conservation worthiness of a specific breed, and consistent development of necessary molecular, genetic and biometric processes.
- Developing best practice breeding programmes, including management guidance for the conservation of small and endangered populations.
- Participation of national research institutes involved in the National Programme in international FAO and EAAP working groups.
- Maintenance and expansion of FLI's research focus on animal genetic resources.
- Providing funds for related research and development projects.

Responsibilities

Federal Research Centres (particularly FLI)
research institutes of the *Laender* and others (universities, technical universities, FBN, etc.).

4 Current Activities and Achievements

4.1 Monitoring

Within BMELV's remit, it is the task of the Information and Co-ordination Centre for Biological Diversity (*Informations- und Koordinationszentrum fuer Biologische Vielfalt, IBV*) to maintain the central database for statistics and characterisation of breeds and breeding animals of the most important farm animal species in Germany. The database "Central documentation on animal genetic resources in Germany" (*Zentrale Dokumentation Tiergenetischer Ressourcen in Deutschland, TGRDEU*) is designed to be an all-encompassing register of organised animal breeding in Germany. This includes the registry of the approved breeding associations in the *Laender* plus approved insemination centres for each animal species and the biotechnology institutions (embryo transfer).

The official breed descriptions for the animal species listed in the Animal Breeding Act, i.e. horse, cattle, pig, sheep and goat, issued by the breeding associations or the umbrella breed associations, are included in the register. In addition to the details of origin and utilisation, the register also contains information on objectively measurable performance data, evaluation data and descriptions of the exterior traits. If


Thueringer Wald Ziege (TWZ)

Herkunft

Beschreibung

Maße und Gewichte

Leistungen

Zuchtziel

Official breed description of the Thueringer Wald Ziege

reported, details of their special genetic characteristics and genetic distances are also documented.
The main activity in TGRDEU currently involves the collection of annual statistics for all registered herdbook animals. Stock records have been taken since 1997 without interruption. The database TGRDEU thus enables an approximate monitoring of all breeding animals registered with German breeding associations and the identification of endangered farm animal breeds.
What is not yet included are the breeding animal stocks held by private breeding companies. Since these lay the foundation for hybrid breeding programmes, they are generally not at risk of extinction.

Further details on special projects, like the integration of endangered breeds in the Ark Farm project run by the GEH, are also listed in the database as are the different poultry species and the rabbit breeds.
An overview of the total number of farm animal breeds of horse, cattle, pig, sheep and goat registered in the database is given in table 10.

Table 10: Number of Breeds in TGRDEU (2005)

Species	Breeds total	Indigenous
Horse	94	14
Cattle	42	19
Sheep	59	21
Goat	26	4
Pig	15	5
total	**236**	**63**

More than 70% of the independently managed breeds are of foreign origin and more than half of them are kept by amateur breeders and are not important from the commercial point of view. Numerous breeds are separated either regionally (in the case of horses) or according to use (cattle), and would be defined genetically as one breed which has several subpopulations in more than one *Land*.

4.1.1 Monitoring and Documentation of Performance Structure and Inbreeding in Current Breeding Populations

The rate of loss of genetic diversity of most of the stringently selected farm animal populations is accelerating. Highly intensive selection, biotechnological advancement and global use of top breeding animals lead to a "genetic restriction" that is hardly noticeable from the outside but should be routinely documented as part of approved breeding programmes, as are performance test results.

For indigenous breeds, which are defined "non-endangered" by their size (or their estimated N_e), the effective population size and rate of inbreeding should also be accurately calculated and published in annual reports. To simplify matters, the inbreeding coefficient can be calculated in routine breeding value estimations, which should be done in any sustainable breeding programme anyway. For 10 years now, data on the large farm animal breeds has been collected in Germany. Whereas in the past, this consisted only of numbers of herd-book animals to calculate the "effective population size" (N_e), according to Falconer, a new approach to future monitoring is now being made, taking into account all population data available including the ancestry of the monitored breeds, and thus increasing the informative value of the monitoring. The Federal Agency for Agriculture and Food *(Bundesanstalt fuer Landwirtschaft und Ernaeh-rung, BLE)* concluded co-operation contracts with the Umbrella Association of the German animal breeding associations (like the German Pig Production – *Zentralverband der Deutschen Schweineproduktion e.V., ZDS* and the German Cattle Breeders' Federation – *Arbeitsgemeinschaft Deutscher Rinderzuechter, ADR)* to carry out the monitoring of farm animals in close co-operation with their affiliated breeding associations. The first results are expected in 2008.

Though the monitoring process is basically the same for sheep and goats, the procedure cannot be copied for these species. This is due to the organisation structure and the difference in animal recording, which renders the monitoring altogether more difficult. However, since there is a large number of endangered sheep and goat breeds, monitoring is all the more important, and a co-operation contract will be drafted in 2008.

4.1.2 Poultry

The most important poultry species – hen, duck, goose, turkey and pigeon – used in agriculture are not covered by the Animal Breeding Act, which means that animal breeding regulations are not applicable in the conservation of poultry genetic resources. Nevertheless, since there are numerous endangered breeds among these species, their conservation must be taken care of. The situation in the case of poultry differs considerably from that of large animals, as will be explained below. Differences also exist between the individual poultry species, though these will not be given further consideration here.

The successful development of commercial poultry breeding has led to an almost complete separation between commercially used breeding lines and a number of breeds that are almost exclusively used by amateur breeders. The production of chicken is differentiated into fattening and laying lines. The entire global market for white and brown shell laying hybrids is covered by only three company groups (with one to three individual breeding companies), of which one company is situated in Germany. The market for fattening chicken, too, is covered by three companies, which share 90% of the total market.

Feeding time for White Layers

A flock of geese fattening for Christmas

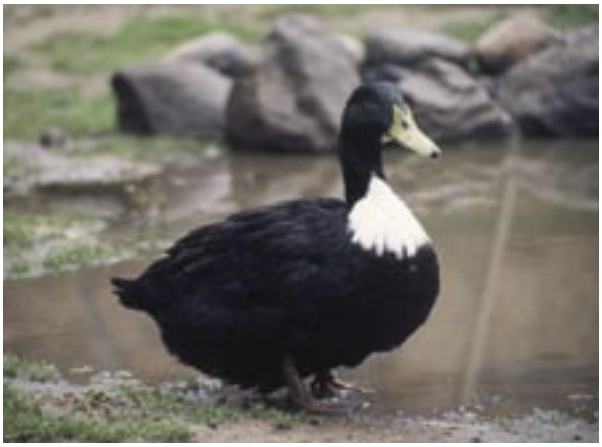
Turkey breeding is run by only three globally active companies. And there are around 20 breeding companies worldwide which only deal in waterfowl, less than five of which provide the largest proportion of parental lines.
Poultry breeding programmes are structured hierarchically. Pure-bred lines are kept in base populations and selected according to the results from performance tests of pure-bred and crossbred offspring. Three- or four-line crossbred production animals are then produced out of the breeding lines selected from the base breeding farm. This means that the base populations for almost all commercially used production animals around the world can be traced back to a limited number of multinational base breeders. Although breeding details are not provided, it is known that the breeding companies have taken measures to limit inbreeding in their breeding populations. Keeping reserve lines, however, plays only a minor role in commercial poultry breeding.

Integration of fancy poultry breeds into commercial breeding programmes is not a topic for commercial poultry breeders, not even for reasons of adaptation of their breeding lines to different husbandry conditions. Also, commercial poultry breeding has been successful in keeping their breeding stocks free of epizootic diseases for many years, while this is still a problem for amateur breeders, who do not have adequate measures at hand. The long term contribution of these breeds, however, cannot be estimated at present as details on the breeds' characteristics and productivity are needed first.

Most breeds and populations that were once distributed throughout Germany are kept by amateur breeders and selected according to breed standards. In organised amateur poultry breeding, there is hardly any herd-book breeding with systematic records of origin as is the case with large animals. Selection is largely based on exterior traits. Private organisations like the GEH are attempting to set up systematic conservation for poultry breeds as a cultural heritage for part-time farmers and smallholders. Examples include the Vorwerk and the Faverolle chicken and the Lippe goose. There are more conservation breeding programmes being developed. The main focus is on the conservation of breeds with closed populations under herd-book management, the implementation of measures to minimise inbreeding, and the use of animals for the sale of niche products.

The Diepholz goose has been recorded in a herd-book over many years. In Lower Saxony, a breeding bonus, funded solely by the *Land* itself, is awarded for geese that are registered in the herd-book and take part in performance tests. The herd-book, which records ancestry and productivity data, has a long tradition with the BDRG. However, participation in herd-book management concerns only 5% of all breeders. The main reason for this might be the huge effort required on the part of amateur breeders in monitoring hatching and fall nests. Targeted measures towards conservation of genetic diversity within and between breeds does not take place in this context.

IBV and the BDRG have successfully co-operated in realising and implementing the first step towards monitoring the stock size of non-commercial poultry breeds. IBV recently published the stock numbers the umbrella organisation BDRG collected manually in TGRDEU.



Pommernente taking a bath

Table 11 shows poultry breeds that are included in the GEH / BDRG "Red List", and the results of the census conducted by BDRG in 2000 and 2005. Where possible, only breeding animals from the respective breeding seasons were included. Contribution to the census was voluntary; about 70% of local associations of BDRG participated. The list does not differentiate between different strains of colour. In the case of chicken, in particular, colour strains are crossed between more or less independent populations so that the genetic difference within breeds between the different colour strains can be greater than the difference between breeds of the same colour.
Genetic distance evaluations have to prove the relationship between the breeds and colour strains. The BLE concluded with BDRG and GEH a contract for the monitoring of poultry in order to start a long-term co-operation in data collection. The first results are expected in 2008.
In Germany, measures for the cryoconservation of semen from poultry are unknown. As part of a series of research projects, the FLI established a blood and DNA bank of aprox. 100 poultry breeds (mostly chicken of different origin).

The German Poultry Breeding Association

The German National Inventory

Official breed description of BDRG

Table 11: Stock Numbers from Census by the BDRG 2005 on Poultry Breeds (Included in the BDRG / GEH Red List of endangered Poultry Breeds)

Poultry Breed	Number of ♂	Number of ♀	Nb. of Breeders
Chicken			
Augsburger	40	164	23
Bergische Kraeher	73	251	35
Bergische Schlotterkaemme	32	161	19
Brakel	258	1,270	159
Deutsche Langschan	79	363	46
Deutsche Reichshuehner	315	1,373	171
Deutsche Sperber	91	395	53
Deutsches Lachshuhn	316	1,395	180
Hamburger	394	1,976	219
Krueper	82	314	45
Lakenfelder	191	829	104
Ostfriesische Moewen	255	1,278	156
Ramelsloher	56	270	34
Rheinlaender	648	3,442	365
Sachsenhuehner	86	450	48
Sundheimer	159	635	84
Thueringer Barthuehner	281	1,584	176
Vorwerk	768	3,880	470
Westfaelische Totleger	340	1,480	213
Ducks			
Deutsche Pekingente	169	359	104
Pommernente	175	403	124
Geese			
Deutsche Legegans	61	164	40
Diepholzer Gans	153	382	83
Emdener Gans	135	255	88
Lippegans	12	14	12
Pommerngans	857	1,849	536
Turkeys			
Bronzepute	123	176	418
Croellwitzer Pute	160	213	519

4.1.3 Rabbits

Like poultry, rabbits, too, are not covered by the Animal Breeding Act, but count numerous endangered breeds.
Income-focussed rabbit breeding and keeping in Germany exist on a minimal, hardly notable scale. Breeders and keepers in this sector make use of special hybrid lines that are usually imported.
Rabbit breeding has nevertheless a long and important tradition in Germany, dating back to1880. Today, ZDRK has some 185,000 members and is the umbrella breed organisation for rabbit breeding and amateur breeders. It co-ordinates and organises breeding work in the German fancy rabbit breeding sector. The ZDRK's organisation is based on 20 regional associations which are built on district and local associations. Its breeders are mainly amateur breeders. 75 breeds are currently bred in some 350 colours. They are divided into five categories as shown in table 12.

- The small breeds comprise rabbits with a weight range of between 1.10 kg and 3.75 kg.
- Animals with a weight range of between 3.25 kg and 5.50 kg make up the medium-sized breed group.
- The large breed group comprises four breeds with a weight of over 5.50 kg.
- Short-hair and long-hair breeds form two further breed groups.

Table 12: Rabbit Breeds in Germany (after ZDRK 2001)

Small Breeds	Medium-Size Breeds	Short-Haired Breeds
Kleinschecken	Meißner Widder	Chin-Rex
Separator	Helle Großsilber	Blau-Rex
Deutsche Kleinwidder	Großchinchilla	Weiß-Rex
Kleinchinchilla	Mecklenburger Schecke	Dreifarben-Schecken-Rex
Deilenaar	Englische Widder	Dalmatiner-Rex
Marburger Feh	Deutsche Großsilber	Gelb-Rex
Sachsengold	Burgunder	Castor-Rex
Rhoenkaninchen	Blauer Wiener	Schwarz-Rex
Luxkaninchen	Blaugraue Wiener	Havanna-Rex
Perlfeh	Schwarze Wiener	Blaugrauer-Rex
Kleinsilber	Weiße Wiener	Rhoen-Rex
Englische Schecke	Graue Wiener	Feh-Rex
Hollaender	Weiße Hotot	Lux-Rex
Lohkaninchen	Rote Neuseeländer	Loh-Rex
Marderkaninchen	Weiße Neuseeländer	Marder-Rex
Siamesen	Große Marderkaninchen	Russen-Rex
Schwarzgrannen	Kalifornier	Rexzwerge
Russen	Japaner	**Long-haired Breeds**
Kastanienbraune Lothringer	Rheinische Schecken	Angora
Zwergwidder	Thüringer	Angora, farbig
Zwergschecken	Weißgrannen	Fuchskaninchen, farbig
Hermelin	Hasen-Kaninchen	Fuchskaninchen, weiß
Farbenzwerge	Satin-Kaninchen	Jamora, harlekinfarbig
	Alaska	Zwergfuchskaninchen
	Havanna	
Large Breeds		
Deutsche Riesen grau	Deutsche Riesenschecken	
Deutsche Riesen weiß	Deutsche Widder	

Negotiations with the National Association of German Rabbit Breeders regarding the monitoring of rabbits, analogous to the monitoring of the poultry species, are under way. The BLE expects to conclude the contract in 2008.

4.1.4 Game

Sustainable hunting of wildlife for which shooting rights apply is ruled by the Federal Hunting Act (*Bundesjagdgesetz, BJG*). The legislation is supplemented by the Hunting Acts of the *Laender* and their rules of application. In Germany, shooting rights are closely linked to the obligation of land owners and hunters to care for sustainable conservation of wildlife and protect its habitats. This applies to wildlife species with year-round close season, too. The regulation of hunting and close seasons is a contribution to the sustainable use of wildlife.

The following animal species are covered by the Federal Hunting Act:

- **Furred game:** bison, elk, red deer, fallow deer, sika deer, roe deer, chamois, ibex, moufflon, wild boar, hare, snow / mountain hare, wild rabbit, alpine marmot, wildcat, lynx, fox, beech (stone) marten, pine marten, polecat, ermine, pygmy weasel, badger, otter, seal.

- **Feathered game:** partridge, pheasant, quail, capercaillie, black grouse, rackel (capercaillie x black grouse), hazel grouse, rock ptarmigan, wild turkey, wild pigeon, mute swan, brant, mallard, mergus, woodcock, coot, seagull, great crested grebe, great bustard, grey heron, hawk, falcon, common raven.

Year-round close season applies to the following species: grouse, otter, seal, lynx and wildcat.

The most important role for human consumption play roe deer, wild boar, red deer and fallow deer.

In 2006, game consumption totalled some 30,000 tonnes in Germany.
A range of research institutes and wildlife research centres of several *Laender* carry out measures for

Red deer

the conservation and sustainable use of wildlife populations like wildlife identification, wildlife and habitat management, concepts for the protection of endangered wildlife species, and projects for their reintroducing. Germany's hunting organisations, the German Hunting Protection Association *(Deutscher Jagdschutz-Verband e.V., DJV)*, and the Ecological Hunting Society *(Oekologischer Jagdverein, ÖJV)* lobby for hunters' interests with the state and society at large. They actively support nature and animal protection. Each year, hunting associations spend more than € 90 million on activities for wildlife habitat enhancement.

Trends in wildlife stocks are identified by means of annual game bag statistics and by individually conducted stock counts / estimates. Since 2000, the Wildlife Informationsystem of the German *Laender* (*Wildtier-Informationssystem der Laender Deutschlands, WILD*) is set into operation. The project was initiated by the DJV and accompanied by scientific studies. Many wildlife species are affected by habitat fragmentation. Migrating species are particularly threatened by genetic loss due to isolation. Natural interactions between populations are achieved by connecting habitats.

Table 13: Game bag (in number of animals) of key wildlife species in Germany in 2000 / 2006

Animal Species	2000	2006
furred game		
Badger	38,419	51,084
Beech (Stone) Marten	47,587	53,496
Chamois	4,097	3,767
Fallow Deer	45,609	52,186
Fox	606,456	604,452
Hare	442,127	519,565
Moufflon	5,889	6,481
Pine Marten	4,243	1,517
Polecat and Weasel	31,241	25,833
Red Deer	53,241	69,902
Roe Deer	1,071,236	1,077,441
Sika Deer	894	1,194
Wild Boar	350,975	476,645
Wild Rabbit	188,172	189,699
feathered game		
Brant	29,720	29,464
Mallard	516,868	495,880
Partridge	11,491	13,181
Pheasant	336,908	377,896
Wild Pigeon	749,729	960,306
Woodcock	8,578	15,612

In addition to hunting, game farming of wildlife species, mainly of fallow and red deer, is becoming more popular. The Federal Association of Agricultural Game-Keeping *(Bundesverband fuer landwirtschaftliche Wildhaltung, BLW)*, as the umbrella association, represents the interests of gamekeepers and breeders organised in regional associations. Husbandry of wildlife species is covered by nature protection regulations of the *Laender*. These, however, mainly focus on the layout and design of paddocks. The BLW keeps statistics on husbandry of wildlife species as shown in table 14.

Table 14: Game-keeping in Germany in 2000

Land	Farms	Dams	Area (ha)
Bavaria	2,324	48,000	5,480
Baden-Wuerttemberg	300	5,100	1,000
Brandenburg / Mecklenburg-Western Pomerania	100	3,700	700
Hesse / Rhine-land-Palatinate	480	13,500	1,500
Lower Saxony	871	13,000	1,300
North Rhine-Westphalia	1,100	16,500	2,000
Saarland	51	1,120	250
Saxony	250	4,000	1,000
Saxony-Anhalt	80	1,750	350
Schleswig-Holstein	130	2,480	260
Thuringia	143	3,150	658
total	**5,829**	**112,300**	**14,498**

Before conservation measures for these wildlife species are considered, it is necessary to carry out comprehensive studies on genetic relationships between the, often isolated, subpopulations within each animal species.

Wild boar

4.2 Cryoconservation

4.2.1 Applicability of Ex Situ Conservation (Cryoconservation)

Table 15 gives an overview of available technology in cryoconservation of semen and embryos from large farm animal species. The important conclusion drawn from the table is that cryoconservation of semen works so well for all five farm animal species that birth rates of 40 to 60% after insemination with deep-frozen semen can be expected. For use in cryoconservation programmes, the process is thus more than satisfactory.

Flow Cytometer

Table 15: Available Technology in Cryoconservation of Semen and Embryos (after Niemann, personal communication, 2001)

a) Effectiveness of Insemination With Deep-Frozen Semen

Species	Birth Rate following AI*	Semen doses per collection (n)	Collection per week (n)	Comments
Horse	40 – 50%	20 – 30	2 – 4	relatively high proportion of premature embryo mortality
Cattle	50 – 60%	300 –1,000	2	
Sheep	55 – 60%	10 – 15	3	after insemination (synchronised oestrous) the pregnancy rate with deep frozen semen is only 10% lower than that achieved with fresh semen
Goat	60%	10 – 12	5	high fertility (lambing rate: 76%) with semen obtained in the second half of the breeding season
Pig	60%	8 –10	1 – 2	greatly improved thinners have allowed longer storage life and a greater increase in pig insemination in recent years

b) Status of Embryo Conservation in Domesticated Animals

Species	Embryos / Superovulation / Collection in Cattle incl. OPU* / IVI* (n)	Conditions for Embryo Collection	Optimal Stage of development for Embryo Conservation	Number of Offspring per Frozen Embryo
Horse	1 (low SO* reaction)	transcervical, can be repeated regularly	Morulae – young Blastocysts	appr. 40 – 45%
Cattle	4 – 6	transcervical, can be repeated regularly	Morulae – Blastocysts	appr. 60%
Sheep	4 – 5.5	surgical; laparoscopy; season-dependent	Morulae – Blastocysts	40 – 65%
Goat	4 – 8	surgical; transcervical; season-dependent	Morulae – expanded Blastocysts	35 – 55%
Pig	15 – 20	surgical	Morulae – Blastocysts	appr. 10 – 20%

*AI: artificial insemination (instrumental insemination); OPU/IVI: ova pick up/in vitro insemination; SO: super-ovulation

Obtaining embryos and storing them is more difficult. This is especially the case with pig embryos, for which a practicable method is not yet available. Due to the lack of super-ovulation effects, the embryo yield in horses is so low that using embryo transfer in horse conservation programmes would render the costs extremely high. Nevertheless, satisfactory results can be expected from the three ruminant species, so that systematic embryo conservation programmes are realistic.

The old breeding type of the Leineschaf is also endangered

Table 16: Cryogenic Storage of Cattle, Pig and Sheep in Germany

Genetic Resources
Cattle
Genetic Resource Bavaria
Braunvieh, Braunvieh alter Zuchtrichtung, Fleckvieh, Gelbvieh, Murnau-Werdenfelser, Pinzgauer
Genetic Resource FLI and other breeding organisations
Deutsches Schwarzbuntes Niederungsrind
Rinderunion Baden Wuerttemberg
Hinterwaelder, Vorderwaelder
Pig
Genetic Resource University Goettingen
Bunte Bentheimer, Sattelschwein, Schwaebisch-Haellisches Schwein
Sheep
Genetic Resource FLI
Bentheimer Landschaf, Coburger Fuchsschaf, Braunes Bergschaf, Graue Gehoernte Heidschnucke, Leineschaf, Merinofleischschaf, Merinolandschaf, Merinolangwollschaf, Ostfriesisches Milchschaf, Rauhwolliges Pommersches Landschaf, Rhoenschaf, Schwarzkoepfiges Fleischschaf, Skudde, Waldschaf, Weiße Gehoernte Heidschnucke, Weiße Hornlose Heidschnucke
Bavarian Genebank
Waldschaf

Cryogenic stores in Germany have up to now been acquired and maintained more or less systematically by public and private institutes. The cryogenic store of Bavaria has a considerable size. A comparison of cryogenic stores in Germany carried out by IBV shows that the nationwide situation is less favourable (table III, annex). Some 20 different institutions in Germany engage in cryoconservation of semen. However, most of the registered programmes lack the most important data, i.e. the number of semen samples taken from each individual sire, and sometimes even identification and origin, too. Clarification on the function of the participating institutions in the various conservation programmes is also needed: who has access to the sperm and embryo banks, and which are the conditions, and can they be integrated into a new overall model for conservation of animal genetic resources. It is thus premature to speak of a National Cryobank at this stage.

Taking tissue samples for Scrapie-testing

4.2.2 National Cryobank

As shown in table III (annex), with the exception of Bavaria, there is no systematic cryoconservation in Germany yet and documentation on cryogenic stores is not detailed enough to be of use for drafting such a programme. It lacks all the relevant details necessary for the prudent use of cryogenic material in endangered populations. Most important is the systematic completion of cryogenic stores for all breeds once the population size falls under the above mentioned critical value.

Braune Bergschafe

Furthermore, the following minimum requirements for cryogenic stores used in breeding must be laid down:

- Precise breed descriptions (for specific subpopulations, as appropriate).
- Number of sires kept (according to semen samples) and individual identification of frozen embryos with details of origin over three generations.
- Number of available semen samples per sire (or embryos per dam) with quality details like packaging, veterinary status (pathogenic germs) and risks associated with thawing.
- Place of origin (insemination centre, laboratory), date and locations (at least two) of the cryogenic store.
- Standardised details on ownership and usage rights for the cryogenic store.

Inadequately identified and incorrectly documented semen and embryo collections cannot be used as cryogenic store for the conservation of endangered farm animal breeds. Regulations are needed in this area, too. Specifications for use need to be developed along with the expansion and central documentation of the relevant data in TGRDEU.

Therefore, in order to complement the above mentioned rough figures collected by IBV and the concept developed by FLI in 2003, BMELV will carry out a detailed survey in order to take inventory of the size and status of existing cryoreserves to be integrated into a National Cryobank. With the results at hand, a National Cryobank can be planned in detail, possibly co-financed by the Federal Government and the *Laender*, and including a definition of the basic organisational necessities for the establishment, the obligatory legal framework as well as the calculation of costs per breed and *Land*.

4.3 In Situ Conservation and On-farm Management

Sheep wool – no longer profitable

At present, the conservation of numerous breeds at risk is supported by funds provided by the *Laender*. The activities and the supported breeds are summarised in the table II (annex). An overview of the support measures by the *Laender* per animal species is provided in table 17. In addition to the activities presented here, other support measures are in place, like those in Lower Saxony for the conservation of the Diepholz goose and in Mecklenburg-Western Pomerania for the Pommern goose and duck, and for four pigeon and two rabbit breeds.

With respect to the European Agricultural Fund for Rural Development (EAFRD, Council Regulation (EC) No 1698/2005), replacing the European Agricultural Guidance and Guarantee Fund (EAGGF), the *Laender* drafted new rules of application. These include financial support for certain local breeds. According to a survey carried out in March 2007, the following breeds are supported by the *Laender*:

Table 17: Number of Farm Animal Breeds supported by the Laender according to Animal Species

Land	Total	Number of supported Breeds According to Animal Species				
		Horse	Cattle	Sheep	Goat	Pig
Baden-Wuerttemberg	6	1	4			1
Bavaria	12	1	4	7		
Brandenburg	4	1	1	1		1
Hesse						
Mecklenburg-Western Pomerania	3	1		1		1
Lower Saxony	17	5	3	8		1
North –Rhine-Westphalia	9	3	2	1		3
Rhineland Palatinate	1		1			
Saarland	1		1			
Saxony						
Saxony Anhalt	9	2	1	4	1	1
Schleswig Holstein	5	1	2			2
Thuringia	7	1	1	3	1	1
Measures total:	**74**	**16**	**20**	**25**	**2**	**11**
Breeds total:	**45**	**9**	**12**	**17**	**2**	**5**

Often enough, shearing costs exceed the market price for wool

13 *Laender* currently operate 74 support measures for 45 breeds, many of which are kept in more than one *Land*. Rotes Hoehenvieh (cattle) and Deutsches Sattelschwein (pig) are supported in five different *Laender*; seven different lines of heavy horses are listed among the thirteen endangered horse breeds, which, genetically, belong to only three different populations. A similar picture can be drawn for pigs: three of the five pig populations actually belong to the Sattelschwein breed.

Many subpopulations are so small that effective conservation programmes are hardly sustainable, which goes for e.g. five of the eight horse and cattle breeds supported in Lower Saxony. This is one example of the differences between the concepts of support used by the *Laender*. While some (like North Rhine-Westphalia and Lower Saxony) award conservation bonuses for many breeds, and not just those typical of their *Land*, others (like Bavaria, Rhineland Palatinate, Brandenburg and Schleswig-Holstein) support only a few breeds that have been bred originally in their *Land*. It is clear that only the latter leads to sustainable conservation programmes, while in the other case bonuses for individual animals are awarded independently of how the supported animals contribute to a conservation programme that is operated in another *Land*. Unfortunately, current EC regulations only allow for the – less appropriate – allocation of funds for individual animals. The use of funding focussed on special breeding programmes (as in Lower Saxony for Bunte Bentheimer pigs and in Rhineland Palatinate for Glanrind cattle) is thus not an option.

Moreover, the sources of funding differ between the individual *Laender*. Some *Laender* rely exclusively on their funds for animal breeding (e.g. Bavaria, Mecklenburg-Western Pomerania and Brandenburg), while an increasing number of others (e.g. Lower Saxony, North Rhine-Westphalia and Baden-Wuerttemberg) makes use of EU co-financing, now under Council Regulation 1698/2005. This means that funding animals of the same breed can vary greatly between the different *Laender*.
Based on the National Programme, the BMELV developed support measures for the sustainable use and conservation of agricultural biodiversity. The measures are intended to maintain the basis for agricultural production in the long run and facilitate their innovative use. The support measures are an addition to intensified research in this field as well as documentation and information in IBV, and granted for pilot projects. A number of projects has been granted since the launch of the programme in 2005 including: development of breeding programmes for Murnau Werdenfelser (cattle), Thueringer Wald Ziege (goat) and Bentheimer Landschaf (sheep), an alternative grazing management system with endangered cattle breeds, acorn fattening of Schwaebisch Haellische pigs and preservation of genetic diversity of the red deer.

A flock of Heidschnucken

4.4 Precautions in Case of Epidemics

The spread of Avian Influenza around the world and the sudden appearance of Blue Tongue across Europe underlined once more the importance of precautionary measures against the loss of irrecoverable animal genetic resources. This includes data on the distribution of breeds, particularly endangered breeds, and the development of an emergency action plan based on this information.

4.5 Other Activities

The "Society for the Conservation of Old and Endangered Livestock Breeds" (*Gesellschaft zur Erhaltung alter und gefaehrdeter Haustierrassen e.V., GEH*) has been working intensely on identifying remaining stocks of endangered farm animal breeds and their breeding management since 1981. With the help of breed custodians and species co-ordinators, the society has developed an early warning system for endangered stocks based on current animal numbers, breeding structures and expected developments in the coming years. The warning is published by GEH in the form of a "Red List of Endangered Livestock Breeds".
One of the main contributions to the conservation of endangered populations is the GEH's Ark Farm Project, where each of the round about 70 participating farms is committed to managing a number of endangered breeds in breeding groups. The society is currently the only nationwide active organisation which makes great efforts to integrate animal genetic resources into extensive and organic farming, landscape management and nature protection programmes.

In order to enhance the co-ordination of work on endangered cattle breeds in Germany, GEH organised a workshop for the cattle breed custodians. The last session was held in October 2006 on the premises of the cattle breeding organisation of Berlin Brandenburg. Outside the GEH, dedicated breeders of endangered farm animal breeds founded special breed societies not only to promote the breeds in general and encourage their conservation, but, especially for those breeds spread over several *Laender*, to exchange experiences and improve co-operation. Following success stories like the Working Group for Rotes Hoehenvieh (cattle), quite a few new breed societies have been established recently:

A variety of cheese

- Apart from financial support, the recovery of some breeds is assisted by the establishment of breeding associations. One very good example is the successful work of the Association for the Conservation of the Deutsches Schwarzbuntes Niederungsrind (cattle).

- GEH chose the cattle breed Murnau-Werdenfelser as endangered breed of the year 2007. Breeders of the cattle breed work jointly as "Friends of the Murnau-Werdenfelser" (*Foerderverein zur Erhaltung des Murnau-Werdenfelser Rindes*) to help promoting the breed and protecting it from extinction.

- A project for the foundation of a breeders' society for the Thueringer Wald Ziege (goat) is financed by BMELV as a pilot project.

- Due to the change in European legislation for animal breeding, an Association for the Senner horse was established at the beginning of 2007.

- Furthermore, the establishment of a Scrapie resistance breeding programme for Bentheimer Landschaf (sheep) was also financed by BMELV as a pilot project.

A range of meat and sausage products

Marketing products of endangered breeds helps to protect them from extinction. Under the title "Eat it to safe it!", the Slow Food Foundation created "The Ark of Taste". The Ark seeks to preserve endangered tastes, the economic, social and cultural heritage of animal breeds, fruit and vegetables, cured meats, cheese, cereals, pastas, cakes and confectionery. So-called "passengers of the Ark" are so far the Murnau-Werdenfelser, Hinterwaelder and Limpurger cattle, the Bunte Bentheimer pig, Rhoen and Weiße Hornlose Heidschnucke sheep. The results of Slow Food's work could be viewed at the "German Slow Food Trade Fair 2008 – The Market for good Taste", which was held in Stuttgart.

The Non-Governmental Organisations Safeguard for Agricultural Varieties in Europe (SAVE foundation), Switzerland, Steunpunt Levend Erfgoed (SLE), Belgium, Associazione Italiana Razze Autoctone a Rischio di Estinzione (R.A.R.E), Italy and the GEH, Germany work together in the European Livestock Breeds Ark and Rescue Net (ELBARN) project which is funded under Council Regulation (EC) 870/2004. The objective of this action is to establish a European ark and rescue net to motivate, document and network towards rescue, *in situ* conservation and use of under-utilised agricultural genetic resources in Europe. The documentation of existing infrastructure, along with the resulting network, will be inventoried as an online, publicly accessible database.

4.6 Latest Research Results

According to the Council Regulation (91/2092), organic production requires sustainable, ecologic animal husbandry with a multifactorial approach to ecological animal breeding. Although the use of rare breeds is not imperative in organic production, there are many aspects that may prove profitable for both sides. This idea was taken up and discussed during the project "Animal Breeding Network", which was financed under the Federal Programme for Organic Production in Germany. The final workshop was held in Kassel in April 2007.
However, another project financed under the Federal Programme for Organic Production in Germany showed that breeding does not differ between conventional and organic production systems ("OeKuh" – Genotype x environment interaction and sustainable breeding strategies").
With regard to the demand of the National Programme for *in situ* conservation of PCPs, BMELV financed another pilot project targeted at finding suitable cross-breeding "partners" for the Murnau-Werdenfelser cattle via calculating the genetic distance to the Tiroler Grauvieh and Murbodener as well as the French Tarantaise cattle.

5 Annex

5.1 Annexed Tables

table I: Animal Genetic Resources and Share of Endangered Breeds in Germany (2006)

Animal Husbandry and Animal Breeding in Germany	numbers
Cattle	
Farms with cattle in total	**175,900**
Thereof with dairy cows	105,800
Thereof with suckler cows	46,400
Number of dairy cows	**4,081,200**
Number of dairy cows registered in herd-books	2,419,177
Dairy cows registered in herd-books in %	59.3
Number of different breeds (dairy cattle)	**16**
Number of endangered breeds	10
Endangered breeds in %	62.5
Number of herd-book cows (dairy) belonging to the three most common breeds	**2,252,568**
Herd-book cows belonging to the three most common breeds in %	93.1
Number of herd-book cows (dairy) belonging to endangered breeds	**18,358**
Herd-book cows belonging to endangered breeds in %	0.8
Number of suckler cows	**659,900**
Number of suckler cows registered in herd-books	53,662
Suckler cows registered in herd-books in %	8.1
Number of different breeds (suckler cows)	**29**
Number of endangered breeds	9
Endangered breeds in %	31.0
Number of herd-book cows (suckler) belonging to the three most common breeds	**27,696**
Herd-book cows belonging to the three most common breeds in %	51.6
Number of herd-book cows (suckler) belonging to endangered breeds	**4,787**
Herd-book cows belonging to endangered breeds in %	8.9
Pigs	
Farms with pigs in total	**82,400**
Thereof with breeding sows	30,900
Number of fattening pigs	10,560,100
Number of breeding sows	**2,483,900**
Number of breeding sows registered in herd-books	38,581
Breeding sows registered in herd-books in %	1.6

Animal Husbandry and Animal Breeding in Germany	numbers
Number of different breeds	**15**
Number of endangered breeds	3
Endangered breeds in %	20.0
Number of herd-book sows belonging to the three most common breeds	**33,788**
Herd-book sows belonging to the three most common breeds in %	92.9
Number of herd-book sows in endangered breeds	**569**
Herd-book sows in endangered breeds in %	1.5
Sheep	
Farms with sheep	**29,200**
Number of herd-book ewes	**1,602,900**
Number of breeding ewes registered in herd-books	92,160
Breeding ewes registered in herd-books in %	5.8
Number of different breeds	**59**
Number of endangered breeds	19
Endangered breeds in %	32.2
Number of herd-book ewes belonging to the three most common breeds	**34,598**
Herd-book ewes belonging to the three most common breeds in %	37.5
Number of herd-book ewes in endangered breeds	**47,508**
Herd-book ewes in endangered breeds in %	51.6
Horses	
Farms with horses	**64,100**
Total number of horses	**500,400**
Number of breeding animals registered in studbooks	> 110,000
Breeding animals registered in studbooks in %	21.9
Number of different breeds	**94**
Number of endangered breeds	12
Endangered breeds in %	12.8
Number of studbook animals belonging to the three most common breeds	**77,180**
Studbook animals belonging to the 3 most common breeds in %	> 70
Number of studbook animals in endangered breeds	**6,221**
Studbook animals in endangered breeds in %	5.7
Goats	
Number of goats	
Total number of goats	180,000
Number of breeding goats registered in herd-books	13,862
Breeding goats registered in herd-books in %	7,7
Number of different breeds	**26**
Number of endangered breeds	3
Endangered breeds in %	11.5

Animal Husbandry and Animal Breeding in Germany	numbers
Number of herd-book goats belonging to the three most common breeds	**10,888**
Herd-book goats belonging to the three most common breeds in %	78.6
Number of herd-book animals in endangered breeds	**4,465**
Herd-book animals in endangered breeds in %	32.2
Chicken	
Farms with chicken	**80,400**
Number of chicken	107,267,400
Number of layers	36,157,100

table II: Support Measures for Endangered Farm Animal Breeds in 2006 by the Laender

Species / Breeds	Laender												
	SH	NI	NW	HE	RP	BW	BY	SL	BB	MV	SN	ST	TH
Horses													
Alt-Wuerttemberger						■							
Duelmener			■										
Rheinisch Deutsches Kaltblut		■	■						■	■		■	
Rottaler							■						
Schleswiger Kaltblut	■	■											
Schwarzwaelder Kaltblut		■											
Schweres Warmblut		■										■	■
Senner			■										
Sueddeutsches Kaltblut		■											
Cattle													
Ansbach-Triesdofer							■						
Braunvieh alter Zuchtrichtung						■	■						
Deutsches Schwarzbuntes Niederungsrind		■							■				
Deutsches Shorthorn	■												
Glanrind			■		■			■					
Hinterwaelder						■							
Limpurger						■							
Murnau-Werdenfelser							■						
Pinzgauer							■						
Rotes Hoehenvieh		■	■									■	■
Rotvieh alter Angler Zuchtrichtung	■	■											
Vorderwälder						■							

Species / Breeds	Laender												
	SH	NI	NW	HE	RP	BW	BY	SL	BB	MV	SN	ST	TH
Pigs													
Angler Sattelschwein	■		■										
Buntes Bentheimer		■	■										
Deutsches Sattelschwein									■	■		■	■
Rotbuntes Husumer Schwein	■												
Schwaebisch-Haellisches Schwein			■			■							
Sheep													
Bentheimer Landschaf		■											
Braunes Bergschaf							■						
Brillenschaf							■						
Coburger Fuchs		■					■						
Graue Gehoernte Heidschnucke		■											
Leineschaf		■											■
Merinofleischschaf		■										■	
Merinolangwollschaf													■
Rauhwolliges Pommersches Landschaf										■		■	
Rhoenschaf							■					■	■
Skudde									■				
Steinschaf							■						
Waldschaf							■						
Weiße Gehoernte Heidschnucke		■											
Weiße Hornlose Heidschnucke		■	■									■	
Weißes Bergschaf							■						
Weißkoepfiges Fleischschaf		■											
Ziege													
Braune Harzer Ziege												■	
Thueringer Wald Ziege													■

Caption:
SH – Schleswig-Holstein; NI – Lower Saxony; NW – North Rhine-Westphalia; HE – Hesse; RP – Rhineland Palatinate; BW – Baden–Wuerttemberg; BY – Bavaria; SL – Saarland; BB – Brandenburg; MV – Mecklenburg–Western Pomerania; SN – Saxony; ST – Saxony–Anhalt; TH – Thuringia;

The activities are partly *Laender*-funded support measures (e.g. Bunte Bentheimer (pig) and Diepholzer Gans (goose) in Lower Saxony) and partly co-financed by the EU.

table III: Cryoconservation of Farm Animal Populations in Germany

Breed / stored material	Location / institution
Horses	
Bayerisches Warmblut	
semen of 20 stallions	Landgestuet Schwaiganger (Bavaria)
Hannoveraner Warmblut	
semen of 50 stallions, sufficient for 20 to 400 inseminations	Landgestuet Celle (Lower Saxony)
Rheinisch Deutsches Kaltblut	
semen of 1 stallion	Landgestuet Celle (Lower Saxony)
Rottaler Pferd	
semen of 3 stallions	University Munich (Bavaria)
Schleswiger Kaltblut	
semen of 9 stallions 30 to 120 straws per stallion	Institute for Reproductive Medicine, Hanover (Lower Saxony)
semen of 1 stallion	Landgestuet Celle (Lower Saxony)
Schweres Warmblut	
semen of 2 stallions	Institute for Reproductive Medicine, Hanover (Lower Saxony)
Sueddeutsches Kaltblut	
semen of 1 stallion	Landgestuet Schwaiganger (Bavaria)
Cattle	
Braunvieh	
9,930 portions of semen of 22 bulls	Bavarian Genebank
Braunvieh alter Zuchtrichtung	
200 to 4,000 portions, each of 18 different bulls	Besamungsstation Bad Waldsee der Rinderunion Baden-Wuerttemberg
8,259 portions semen of 18 bulls, 29 embryos	Bavarian Genebank
Deutsches Schwarzbuntes Niederungsrind	
semen of 16 bulls	Masterrind (Lower Saxony)
semen of 6 bulls	Verein ostfriesischer Stammviehzuechter e.V. (Lower Saxony)
semen of 13 bulls	Weser–Ems Union e.V. (Lower Saxony)
300 embryos of 10 bulls and 95 cows resp.	FLI
143,900 portions of semen of 101 bulls from 10 genealogical lines	Rinderproduktion Berlin-Brandenburg
Fleckvieh	
42,999 portions of semen of 24 bulls	Bavarian Genebank
Gelbvieh	
9,150 portions of semen of 24 bulls	Bavarian Genebank

(S

Breed / stored material	Location / institution
Hinterwaelder	
34,000 portions of 32 different bulls	Besamungsstation Bad Waldsee der Rinderunion Baden-Wuerttemberg
Murnau-Werdenfelser	
7,744 portions of semen of 24 bulls 27 embryos	Bavarian Genebank
Limpurger	
between 1,000 and 20,000 portions of 26 different bulls, 20 embryos from 5 flushings	Rinderunion Baden-Wuerttemberg
Pinzgauer	
7,310 portions of semen of 19 bulls	Bavarian Genebank
Rotes Hoehenvieh	
deposit of at least 50 portions of semen of all bulls used, appr. 15 bulls	Zucht- und Besamungsunion Hessen e.G.
approx. 500 portions of semen from 1 bull (not tradeable)	Institute for Reproductive Medicine, Hanover (Lower Saxony)
Rotvieh alter Angler Zuchtrichtung	
deposit, 490 embryos of 15 different bulls from 77 flushings	Rinderzuchtverband Schleswig Holstein
Vorderwaelder	
between 200 and 4,000 portions of 18 different bulls	Besamungsstation Bad Waldsee der Rinderunion Baden-Wuerttemberg
Sheep	
Bentheimer Landschaf	
semen of 7 rams	FLI (2003)
semen of 2 rams	Landwirtschaftskammer Weser–Ems (Lower Saxony)
Coburger Fuchsschaf	
semen of 7 rams	FLI (2003)
Braunes Bergschaf	
semen of 1 ram	FLI (2003)
Graue Gehoernte Heidschnucke	
semen of 10 rams	FLI (2003)
semen of 6 rams	Landwirtschaftskammer Hanover (Lower Saxony)
Leineschaf (incl. urspruenglicher Typ)	
semen of 8 rams	FLI (2003)
Merinofleischschaf	
semen of 5 rams	FLI (2003)
semen deposit	IFN Schoenow (Brandenburg)
Merinolandschaf	
semen of 11 rams	FLI (2003)
Merinolangwollschaf	
semen of 7 rams	FLI (2003)
Ostfriesisches Milchschaf	
semen of 12 rams	FLI (2003)
Rauhwolliges Pommersches Landschaf	
semen of 2 rams	FLI (2003)

Breed / stored material	Location / institution
Rhoenschaf	
semen of 7 rams	FLI (2003)
Schwarzkoepfiges Fleischschaf	
semen of 19 rams	FLI (2003)
Skudde	
semen of 7 rams	FLI (2003)
Waldschaf	
semen of 3 rams	Bavarian Genebank
Weiße Gehoernte Heidschnucke	
semen of 3 rams	FLI (2003)
semen of 1 ram	Landwirtschaftskammer Weser–Ems (Lower Saxony)
Weiße Hornlose Heidschnucke	
semen of 7 rams	FLI (2003)
Pigs	
Bunte Bentheimer	
semen of 22 boars (between 125 and 291 doses)	University Goettingen (Lower Saxony)
Deutsche Sattelschweine	
semen of 19 boars (between 52 and 309 doses) (Deutsches Sattelschwein)	University Goettingen (Lower Saxony)
semen of 9 boars (between 37 and 227 doses) (Schwaebisch Haellisches Schwein)	University Goettingen (Lower Saxony)
semen of 4 boars (100 doses) (Schwaebisch Haellisches Schwein)	IFN Schoenow (Brandenburg)
semen (Schwaebisch Haellisches Schwein)	TiHo Hanover (Lower Saxony)
Goats	
Bunte Deutsche Edelziege	
350 doses semen of 12 rams	IFN Schoenow (Brandenburg)
560 doses semen	TiHo Hanover (Lower Saxony)
Thueringer Wald Ziege	
semen of 4 rams (between 120 and 200 doses)	IFN Schoenow (Brandenburg)
Weiße Deutsche Edelziege	
350 doses of semen of 21 rams	IFN Schoenow (Brandenburg)

table IV: Indigenous Farm Animal Populations According to Animal Species and Risk Category

Notwithstanding the classification given in table 8, the National Committee can classify breeds according to further technical aspects.

	Numbers of herd-book breeding animals				2006	
	2000		2006			
species / breeds *	♂	♀	♂	♀	N_e	category
Horses						
Senner	3	11	0	7	**n.c.**[1]	CPC
Leutstettener			3	13	**9.8**	
Pfalz Ardenner Kaltblut	1	27	6	31	**20.1**	
Rottaler Pferd	4	15	7	21	**21.0**	
Alt–Wuerttemberger	6	45	9	48	**30.3**	
Duelmener *)	20	44	27	62	**75.2**	
Schleswiger Kaltblut	27	211	26	194	**91.7**	CP
Schwarzwaelder Kaltblut *)	45	751	56	906	**211.0**	
Schweres Warmblut (inkl. ostfriesisch – altoldenburgisch) *)	58	1,316	80	1,370	**302.3**	
Sueddeutsches Kaltblut	93	1,849	103	2,187	**393.5**	MP
Rheinisch Deutsches Kaltblut	86	820	167	1,331	**593.5**	
Ostpreußisches Warmblut Trakehner Abstammung	174	4,267	186	3,623	**707.7**	
Deutsches Reitpony	770	7,825	721	6,403	**2,592.1**	NE
Deutsches Reit- / Sportpferd incl. 17 subpopulations	2,065	66,048	2,285	63,387	**8,822.0**	
Cattle						
Ansbach-Triesdorfer	1	25	1	25	**n.c.**[1]	PCP
Murnau-Werdenfelser	1	161	6	129	**22.9**	
Deutsches Shorthorn *)	43	273	22	284	**88.3**	
Uckermaerker *)	77	1,601	65	2,299	**252.9**	
Doppelnutzung Rotbunt *)	8	9,648	0	6,460	**n.c.**[1]	CP
Rotvieh alter Angler Zuchtrichtung *)	8	82	8	152	**30.4**	
Limpurger *)	100	110	12	129	**43.9**	
Pinzgauer (inkl. Fleischnutzung)	35	1,079	16	830	**62.8**	
Braunvieh alter Zuchtrichtung	25	264	18	280	**67.7**	
Deutsches Schwarzbuntes Niederungsrind	8	1,994	19	1,958	**75.3**	
Gelbvieh (inkl. Fleischnutzung)	49	8,085	36	4,603	**142.9**	
Hinterwaelder (inkl. Fleischnutzung)	43	662	51	627	**188.7**	
Rotes Hoehenvieh *)	39	525	54	701	**200.6**	
Glanrind *)	50	420	70	600	**250.7**	
Vorderwaelder *)	297	5,325	207	4,050	**787.7**	

1 not calculated

	Numbers of herd-book-breeding animals				2006	
	2000		2006			
species / breeds *	♂	♀	♂	♀	N_e	category
Holstein-Rotbunt	1260	169,464	692	142,900	**2,754.7**	**NE**
Braunvieh	843	164,669	1,069	143,917	**4,244.5**	
Fleckvieh (inkl. Fleischnutzung)	2,583	656,081	3,401	642,448	**13,532.4**	
Holstein-Schwarzbunt	7,427	1,466,847	7,960	1,475,624	**31,669.2**	
Pigs						
Rotbuntes Husumer Schwein	7	100	11	42	**34.9**	**CPC**
Bunte Bentheimer	10	41	62	207	**190.8**	**CP**
Angler Sattelschwein	13	87	23	69		
Deutsches Sattelschwein	24	125	16	81		
Schwaebisch Haellisches Schwein	25	139	24	170		
Sattelschweine (total) *)			63	320	**210.5**	
Deutsche Landrasse	808	36,579	495	24,162	**1,588.7**	**NE**
Deutsches Edelschwein (Large White)	727	4,786	421	7,019	**1,940.3**	
Sheep						
Alpines Steinschaf	11	168	8	191	**30.7**	**PCP**
Krainer Steinschaf *)			24	310	**89.1**	
Merinolangwollschaf	77	6,478	31	4,453	**123.1**	**CP**
Brillenschaf	21	440	45	677	**168.8**	
Weiße Gehoernte Heidschnucke *)	58	978	55	796	**205.8**	
Weißes Bergschaf *) (incl. Gescheckte Bergschaf)	57	1,067	55	1,302	**211.1**	
Leineschaf (inkl. urspruenglicher Typ) *)	80	1,852	89	2,261	**342.5**	
Braunes Bergschaf	43	754	53	1,355	**204.0**	**MP**
Waldschaf	44	717	57	1,139	**217.1**	
Merinofleischschaf	111	6,458	84	3,225	**327.5**	
Weiße Hornlose Heidschnucke	106	2,491	90	2,916	**349.2**	
Bentheimer Landschaf	96	2,105	96	2,240	**368.2**	
Weißkoepfiges Fleischschaf	200	1,624	185	1,831	**672.1**	
Rhoenschaf	162	6,691	210	5,523	**809.2**	
Graue Gehoernte Heidschnucke	159	3,445	213	4,625	**814.5**	
Coburger Fuchsschaf	162	4,012	224	3,792	**846.0**	
Ostfriesisches Milchschaf *)	313	3,538	255	2,691	**931.7**	
Rauhwolliges Pommersches Landschaf *)	258	3,871	288	3,481	**1,064.0**	
Skudde *)	277	2,875	291	3,398	**1,072.2**	
Merinolandschaf	295	15,369	337	15,681	**1,319.6**	**NE**
Schwarzkoepfiges Fleischschaf	451	16,032	393	13,394	**1,527.2**	
Goats						
Braune Harzer Ziege	8	10	52	392	**68.8**	**CP**
Thueringer Wald Ziege	104	386	151	871	**514.8**	**MP**
Weiße Deutsche Edelziege	207	3,326	263	3,202	**972.2**	
Bunte Deutsche Edelziege	358	5,121	316	4,961	**1,188.3**	**NE**

1 not calculated

5.2 Calculating the Rate of Inbreeding and the Effective Population Size

The accuracy with which the effective population size and the rate of inbreeding within a population can be calculated depends on the available data on pedigree and family structure.
In herd-book populations, pedigree data can be used to calculate the expected rate of inbreeding for all potential matings, and to minimise it, where necessary. The effective population size can be routinely calculated and monitored from generation to generation in all herd-book populations. Given the large variation in the number of offspring per sire (unbalanced distribution), the questionable classification of sires available from sperm banks, and the great variations in the period of potential use (including the problem of overlapping generations), it is often safer to estimate the rate of inbreeding DF in a registered herd-book population and use that estimate to calculate N_e (Falconer, 1960):

$$\Delta F - \frac{F_t - F_{t-1}}{1 - F_{t-1}} \qquad \textit{and} \qquad N_e - \frac{1}{2\,\Delta F}$$

Under the National Programme, DF is to be calculated using the estimated effective population size (N_e), whereby the following relationship applies (Falconer, 1960):

$$\Delta F = \frac{1}{2N_e}$$

The degree of inbreeding that results after t generations of random mating is

$$F_t = 1 - (1 - \Delta F)^t.$$

The probability that an allele with the starting frequency qo is lost after t generations is

$$p_o - 3\, p_o q_o\, (1 - \Delta F)^t$$

which also defines the frequency with which the alternative allele (assuming only 2 alleles per gene location) is fixed. It can be assumed that after t generations of random mating, a numerically finite population with the size N_e still segregates a proportion of

$$6\, p_o q_o \qquad (1 - \frac{1}{2N_e})^t$$

gene locations, i.e. contains both primary alleles. Table V shows the distribution of genetic diversity in populations dependent on time lapse.

table V: Proportion of Remaining Segregating Gene Locations in Populations Sized N_e in Relation to the Allele Starting Frequencies and the Number of Random Matings Per Generation (t)

N_e	t = 10		t = 20		t = 50	
	q_o = 0,5	q_o = 0,1	q_o = 0,1	q_o = 0,1	q_o = 0,5	q_o = 0,1
10	90	32	53	19	12	4
20	100	42	90	33	42	15
50	100	49	100	44	91	33
100	100	51	100	49	100	42
200	100	53	100	51	100	48

The figures show that long-term genetic loss occurs in each population of finite size, but that an effective population size of only 10 is definitively too small because, after 20 generations, one of the two segregating alleles is lost at 50 – 80% of the gene locations. The figures also show that there is little fluctuation in conservation effects above $N_e = 50$, but that rare alleles ($qo < 0.1$) contained in the starting population still have a 56% chance of loss, which is further reduced to 47% at $N_e = 500$. These figures are more favourable if spontaneous new mutations and multiple alleles per gene location are calculated. The figures presented here should be sufficient for discussing the endangerment of a population.

The degree of endangerment can be assessed better with the help of an accurate estimate of the effective population size, and in order to obtain this, data on the number of active male and female breeding animals and their relationship to one another are needed. Rough formulas that can be applied to define the effective population size (and the rate of inbreeding = ΔF) per generation) based on the number of male (N_m) and female (N_f) breeding animals are:

$$N_e = \frac{4N_m \bullet N_f}{N_m + N_f} \quad \textit{and} \quad \Delta F = \frac{N_m + N_f}{8N_m \bullet N_f}$$

These formulas are simplified versions of a more comprehensive formula devised by Latter (1959) and are based on the assumption of a Poisson-distributed family structure.

N_e can decrease dramatically if the active breeding animals are closely related, and can be increased if the family size is kept consistent. In this case, the rate of inbreeding (Falconer, 1960) is calculated as follows:

$$\Delta F = \frac{3}{32N_m} + \frac{1}{32N_f}$$

A sensible strategy with small populations would thus be to keep family sizes constant.

SIMON and BUCHENAUER (1993) engaged in an intense discussion on the possibilities of calculation, classification and the criteria needed in the EAAP Publication No. 66. Their methodology is based on the effective population size, but they identify other conditions as risk factors, too: the proportion of purebred animals (or the degree of crossbreeding), trends in the number of active female breeding animals and, in very small populations, the number of male breeding animals and breeding herds. They also correct the population size below $N_e = 100$ for relationship effects to ΔF, which means that $N_e = 50$ is corrected to $N_e = 28$ for inbreeding. They recommend that the critical value should be set based on the degree of inbreeding after 50 years (<5%, 5– 15%, 16 – 25%, 26 – 40%, and > 40%), which means that, for each animal species, different generation intervals must be defined (1.5 years for pigs and up to 4.5 years for horses), and critical values for N_e vary (≥ 304 for pigs compared to ≥ 112 for horses, in order to achieve $Fx < 5\%$ after 50 years). All of this applies to the varying intensities of inbreeding in European countries with or without herd-book management. It would not have to be applied within Germany's National Programme.

5.3 References

Deutscher Bauernverband: Situationsbericht 2007 – Trends und Fakten zur Landwirtschaft, 2005, *http://www.situationsbericht.de/*

Falconer, D. S.: Introduction to Quantitative Genetics. R. Mac Lehose and Com., Glasgow, 1960.

FAO: Revival of the Bentheim Black Pied Pig, 2007, *http://www.fao.org/ag/againfo/programmes/en/genetics/map_europe.html*

FAO: The Global Plan of Action and the Interlaken Declaration, 2007, *http://www.fao.org/ag/againfo/programmes/en/genetics/documents/Interlaken/GPA_en.pdf*

FAO: The State of the World's Animal Genetic Resources for Food and Agriculture, 2007, *http://www.fao.org/docrep/010/a1250e/a1250e00.htm*

Forschungsinstitut für Biologischen Landbau: Genotyp x Umwelt Interaktionen und nachhaltige Zuchtstrategien (ÖKUH), 2006, *http://www.fibl.org/forschung/tierzucht/biorinderzucht/oekuh.php*

Gravert, H.O.: Erhaltung der genetischen Vielfalt bei landwirtschaftlichen Nutztieren. DGfZ-Schriftenreihe, Heft 14, 1999.

Ollivier, L., F. Labroue, P. Glodek, G. Gandini and J.V. Delgado: Pig Genetic Resources in Europe. EAAP-Publ. No. 104, 2001.

Secretariat of the Conference of Parties: The Convention on Biological Diversity, 1992, *http://www.cbd.int/doc/legal/cbd-un-en.pdf*

Simianer, H., S.B. Marti, J. Gibson, O. Hanotte, I.E.O. Rege: An approach to the optimal allocation of conservation funds to minimize loss of genetic diversity between livestock breeds. Ecological Economics 2002a (accepted).
Draft unter:
http://www.cgiar.org/ilri/research/proj4/angr.cfm.

Simianer, H.: Noah's dilemma: Which breed to take aboard the ark? 7th WCGALP, 2002b, Montpellier, France.

Simon, D.L. and D. Buchenauer: Genetic Diversity of European Livestock Breeds. EAAP-Publ. No. 66, 1993.

Statistisches Bundesamt: Konsumausgaben privater Haushalte nach Verwendungszwecken, 2007, *http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Statistiken/Zeitreihen/LangeReihen/LebensunterhaltKonsum/Content100/lrleb03ga,templateId=renderPrint.psml*

Weitzmann, M.L.: On diversity. Quart. J. Economics CVII, 1992, 363-405.

Weitzmann, M.L.: What to preserve? An application of diversity theory to crane conservation. Quart J. Economics, CVIII, 1993, 157-183.

List of abbreviations

ADR	*Arbeitsgemeinschaft Deutscher Rinderzuechter* German Cattle Breeders' Federation
AI	artificial insemination
AMK	*Agrarministerkonferenz* Conference of Agricultural Ministers
BDRG	*Bundesverband Deutscher Rassegefluegelzuechter e.V.* Federation of German Poultry Breeders
BJG	*Bundesjagdschutzgesetz*, Federal Hunting Act
BLE	*Bundesanstalt fuer Landwirtschaft und Ernaehrung* Federal Agency for Agriculture and Food
BLW	*Bundesverband fuer landwirtschaftliche Wildhaltung,* National Association of Agricultural Gamekeeping
BMELV	*Bundesministerium fuer Ernaehrung, Landwirtschaft und Verbraucherschutz* Federal Ministry for Food, Agriculture and Consumer Protection
CAP	Common Agricultural Policy
CBD	Convention on Biological Diversity
CGRFA	Commission on Genetic Resources for Food and Agriculture
COP	Convention of Parties
CP	conservation population
CSD	United Nations Commission on Sustainable Development
DAD-IS	Domestic Animal Diversity Information System
DBV	*Deutscher Bauernverband* German Farmers' Association
DFG	*Deutsche Forschungsgemeinschaft e.V.* German Research Foundation
DGfZ	*Deutsche Gesellschaft fuer Zuechtungskunde* German Society for Animal Production
EAAP	European Association for Animal Production
EAFRD	European Agricultural Fund for Rural Development
EAGGF	European Agricultural Guidance and Guarantee Fund
EC	European Community
ERFP	European Regional Focal Point for Animal Genetic Resources
ET	embryo transfer
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FBN	*Forschungsinstitut fuer die Biologie landwirtschaftlicher Nutztiere (FBN)* Research Institute for the Biology of Farm Animals
FBR TGR	*Fachbeirat Tiergenetische Ressourcen* National Committee on Animal Genetic Resources
FLI	*Friedrich-Loeffler-Institut, Bundesforschungsinstitut fuer Tiergesundheit, Institut fuer Nutztiergenetik Mariensee* Friedrich-Loeffler-Institute, Federal Research Institute for Animal Health, Institute of Farm Animal Genetics
GEH	*Gesellschaft zur Erhaltung alter und gefaehrdeter Haustierrassen e.V.* Society for the Conservation of Old and Endangered Livestock Breeds
IBV	*Informations- und Koordinationszentrum fuer Biologische Vielfalt* Information and Coordination Centre for Biological Diversity
ITWG-AnGR	Intergovernmental Technical Working Group on Animal Genetic Resources
IVI	in vitro insemination
JPOI	Johannesburg Plan of Implementation
MP	monitoring population
NE	non-endangered population
N_e	effective population size
NGO	non-governmental organisation
OPU	ovum pick-up
PCP	phenotypic conservation population
SO	super-ovulation
SoW-AnGR	State of the World's Animal Genetic Resources
SYN	synthetic population
TGRDEU	*Zentrale Dokumentation Tiergenetischer Ressourcen in Deutschland* Central documentation on animal genetic resources in Germany
TiHo	*Tieraerztliche Hochschule Hannover* Unitversity of Veterinary Medicine Hanover
UAA	utilised agricultural area
UN	United Nations
UNCED	United Nations Conference on Environment and Development
VDL	*Vereinigung Deutscher Landesschafzuchtverbaende e.V.* Federation of German Sheep Breeding Associations
WILD	*Wildtier-Informationssystem der Laender Deutschlands* wildlife information system of Germany's *Laender*
ZDRK	*Zentralverband Deutscher Rasse-Kaninchenzuechter e.V.* National Association of German Rabbit Breeders
ZDS	*Zentralverband der Deutschen Schweineproduktion e.V.* Umbrella Association of German Pig Production

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