Contents

Summary

In April 2001, the French government undertook to write its first national report on the state of the country's animal genetic resources (AnGR). This report is the result of the concerted efforts of those variously involved in managing AnGR: administrative, research and teaching bodies, professional bodies, regional conservation centres, breed associations etc. Their active involvement reflects the importance of AnGR in France, for the country's economy and heritage.

The first part of the report highlights the diversity of the French countryside and the strong bonds the French have with their land in their area. This is reflected in a wide variety of farming systems. Stock farming is found in all parts of the country, but is predominant in the Brittany, Normandy, and Pays de la Loire regions and upland areas. Animal production thus plays a decisive role in the equilibrium of rural areas, and accounts for 2% of gross domestic product. The number of stock farms is declining because stock farming, dairy farming especially, is rapidly becoming more concentrated in medium-sized holdings. Nonetheless, France is still a major livestock[1] producing country.

Genetic improvement of farm livestock is governed by the law on livestock farming, but the management of genetic resources comes under a more flexible framework in which the Bureau des Ressources Génétiques (BRG) plays a central part. Alongside the government bodies, livestock farmers have formed their own organisations to improve farm stock: for ruminants and, to a lesser extent, pigs, breeding is based on collective initiatives.

Breeding is made more efficient by effective identification of stock, centralisation of genetic data, the development of insemination as a tool for creating and disseminating genetic advances, command of reproductive biotechnologies such as embryo transplants, and genomics, e.g. the use of markers to aid breeding.

The French are aware of the important implications of conserving their genetic heritage, and have set up a system to manage and optimise their farm animal breeds. Government action focuses mainly on *in situ* conservation, helping farms that keep local breeds and supporting associations and conservation centres. France has also developed *ex situ* conservation of sperm, embryos and cells. The national cryobank provides long-term protection for the most threatened breeds, and is a way of keeping «original» animals and maintaining an overview of the diversity of livestock genetic resources.

However, AnGR management policy needs to follow the following strategy.
In France:
- strengthen coordination between the various government bodies and other national and local organisations that manage animal populations. The purpose of this is to define a common strategy for managing animal populations;
- develop tools for characterising and conserving genetic resources, and facilitating the use of information about them;
- provide a stable framework for genetic conservation, ensuring a proper balance between *in situ* and *ex situ* conservation;
- develop all channels for making economic use of these resources, by supporting local initiatives;
- ensure that public policy on livestock farming (in health, environment and economic terms) takes fuller account of the need to conserve biodiversity;
- raise awareness of the importance of AnGR among all stakeholders: farmers, scientists, managers and consumers.

Internationally:
- develop concerted technical cooperation programmes involving government research bodies and professional organisations;
- encourage exchange of knowledge and know-how by making it possible for professional organisations to share their experiences;
- define the principles for access to resources and fair sharing of the advantages.

[1] For the purposes of this document «livestock» includes poultry.

Introduction

This document is a response to the invitation issued by the Director General of the FAO (UN Food and Agriculture Organisation), Jacques Diouf, on 7 March 2001. He invited France to draw up a country report on farm animal genetic resources. This is intended as a preparatory stage towards the first Report on the state of the world's animal genetic resources, and towards identifying guidelines for a global strategy on sustainable management of AnGR.

This country report keeps mainly to the recommendations the FAO set out in the documents it produced to help prepare this first world report on animal genetic resources. By requiring each country to restrict its report to its specific national features, these directives should make it easier to integrate reports from 150 countries into the world report.

The report starts with an inventory of existing AnGR and production systems in France. It assesses the conservation situation regarding biodiversity among farm animals, and the use of that biodiversity. Part II analyses trends in demand for livestock production and examines the impact on national policy, strategy and programmes on genetic resources. Part III examines the state of the country's capability to meet future needs, and considers how this might be increased. Taking this three-stage approach the report identifies national priorities for the conservation and use of AnGR and makes recommendations for strengthening international cooperation on livestock biodiversity.

This national document should be regarded as a report on the management (in its broadest sense) of AnGR in France: current situation, recent changes and likely future trends. It is also the starting point for thinking about policy and strategy. Not least, it is evidence that will enable the FAO to define priorities, debate trends in world strategy and, in the immediate term, publish the world report on AnGR.

This document is the result of work conducted by the Ministry of food, agriculture, fishery and rural affairs and coordinated by the BRG. The Ministries responsible for industry, foreign affairs, ecology and sustainable development, and research also played a part. The many other organisations involved included INRA (National Institute for Agricultural Research), the Institut de l'Élevage (Livestock Institute), CIRAD (International centre for cooperation in agricultural research for development), INA-PG (National agricultural sciences institute, Paris-Grignon), France UPRA Sélection (federation of national breed promotion units). All these bodies are involved in a major way in the management of animal genetic resources in France.

The report covers not only those farm species that provide the bulk of our food, but also the breeds, lines and varieties that are connected with our image of our farmers and are used today for such purposes as specifically local high-quality products, leisure and care of the countryside. They are part of our heritage and are managed through conservation programmes.

While this report was under way, France was also playing an active part in setting up international structures coordinated by the FAO under its global strategy for the management of farm animal genetic resources. In this connection the French BRG is responsible not only for coordinating and overseeing national actions but also for coordination in the FAO Europe region.

This first report reflects the work of farmers, managers, trainers and researchers working on livestock and the maintenance of French animal genetic resources. It is also the expression of a long-standing French policy on this issue. And above all, it is the result of work by people who were among the first to recognise the value of diversity in landscapes, know-how and opinions.

I. Assesment of biodiversity in farm animals

I. FRANCE AND THE FARM SECTOR

France has a population of 58,4 million and a land area of 544,435 km$^{2;}$ most of the land is utilised, but not to saturation level. Population density is 106/km^2 – low for Europe. Its wide, open spaces are a characteristic of the country. However, there are wide differences between regions. The least populated department of France is the Lozère, with a population of 14/km^2, while the Ile de France has a density of 912/km^2. With this relatively low population density, large areas of lowland and plateau and a temperate climate, more than 80% of the country's land area, are given over to farming and forestry.

I.I FRANCE: EUROPEAN GEOGRAPHY IN A NUTSHELL

Europe encloses mainland France and extends into it. Lying at the western edge of the continent, between the coasts of the Atlantic, the English Channel and the Mediterranean, France incorporates all the contrasts of Central and Eastern Europe in an accentuated form.

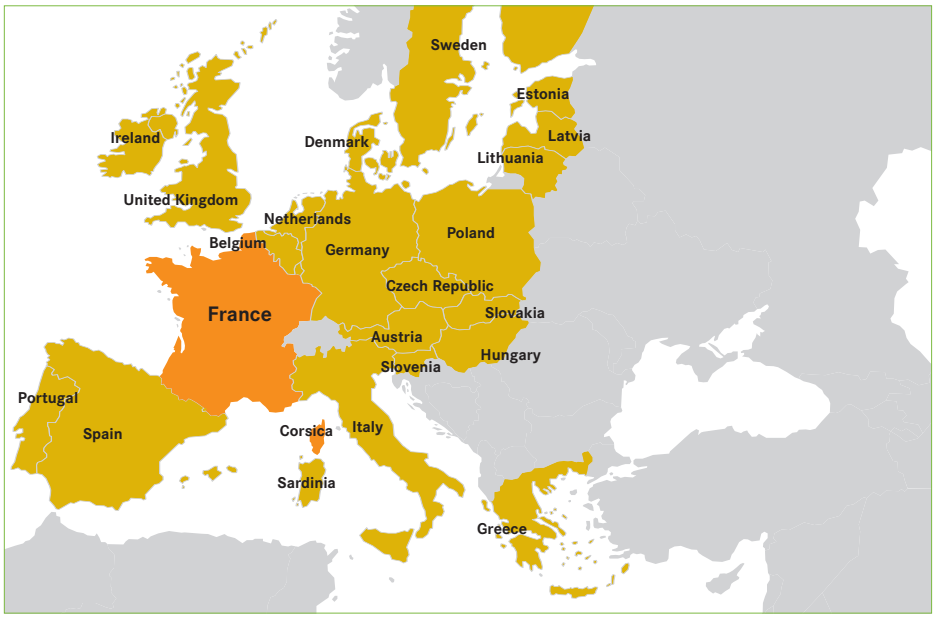


Figure 1.
France in Europe

Europe's ancient massifs extend into France, forming a V from the low plateaus of Brittany to the Ardennes, Vosges and Massif Central – a fan-shape of shields, crests and vast flat areas of poor land. These were all once high mountains. After aeons of erosion that wore them down to peneplains, they were raised and rejuvenated by the strong pressure of Tertiary era folding – whence the faults, rifts, lifting, fertile alluvial deposits and volcanic eruptions. There are fertile soils across large rift bottom areas where thick layers of sediment have accumulated: the 140,000 km^2 Paris basin and 80,000 km^2 Aquitaine basin account for a major part of the country's land area.

Some coastal plains such as the Flanders plain formed when the seabed was gradually raised by river or marine sediments. Some low plateaus, as in the Beauce, Brie and Picardy, are of sedimentary origin. They were formed in the calcareous rock and clays deposited on shallow sea floors during the Secondary and Tertiary eras. Here farming is rich and the major breeds are raised.

The east and south of the country have rougher country. Highlands between 500 and 1,700 meters, such as the Vosges and Massif Central, have formed from ancient Hercynian ranges tilted by the Alpine uplift. Their steep-sided valleys and craggy summits greatly hamper communications; locally specific breeds and livestock products have developed in these isolated areas.

The Jura is in the same altitude range, but these are recent mountains, formed in the Tertiary era. They have a steeper topography with successions of hills and dales, sometimes with sharp high ridges. The folds often have narrow valleys running through them, providing for easier communications. The Prealps, north and south, have similar landscapes, though the altitude often exceeds 2,000 meters.

It is mostly in the central parts of the Pyrenees and Alps that the high mountains are found. These ranges, overlapping the country's borders, reach altitudes of 4,807 meters for Mont Blanc in the Alps and 3,404 meters for the Pico de Aneto in Spain.

France has four major rivers, providing prime thoroughfares for industrial and urban development and so fostering farm trade. Flow in the Loire (1,012 km) and Garonne (575 km) is fairly irregular, making these rivers unsuitable for modern navigation, but their estuaries still have active ports such as Nantes, Saint-Nazaire and Bordeaux. The other major rivers, with steadier flow and good engineering, are major transport arteries. On the Seine (776 km), Rouen and Le Havre are the Paris region's great ports, and the Rhône (522 km in France) is fully engineered from Lyon to the Mediterranean. The Rhine, which for 190 km forms the French-German border, is one of the world's major shipping thoroughfares.

The country's 5,500 km of coast have equally varied landforms and landscapes. In the Artois, Picardy and Upper Normandy the Channel coast is lined with many straight cliffs, interrupted by a few estuaries, such as those of the Somme and Seine, and the coastline is retreating under the impact of marine and continental erosion. Brittany, Provence and West Corsica have rocky, irregular coastlines, providing for good harbours but making navigation difficult. The sandy beaches tourists appreciate are found alongside the plains and low plateaus, in Flanders, the Landes, Languedoc and East Corsica. And finally marshy coasts like the Camargue and the Poitou marshes, which remained hostile to human settlement for many centuries, are now tourist attractions, often incorporated into nature parks.

I.2 TEMPERATE CLIMATE

France lies between 41° and 52° N, in the temperate zone. Its prevailing westerly winds bring maritime air that makes the climate milder on the coasts and inland.

Photo 1. The Tarentais cattle breed is remarkably well adapted to conditions in the high mountains. *Source: P. Xicluna - MAAPAR*

In the west, the oceanic climate predominates, with regular, abundant precipitation. This climate provides mild winters, especially in the south, and cool summers. In Lorraine and Alsace it is tinged with continental influences, giving hot and stormy summers, colder winters and less precipitation. The oceanic climate of the southwest has hotter summers and clearer skies in autumn.

The Mediterranean climate predominates in the south-east and in Corsica, with hot, dry summers and mild winters. These areas often receive more than 2,500 hours' sunshine a year. Precipitation falls mainly in spring and autumn, often in the form of violent rainstorms that cause erosion and dangerous floods. The Mediterranean climate is good for perennial crops and, not least, summer tourism.

The mountain climate has lower temperatures and more precipitation. In the high mountains, the number of days of frost per year can exceed 150 and snow cover may last for six months. As the climate changes with altitude, so does the vegetation: deciduous trees gradually give way to conifers and these in turn give way to Alpine pastures beyond 6,500 feet. These areas are suitable for hardy breeds (photo 1).

I.3 OVERSEAS DEPENDENCIES (DOM-TOM)

The overseas dependencies have a total land area of 95,380 km² (17% of French territory) and a total population of 1,509,000. Population density (248/km² in Guadeloupe, 338/km² in Martinique and 282/km² in La Réunion) is twice or three times as high as in metropolitan France. French Guiana accounts for 94% of the overseas departments' (DOM) land area but has a population density of only 2/km² concentrated in a narrow coastal strip.

The French Antilles consist of two main islands, Guadeloupe and Martinique. Guadeloupe (1,787 km² of which 33% is utilised agricultural area or UAA) and Martinique (1,080 km² of which 35% is UAA) have a tropical climate which is wetter at higher altitudes. The farming economy is mostly based on export crops (bananas and sugar cane), but stock farming has expanded considerably in the past thirty years.

French Guiana, on the South American mainland, (90,000 km^2 of which 0,26% is UAA) has an equatorial climate. Most of the land is covered in dense rainforest. The main agricultural resources are vegetables, rice and extensive livestock farming. La Réunion in the Indian Ocean covers 2,512 km^2 (23% UAA and 5% permanent grassland). The climate is tropical, tempered by its island nature and mountainous relief. Most of the population lives on the coastal plain. Sugar cane is still the main crop, along with some specialist crops: vanilla, flowers and spices. Livestock has long been raised on the island, under a variety of systems.

France's other overseas dependencies (TOM) are an integral part of the Republic, but not of the European Union. Their status with regard to the EU is that of associated countries and overseas territories. The economic importance of agriculture varies. It supplies part of the populations' food needs and exports specific products (copra, aromatic herbs, perfume plants) and cattle to neighbouring islands. The import-export balance is in serious deficit.

Photo 2. Zebus in French Guiana, under extensive grazing systems.
Source MAPAAR

To conclude, metropolitan France lies at a junction between different geographical and climatic influences. Its human settlement history reflects the diversity of thousands of years' migration across Europe. All these conditions have made France a varied country, and this is also a key feature of its agriculture in general and stock farming in particular: a variety of production systems, products and practical skills, and a wide range of breeds.

2. LIVESTOCK FARMING AT A GLANCE

2.1 STOCK FARMERS AND THEIR HOLDINGS

The Farm Census conducted in France in 2000 counted 663,797 farm holdings in metropolitan France -47% fewer than in 1979. It is mainly the number of individual holdings that has declined, whereas there has been a sharp increase in GAEC partnerships (in which farmers pool means of production) and companies: 19% of holdings are now in some form of association. Over half of all farm holdings (397,338 farms) raise livestock.

Half of all farmers do not work on their farms full-time, either because they have another occupation or because they are relatively old and work less than before. Full-time working predominates in livestock and field crop regions. Farmers' wives are now less likely to work on the farm: fewer than half did so in 2000, compared to three quarters of them in 1979. These women do not form a uniform population. Some are becoming more professional and working more, the rest are reducing their working hours.

Farmers doing two jobs number 150,000 -20% of the total, mostly with small farms. This practice is stable over time. Not all production systems lend themselves readily to the practice of a second profession, and this is particularly true of livestock farming. The income it brings in is often crucial.

Modernisation of farm holdings partly depends on renewal of the farmer population, and not all retiring farmers are replaced by young farmers setting up. To remedy this, in the charter for new young farmers the definition of «farming as main occupation» now includes closely related occupations such as farm tourism and sale of farmhouse products.

2.2 AGRICULTURAL LAND USE AND LIVESTOCK PRODUCTION

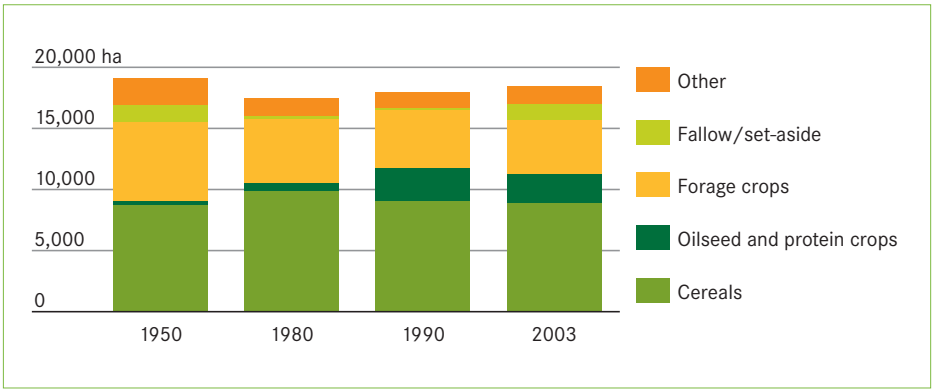
Today farming occupies 33 million hectares of the 55 million that make up metropolitan France. The utilised agricultural area (UAA) has been shrinking steadily for half a century (Table I). Forest and woodland are increasing and now cover 15 million hectares. The rest, about 7 million hectares, is non-agricultural land: built-up areas, artificially stabilised or surfaced land and natural areas such as rivers, lakes and glaciers. The breakdown of UAA between arable land (66%), permanent grassland (30%) and permanent crops (4%) is changing only slowly.

Table 1. Land use in metropolitan France ('000 ha) *(source Agreste)*

	1950	1980	2003
Utilised agricultural area	34,407	31,744	29,585
- Arable land	19,137	17,472	18,420
- Permanent grassland	13,221	12,850	9,957
- Perennial crops (vines, orchards)	2,050	1,422	1,208
Uncultivated agricultural land	4,780	2,757	2,807
Poplar plantations, woodland and forest	11,301	14,615	15,440
Non-agricultural land	4,431	5,804	7,182
Metropolitan France total area	54,919	54,919	54,919

Half the arable land is given over to cereal growing, and this proportion is fairly stable over time (Figure 2). The proportion under forage crops has been shrinking continually for the past 50 years. Other trends, such as the increased proportion of land under oilseed and protein crops and the renewed use of fallowing, reflect aspects of the EU Common Agricultural Policy.

Figure 2.
Trends in use of arable land
('000 ha UAA)



In the past twenty years, there has been a major change in the types of cattle farming, mainly owing to the introduction of milk quotas in 1984: total cow numbers have fallen by 16%; more precisely, dairy cow numbers have fallen by 44% while suckler cow numbers have increased by 57%. Beef and veal production is relatively stable at about 1.5 million tonnes (Table II).

The national sheep herd is also shrinking and less sheep meat is being produced despite a slight increase in consumption. Goat numbers are relatively stable (Table II).

Pig and poultry meat production were increasing rapidly until 2000, since when they have remained stable. Egg production is stable (Table II).

Table II. Livestock numbers ('000 head) *(source Agreste)*

	1980	1990	2002
Cattle total	23,554	21,647	19,729
- dairy cows	7,452	5,489	4,095
- suckler cows	2,753	3,595	4,128
Pigs	11,610	12,520	15,046
Sheep total	13,127	11,071	9,126
- dairy ewes		1,172	1,315
- suckler ewes		6,581	4,782
Goats	1,263	1,161	1,206
Horse family	361	339	451*
Poultry total	228,713	260,525	297,369
- laying chickens	43,290	41,972	47,251
- broiler chickens		107,000	126,300
Doe rabbits		2,000	1,300

** + 350 not on farm holdings.*

Table III: Annual meat and egg production ('000 tonnes carcass equivalent) *(source Agreste)*

	1980	1990	2002
Adult cattle	1,560	1,599	1,580
Calves	405	313	327
Pigs	1,570	1,727	2,361
Sheep and goats	180	177	136
Horse family	19	10	13
Poultry	1,125	1,657	2,156
Total eggs (billion units)	14.4	14.8	16.5

Table IV: Milk collected in 2002 (million litres) *(source Agreste)*

	2002
Cows' milk	22,947
Goats' milk	370
Ewes' milk	233

Since 1970, total annual per capita meat consumption has increased by 19% (Table III). Within this trend there are wide differences between the different types of meat. Poultry meat consumption has more than doubled and pig meat consumption has increased by 15%. Between them these two currently account for two-thirds of annual meat consumption. Beef and veal are still important, but consumption has fallen by 15% in thirty years. Of the less widely eaten meats, sheep and goat meat consumption is stable or rising, while horse meat consumption is in sharp decline (Table V).

Table V: Consumption of meat and dairy products (kg/yr per capita) *(source Agreste)*

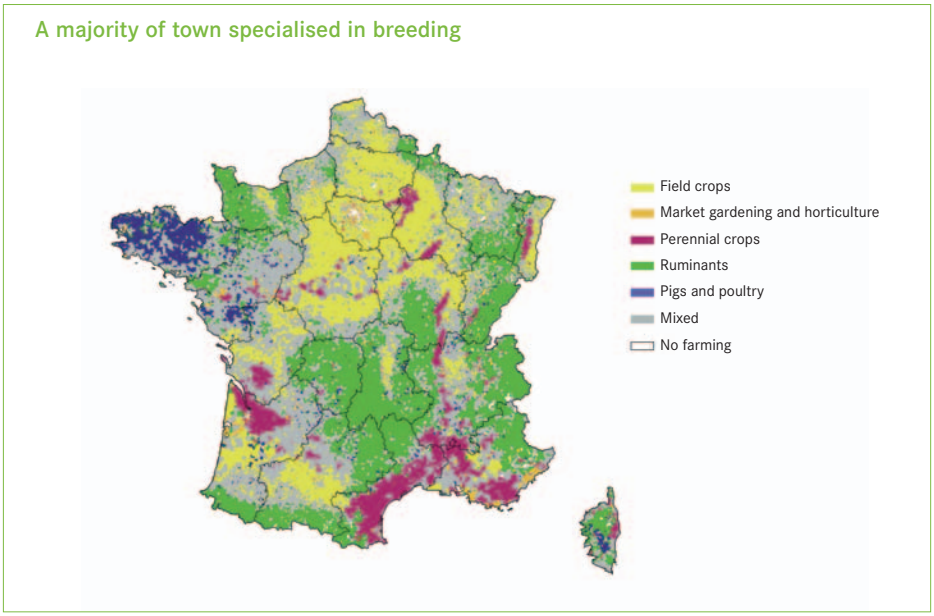
	1970	1980	1990	2000
Adult cattle and calves	30.0	38.8	29.8	25.5
Sheep and goats	3.0	4.1	5.5	5.1
Pigs	30.7	35.5	35.4	36.0
Horse family	1.8	1.7	1.0	0.5
Poultry	12.1	16.0	21.3	25.0
Total meat	**77.6**	**90.2**	**93.0**	**92.1**
Fluid milk		77.9	78.2	73.3
Cheese		18.6	22.3	24.1
Fresh dairy products (yoghurt, fresh dairy desserts, cream)		14.7	25.3	32.1
Total dairy products (fluid milk equivalent)		**350***		**406**

** approximation.*

Annual per capita consumption of dairy products is high (Table V): 2002 figures are 65 litres of fluid milk, 25 kg of cheese and 25 kg of fresh dairy products (yoghurt, cream, etc.). Within a steady overall increase since 1980, consumption of some products like fluid milk has remained almost stable (- 6%), others like cheese have increased continually (+ 27%), and consumption of fresh dairy produce has more than doubled.

Livestock production is unevenly spread around the country. Some regions are largely given over to field crops or permanent crops and these have very little livestock farming; examples are the Paris region, the plateaus of Picardy, the Champagne and round Bourges and Châteauroux, and the Mediterranean zone. In other regions, stock farming is the main type of farming. This is so in the Brittany, Pays de Loire and Basse-Normandie regions), where generally intensive production systems have developed which account for 44% of the national dairy cattle herd, 60% of poultry and 70% of pigs. Stock farming also predominates in the upland and mountain grassland regions, though these lend themselves to far more extensive systems and have huge areas given over to suckler herds of cows and ewes.

Figure 3.
Distribution of predominant farming types
(Source Agreste)



2.3 CURRENT STATE OF GENETIC DIVERSITY

In 2002, 49 cattle breeds were counted in France (Table VI). French Holstein-Friesian alone account for 67% of the dairy herd and Charolais for 43% of the suckler herd. These two breeds account for slightly more than half the national cattle herd. Four other breeds each account for 5% of the cattle herd: Limousin and Blonde d'Aquitaine (sucklers), Montbeliard and Normand (dairy). The 43 other breeds listed account for about 22% of total cattle numbers. The predominance of specialist breeds increased throughout the 20th century.

With sheep the situation is very different, as flocks mainly graze on rough land. Breeding objectives and production systems are still very varied. Of a total 59 breeds, ten account for 70% of the total (Lacaune Dairy, Lacaune Meat, Blanc du Massif Central, Charolais, Ile de France, Arles Merino, Red-face Manech, Vendeen, Texel and Southern Prealps). Twenty breeds account for at least 1% of the national flock each and together make up 93% of the total. Thirty-five breeds form 99% of the national flock.

Goats are a special case: goat production began to be professionally organised much later than the other species and the current situation is significantly different. Of all the goat breeds in France, two – the Alpine and French Saanen – account for 97% of the national flock. One other breed, the Creole, accounts for more than 1% of the total.

Pig breeds, which are crossed for commercial production, belong to international populations; genetic material is frequently traded between countries. In France, 36 pig breeds or lines are recorded. The breeds mainly used for breeding are the Large White, French Landrace and Pietrain. Synthetic lines incorporating genes from these three breeds and Chinese breeds (Meishan, Black Jiaxing) or other European breeds (Duroc) are also widely used. There are five recognised local breeds: Bayeux, Blanc de l'Ouest, Limousin, Basque and Gascon. The Corsican and Creole breeds have a separate status.

The horse family falls into five main categories: blood horses (Thoroughbred, French Trotter, Arab, Anglo-Arab, French Saddlebred, Camargue, Castillon and Merens), foreign breeds (Appaloosa, Barb, Iceland pony, Lipizzan, Lusitanian, Quarter Horse, Shagya, Trakehner), ponies (Connemara, Dartmoor, Fjord, French Saddlebred Pony, Haflinger, Highland, Landais, New-Forest, Pottok, Shetland, Welsh), draught horses (Ardennais, Auxois, Boulonnais, Breton, Cob Normand, Comtois, Percheron, Poitevin, North Ardennes) and donkeys (Baudet du Poitou, Ane du Cotentin, Ane Grand Noir du Berry, Ane Normand, Ane de Provence, Ane des Pyrénées, Bourbonnais). Of 51,000 recorded births of equine stock in 2002, 57% were blood horses, 32% draught horses, 9% ponies and 2% donkeys. To these figures should be added an estimated 30,000 horses or donkeys whose lines of descent are not recorded.

For poultry, the lines used for commercial production are produced from breeds with an international distribution, or are synthetic lines. A quality label, the «Label Rouge», was introduced in the 1960s, and this encouraged the maintenance of some degree of diversity in poultry systems and the associated breeds, insofar as slow-growing lines were deliberately established, mainly from local populations on which little or no selective breeding had been done. Old breeds have also been maintained for non-agricultural uses. Inventorying work resulted in identifying 150 breeds of chicken, 45 of which are of French origin, 15 breeds of turkey including 4 of French origin, 30 breeds of duck and 20 of geese, with 7 and 9 French-origin breeds respectively.

Table VI. Breed diversity in 2001 *(Number of breeds) (Source Agreste)*

Species	Total now		At risk		Widely used		Other	
Origin	Local	Other	Local	Other	Local	Other	Local	Other
Cattle	47	8	19	4	14	1	14	3
Sheep	52	9	8	3	23	2	21	4
Goats	7	3	3		4			3
Horses	20	17	13	7	7	4		6
Donkeys	7		1				6	
Pigs	7	29	5	8		3	2	18
Chickens	45	105	33			20	12	85
Turkeys	4	11	2			3	2	8
Ducks	7	23	7	2		5		16
Geese	9	11	7			5	2	6
Rabbits	8	7	2		2	2	4	5

2.4 BREED TRENDS

The inventorying work carried out in France over past twenty years has resulted in a long list of extant livestock breeds. There are two reasons why the number of known breeds has increased: some new breeds and varieties have been produced by selection or by importing and adapting foreign breeds, and some ancient endangered breeds have been «restored» on the basis of historical data.

Photos 3. One factor in genetic diversity is the large number of species raised. *Photos: C. Saidou/MAAPAR, P. Xicluna/MAAPAR, X. Remongin/MAAPAR, BRG.*

The new breeds, lines and varieties – mainly pigs and poultry but also cattle and sheep – have been created in response to economic necessity and production constraints, and these stock are now widely used.

As regards breed restoration, this has been due to farmers seeking to use old landraces for alternative production systems relying on the positive image of regional produce and aiming for superior quality. These new uses for or re-creations of old breeds stem more from social demand for quality than from any real economic demand. However, this new demand provides a way to integrate local breeds in sectors that are profitable for the producers and helps to conserve these breeds *in situ*. Using a familiar name or one with a strong regional connotation helps the product find a place in the market more quickly.

The increase in the number of identified breeds and the marked increase in their contribution to meeting economic needs reflects the balance between the heritage and economic goals of conservation in France (Photo 3). Current policy on AnGR takes more account of society's expectations than did the conservation programmes launched in the 1970s, which were basically a response to a concern to safeguard the breeds.

3. ASSESSMENT OF CONSERVATION PROGRAMMES

The conservation programmes discussed in this section concern rare breeds for which conservation measures are now necessary. Management of genetic variability in breeds being selectively bred is addressed in other sections.

3.1 *IN SITU* CONSERVATION

On of the main issues for *in situ* conservation is to ensure that females reproduce a purebred line.

In cattle, better semen freezing technology has played a fundamental part in the development of conservation programmes. Artificial insemination (AI) is now a fully integrated part of live herd management. It provides a way of spreading the females' genetic variability via the males. These conservation programmes are also based on inspection and an exhaustive annual inventory of all herds and their owners, from which a directory is published annually and distributed to all herd owners. This is an excellent tool for breed development. It receives state support through the fieldwork of the Institut de l'Élevage, which is responsible for keeping the herdbooks of most of these breeds, in collaboration with various local structures (farmers' associations, regional conservation centres etc.). After 20 years of this work, a recent analysis of genetic variability in ten particularly rare cattle breeds, drawn up from pedigree information, confirmed that their genetic situation was sound. Some breeds are in a less favourable situation because they were in a more critical state when the conservation programme began, but in most cases, most of the genetic variability in the females has been transferred to the AI sires through calculated reproduction of bulls for semen collection purposes. The development of these breeds is encouraging, in terms of both animal numbers and farmer numbers (an increase of over 200% between 1990 and 2002).

Photo 4. Rove breed goats. *Source BRG*

Genetic management programmes for sheep and goats are based on reproduction and rearing of males by and for natural service, and exchange of sires among farms. It has depended on farmers organising collectively and active involvement from the breed associations. The means of coordination at the national level came later and are less developed than for cattle. The specific constraints of small ruminants (faster generation turnover, larger average flock size per farm) require closer population monitoring on farms. A recent analysis of genetic variability in certain sheep breeds, based on pedigree information, showed that if certain genetic management rules are applied, the inbreeding rate will increase only slowly and the different gene origins will make a more balanced contribution to a conservation breed (e.g. the Solognot sheep) than in some much more common breeds which are selectively bred. This kind of analysis has yet to be done for other conservation breeds.

Conservation of pig breeds has relied since 1980 on close involvement by the Institut Technique du Porc. In 1996, the sector's professionals formed LIGERAL, a breed association for local pig breeds. For pigs too, retrospective analyses show that the programmes are effective both in demographic terms and for controlling inbreeding.

Genetic management and selective breeding of horses and donkeys is the responsibility of a public body, the Haras Nationaux (National Studs), which thus conserves the genetic heritage of officially recognised breeds. Its work focuses on redeploying equine stock for new economic outlets. Breeders' associations are now playing a more important part in population management.

Some conservation and development initiatives for local poultry breeds have been taken at various levels:
– by amateur breeders belonging to the Fédération Française des Volailles (FFV), which in turn is a member of the Société Centrale d'Aviculture Française (SCAF), which covers all domestic bird species and also rabbits; conservation is based on keeping to the standard phenotype defined for each breed;
– by local partners such as chambers of agriculture and agricultural schools, taking ad hoc initiatives aimed at reviving a local breed with a project for marketing a typical product;
– by breeders belonging to SYSAAF (Syndicat des Sélectionneurs Avicoles et Aquacoles Français), who maintain small numbers of animals of lines produced by sampling local breeds;
– by the national agricultural research institute INRA on its experimental stock farms.

3.2 *EX SITU* CONSERVATION

In France, *ex situ* breed conservation is organised nationally for frozen biological material (sperm, oocytes, embryos, tissue or DNA). On-farm *ex situ* conservation depends on initiatives by local bodies such as heritage museums, or private initiatives (e.g. «conservation farms», SYSAAF) to complement *in situ* conservation programmes. In a few cases, these organisations act as transit or preservation centres for animals of interest for their type or original genetic features and which would otherwise go for slaughter.

For endangered cattle and pig breeds, systematic *ex situ* conservation of semen has been organised since the early 1980s. The purpose of collecting this semen was to allow for purebred reproduction and long-term conservation of existing genetic variability. For other species, initiatives often came later and have been less systematic. Since 1999 there has been a national cryobank, a GIS partnership called Cryobanque Nationale. It is an umbrella organisation for initiatives to freeze biological material from farm animals, and it has set up new programmes for breeds or species (particularly poultry, rabbits and fish) for which there was no other initiative of this type.

The national cryobank receives funds from the Ministry of Agriculture, and mainly relies on biological material being voluntarily deposited by its holders (often managers of conservation or genetic improvement programmes). Considerable efforts are being made to clarify the legal status of these collections, to make sure that those depositing biological material have some control over its future use and to lay down the conditions under which the material may be removed from the cryobank.

4. CURRENT USE OF ANIMAL GENETIC RESOURCES

4.1 ECONOMIC IMPACT

In 2002, farming and the food and drink industry produced a gross value-added of 66 billion euros, and 4.4% of market GDP. This share has been declining steadily since 1982, when it was 7%.

France is the largest agricultural producer in the European Union, with 23% of total EU agricultural production. It is the largest EU producer of poultry meat and beef/veal, and ranks third as a producer of pigs and small ruminants (Figure 4).

Figure 4.
Production of fresh and frozen meat in 2001, by value
(Source Agreste)

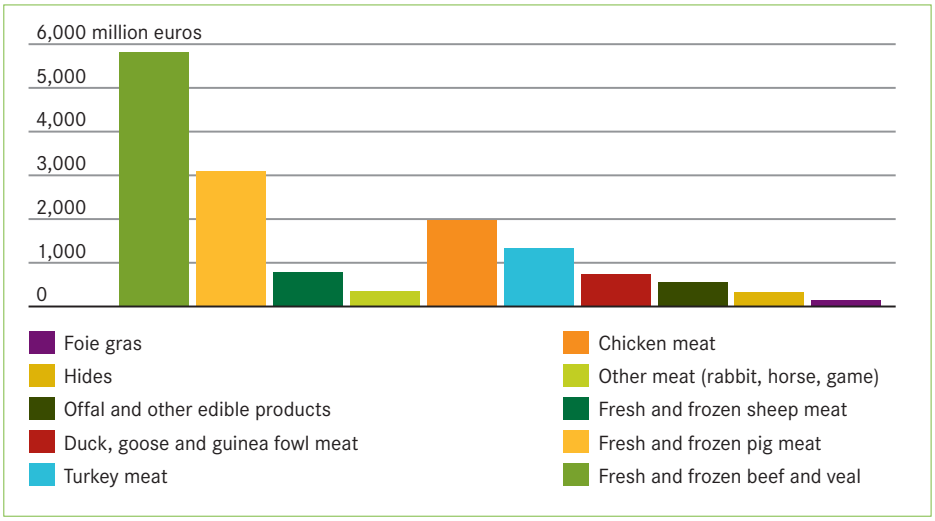
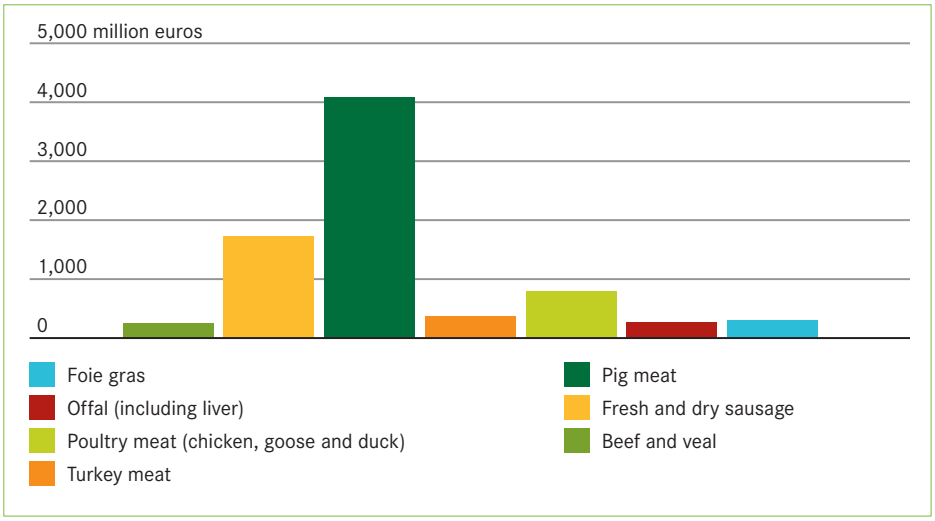
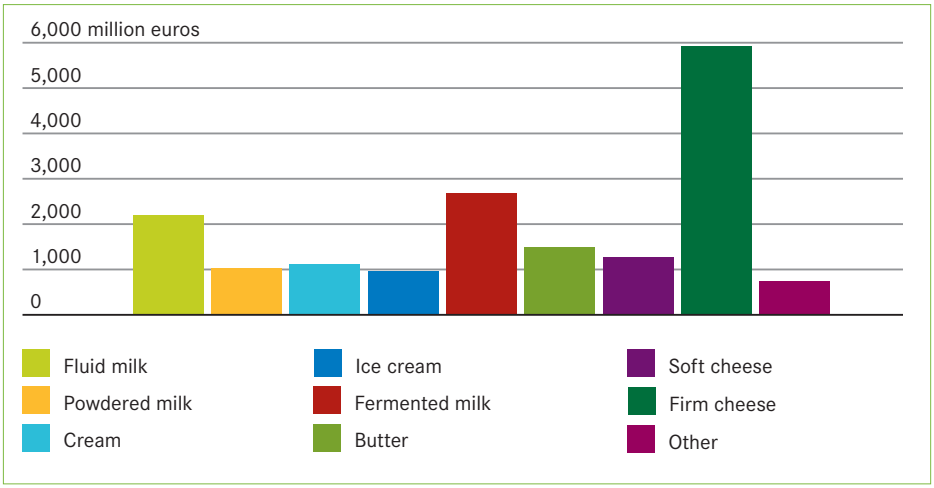


Figure 5.
Production of industrially processed meat-based preparations in 2001, by value
(Source: Agreste)



Of a total food and drink sector sales figure of 123 billion euros in 2002, the meat industry accounted for 25% and the dairy industry for 19%. So livestock sectors generate over half of all food and drink sales (figure 5). The animal products sector also provides 210,000 manufacturing jobs. While cattle provide 50% of total livestock production, the pig and even more poultry sectors are now taking an increasing share of the total.

Figure 6.
Breakdown of dairy industry sales in 2001: production dominated by cheese and fresh dairy desserts
(Source Agreste)



With the growing trend towards specialist farming, increasing use has been made of specialist breeds. Single-purpose breeding has increased milk yields from 3,600 kg per cow per year in 1980 to 5,600 in 2000, while beef breed animals are now heavier, with good conformation and fast growth.

The trade balance shows how vigorous the livestock-based industries are. In 2002, France's trade surplus was 2.1 billion euros for dairy products and 1.7 billion for animals and meat. More than three-quarters of this trade is with other member states of the European Union. The poultry sector is an exception, with a lively trade with non-EU countries. In most cases trade amounts to only a moderate proportion of domestic output, except for sheep meat: 60% of the sheep meat consumed in France is imported.

The economic development of the cattle, goat, sheep and pig sectors has largely been due to the spectacular increase in yield potential generated by breeding programmes. In the drive to remain competitive, several decades of intense breeding work has focused on a small number of breeds; these have made enormous genetic progress and are now in widespread use, nationally and internationally. These French breeds are also competitive in terms of exports of live animals (before or after fattening), and of semen and embryos for breeding. In 2002, for example, exports of cattle on the hoof brought in 1.08 billion euros.

However, the multifunctional aspects of farming and increasingly diverse food habits are helping to maintain other breeds with distinctive features (e.g. meat quality, the cheese- or butter-making quality of the milk, or good maternal quality) for niche markets. Maintaining such local products – often with the help of quality labels – greatly helps to maintain a balance among different rural areas and regions.

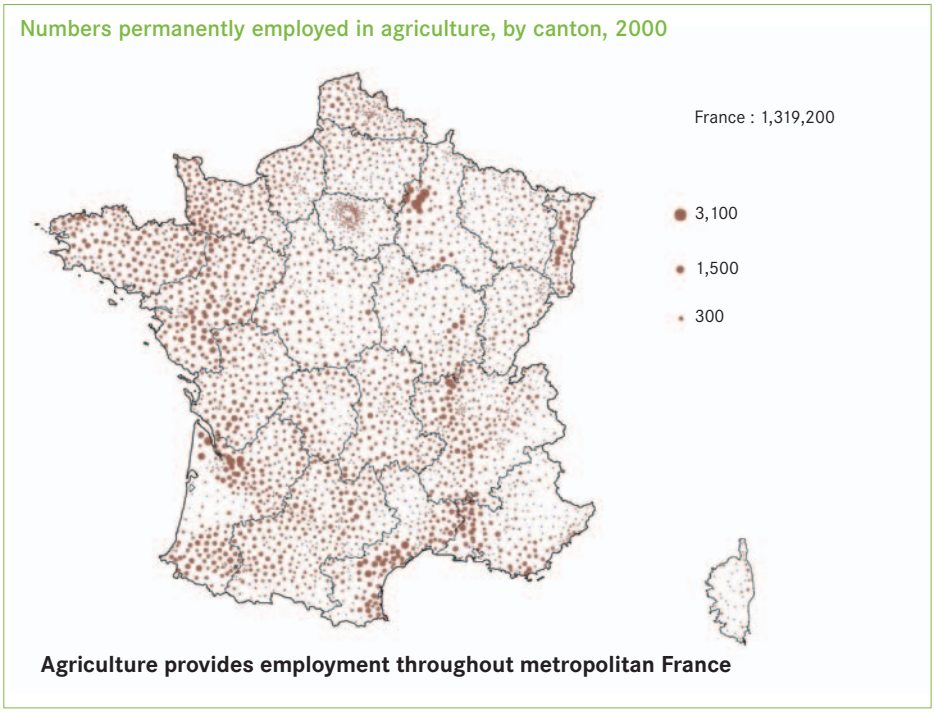
Horses are an economic sector in their own right in France, employing 54,000 people. Racing and equestrian activities are the main sectors, but the industry covers meat production from heavy horses, leisure with sport horses and ponies, breeding, and trading.

4.2 SOCIAL IMPACT

In the past fifty years, six million hectares of French farmland – slightly over half the total – has reverted to forest. But output has increased, owing to an average threefold increase in yields. Higher labour productivity and the corresponding decline in numbers employed have been even more spectacular. Farmers' incomes and living conditions have improved considerably.

Although there are now fewer farms, French farmers still wield considerable political influence. However, in the highly integrated pig and poultry industries, where breeding is mainly handled by private firms, the effects of globalisation weaken the impact of national policy.

Figure 7.
Distribution of farm employment in France: farming, especially livestock farming, helps to maintain a balance between rural areas
(Source Agreste)



The modernisation and greater efficiency of agriculture were only possible with the use of machines in place of draft animals. This decline has been the most spectacular of all: from the records, in 1950 there were 2.2 million horses, mules and donkeys; twenty years later, there were only 500,000. However, numbers have been on the increase again over the past twenty years as recreational and other equestrian activities have developed. According to the farm census, equine stock increased by 35% between 1988 and 1990, and the number of equine stock owners by 5%.

Farmers also used to use cows and oxen as an «energy source». There were over 2.6 million of these draft cattle in 1950, 35,000 twenty years later, and none at all today.

With the new focus on sustainable management of agricultural biodiversity, projects to conserve local breeds (many of which are named after their area of origin), tie in with a new social demand for environmental management, quality products, rural tourism and recreation, and education for future generations. They also help maintain the rural population and contribute to regional planning.

Projects of this kind are on the increase in France. For example, new functions are being found for horses in the maintenance, management, and optimum economic use of the countryside in disadvantaged and ecologically fragile areas. They are also reappearing in urban areas with the gradual introduction of mounted policing.

There has been a particular renewal of interest in regional poultry breeds, as producers aim for niche markets for typical, high-quality products associated with a particular livestock farming system.

4.3 OPTIMISING THE USE OF ANIMAL GENETIC RESOURCES

Arrangements for optimising the use of genetic resources vary widely between species, breeds and regions. They vary according to the stakeholders involved (farmers, associations, technicians, regional parks, research scientists, pubic services, elected officials and economic operators), the local, regional, national, European or international institutional structures concerned and the material and financial resources deployed.

Although not all local farm animal populations have breed management structures, individual breed development projects develop as opportunities arise. Organisations such as breed associations may set up or support collective management systems. Some of these call on member organisations' technical know-how (e.g. Technical Institutes, UPRAs, technicians from chambers of agriculture) or other scientific knowledge. They may or may not be integrated into programmes run by regional organisations.

The most recent censuses show that with breeds that had become rarer in the 1950s to 1980s, headage is now tending to stabilise or increase. Meanwhile the general public has become more aware of the issue of livestock diversity.

5. PARTICULAR FEATURES OF THE FRENCH SYSTEM

Selective breeding, farming methods and more intensive use of crop protection products and fertilisers have played a major part in the modernisation of agriculture.

In recent decades as products have become more standardised, a national policy to encourage quality labels has been developed on the joint initiative of the government and the product sector federations. These labels include AOC (Appellation d'origine contrôlée) to highlight a particular local area and its technical know-how, the Label Rouge to encourage superior quality, the Certificat de Conformité Produit (certificate of product conformity) and the AB (Agriculture Biologique) label for organically produced food. European regulations have adopted some of these systems, e.g. with the Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). Many of these labels include in their product specifications the particular livestock breed that is supposed to represent a balance of the aptitudes required for that product and to be purpose-bred for it.

For nearly ten years now French agriculture has also been taking account of environmental concerns, not least through the recently instituted Sustainable Agriculture Contracts (Contrats d'Agriculture Durable or CADs).

A CAD contract sets out an overall project for the farm, the farmer undertaking to develop multifunctional activities that will further agricultural economic development and generate value-added, help to protect and manage the countryside, landscapes and biodiversity, and contribute to job creation and the balance between rural areas. The State, with European Union support, undertakes to assist the farmer's initiative financially for the five-year duration of the contract, particularly for services that are not fully viable commercially.

A CAD project may include:
– an economic aspect: e.g. this may mean diversifying the farm's business, helping a young farmer set up, or improving the quality and traceability of farm produce,
– an environmental and territorial aspect, e.g. better control of fertiliser and pesticide use, planting and maintaining hedges, conserving endangered breeds or integrating farm buildings into the landscape.

French agriculture, once a purely economic activity whose primary purposes were to provide the population's food supply and earn profits from commercial farming, now has a major social role that requires a combination of high quality and sustainable farming systems.

II. Animal production demand trends in French

1. LIVESTOCK MANAGEMENT POLICY, STRATEGY. PROGRAMMES AND INFRASTRUCTURE

1.1 THE 1966 LIVESTOCK LAW

In France, breeding methods for ruminants, pigs, horses and donkeys are governed by the 1966 livestock law. This is based on a system for gathering and processing livestock information and spreading genetic improvement more widely, with artificial insemination playing a major part. Financial and administrative measures were introduced, with regulations, resources for monitoring and assessing breeding stock health and performance, a technical supervision system and close involvement by agricultural research. This law also set up a national commission for genetic improvement (the Commission Nationale d'Amélioration Génétique, CNAG), responsible to the Ministry of Agriculture. The CNAG is a consultation body involving the public authorities along with research, higher education and professional bodies.

Not all of these arrangements were applied to horses and donkeys. This sector is mainly organised by a state-owned body, the Haras Nationaux. Besides providing technical assistance and research, the Haras Nationaux manage databases of genetic and ownership data on a large number of stallions and on breeders' associations accredited by the Ministry for each breed.

1.2 INSTITUTIONALISATION OF CONSERVATION IN FRANCE

For the sake of efficiency, most of the genetic improvement programmes of the 1960s concerned widely-used breeds. Under this policy, milk and meat yields in controlled rearing conditions increased rapidly, while other breeds declined.

In 1970 the earliest conservation programmes began, with several farm species and in direct relations with farmers and their associations. These programmes received financial help from the Ministry of Agriculture and were coordinated by the Technical Institutes, particularly the pig and ruminant programmes. Government subsidies became a regular feature in 1977.

1.3 BUREAU DES RESSOURCES GÉNÉTIQUES

In 1983, the Bureau des Ressources Génétiques (BRG) was formed. This is a scientific partnership involving six Ministries and six state-owned scientific organisations. It facilitates and coordinates the scientific aspect of French genetic resources conservation, research and management projects.

The BRG provides support for livestock management through pilot groups involving associations and professionals in livestock farming, research and education. The groups have been gradually formed since 1996, and there is now an operational group for cattle, sheep and goats, another for pigs, one for poultry and one for rabbits.

The BRG has established a national database to provide full information on farm animal breeds in France, for specialists and the general public. The data cover the headage, origins, description, suitability for purpose and performance of each breed and information on the breed management organisation.

1.4 REGIONAL DEVELOPMENT PROJECTS

The gradual emergence of local initiatives to optimise the use of rare breeds has prompted regional authorities to take responsibility in the matter. Some local authorities, seeing a prospect for economic development based on local biological and cultural resources, are supporting conservation for reasons of both heritage and regional development. Central government has yet to play a definite role in co-ordinating and supporting these regional policies.

2. MANAGEMENT PROGRAMMES AND STRUCTURES

2.1 NATIONAL CRYOBANK

The national cryobank (Cryobanque Nationale) was created in 1999, to conserve semen and embryos of farm animal breeds. It has the legal status of Groupement d'Intérêt Scientifique (GIS – partnership of scientific interest), and has eleven national organisations as members. It links different collections of frozen biological material, gives them greater security and rationalises the system (Photo 5).

Photo 5. Semen storage tanks. *Source BRG.*

Three kinds of genetic material are eligible for inclusion in the cryobank:
– Type I material, from rare breeds in real danger of extinction,
– Type II, from animals of common farm breeds that have exceptional performance aptitude. These may or may not be animals used as breeding stock.
– Type III material, consisting of representative samples of breeding populations (representative at a given moment).
The system is highly secure. To prevent accidents, the cryobank duplicates its collections:
– there is a single national facility where all collections are stored,
– duplicates of the material held at the main facility are kept at one or more back-up facilities, depending on the species concerned.

Plans for a DNA bank and a serum bank are under way. The conditions for deposit and use are regulated. Sample deposit is voluntary. The conditions for input and removal from the cryobank are strictly defined to prevent the biological material being used for other purposes than proper management of the country's heritage. Only a part of the material in store for a breed may be removed. The applicant must supply well-supported arguments, justify their need and undertake to reconstitute equivalent material and return it to the cryobank.

The collections are catalogued and described. There is a management system to record all inputs and removals of material. Biological material transferred within the cryobank is accompanied by a data sheet with two levels of information, one for the general public and one confidential. The data on the sheet concern the type of material and also the animal it came from (identity, pedigree etc.). The non-confidential part can be consulted on a database. Model agreements regarding the ownership, conservation and use of the semen are now being drawn up.

2.2 BIOLOGICAL RESOURCE CENTRES

The OECD has a project for specialised biological resource centres (BRCs) which will acquire, validate, study and distribute collections of culturable organisms (e.g. microbial, animal, plant and human cells), replicable parts of these organisms (genomes, plasmids, cDNA etc.) and viable but not yet culturable organisms. They may also keep non-renewable biological samples such as serums, tissue or tissue fragments. Most BRCs will run databases accessible to potential users, and they may provide access to data processing tools and databases of molecular and physiological information relevant to their collections. They will be essential elements in the infrastructure underpinning biotechnology. France's national cryobank will qualify as a BRC.

2.3 GENETIC MANAGEMENT SYSTEMS

The 1966 livestock law set up a national animal production information system for ruminants and pigs. It covers on-farm data gathering, regional data processing centres and a single national data processing centre, the Centre National de Traitement de l'Information Génétique (CTIG). Information systems are vital for this work, and they are engineered and run by the Institut de l'Élevage for ruminant genetics and the Institut Technique du Porc for pigs. A similar system has now been set up for horses, also centralised at the CTIG. An efficient animal identification system is essential for effective selective breeding and conservation.

With cattle and horses, all animals used for public stud undergo a parentage test using a protocol that covers type and number of genetic markers. The protocol was drawn up by the reference laboratory Labogena.

The animal genetics department at INRA has the task of developing methods for assessing the genetic potential of breeding stock. The genetic evaluation work itself is done jointly by INRA and the Institut de l'Élevage for ruminants, by INRA and the Haras Nationaux stud organisation for horses, and by the Institut Technique du Porc for pigs. For poultry, private breeders have formed a federation, SYSAAF, to handle all breeding stock assessments and manage the related information.

Because of the risks associated with genetic anomalies, a national monitoring unit was set up in 2002 to look for these anomalies. Its tasks are to organise the gathering of information on genetic anomalies found on farms, analyse their origin and co-ordinate research to eradicate them.

Since 2002, the Technical Institutes have regularly published genetic variability indicators for selectively bred ruminant and pig populations.

2.4 HEALTH MANAGEMENT SYSTEMS

The veterinary services ensure that food producers, processors, transporters and distributors comply with the regulations for producing healthy food without causing public nuisance or animal suffering.

They also monitor for the emergence of any disease that may present risks for public health or animal health. They monitor Europe's borders and draw up emergency intervention plans.

The French food safety agency AFSSA was established in 1999. Its mission is to ensure food safety from raw materials production right through to retail distribution (Photo 6).

Photo 6. As in all livestock sectors, poultry farms are thoroughly inspected for health and safety compliance. *(Source: K. Beck - MAAPAR)*

3. DEMAND

The 1966 livestock law laid down the technical and institutional framework for genetic improvement and certification work. It focuses on improving the immediate economic value of the stock and therefore mainly concerns selectively bred breeds. There are as yet no explicit rules setting out the organising principles for conservation breeding for future needs.

This omission leaves it to the various stakeholders to organise and manage endangered breeds as renewable resources. Although keeping breeds in economic use is necessary for dynamic, sustainable conservation of genetic diversity, it is not sufficient.

For genetic resource management to be viable and efficient, there must be staff, structures and financial resources available over the long term, under a system that co-ordinates the national level with the regional. Long-term government support is necessary. Only such support will provide a satisfactory response to the other sectors.

3.1 LIVESTOCK FARMING SYSTEMS

Whatever the product, a livestock system must:
– simplify farming practices, make them safe, and keep production competitive,
– meet market demand, including demand for product identification and quality (meaning sensory, nutritional and health quality),
– help to protect the environment and care for the countryside, especially in areas where agriculture has declined or land has been set aside,
– ensure animal welfare.

There are many possible ways to achieve these goals. It is mainly a matter of seeing how best to manage the key factors so as to adapt existing livestock management systems or find new, alternative systems that will meet these requirements.

3.2 CONSUMER DEMAND

Consumer demand is complex and not easy to analyse. While product quality is often spotlighted, price is still an important criterion. Consumers also take animal welfare and environmental protection into account, though to a lesser extent.

The main problem is how to reconcile different aspects of quality with each other and with environmental and welfare requirements, and yet remain profitable.

3.3 JOINT DEVELOPMENT OF BREEDS AND THEIR LOCAL ENVIRONMENT

Interest in local breeds has greatly increased owing to tourist demand and consumer demand for diversification and local produce (Figure 8). Meeting this demand means protecting historical and cultural heritage connected with AnGR, conserving genetic diversity and bringing local breeds back into use in well-designed production systems with quality-based product chains. Developing this dimension will mean designing countryside management systems that combine efficient animal nutrition with care of the environment and bringing husbandry practices into line with animal welfare.

Figure 8.
Distribution of cattle and sheep breeds in France.
(Source Agreste)

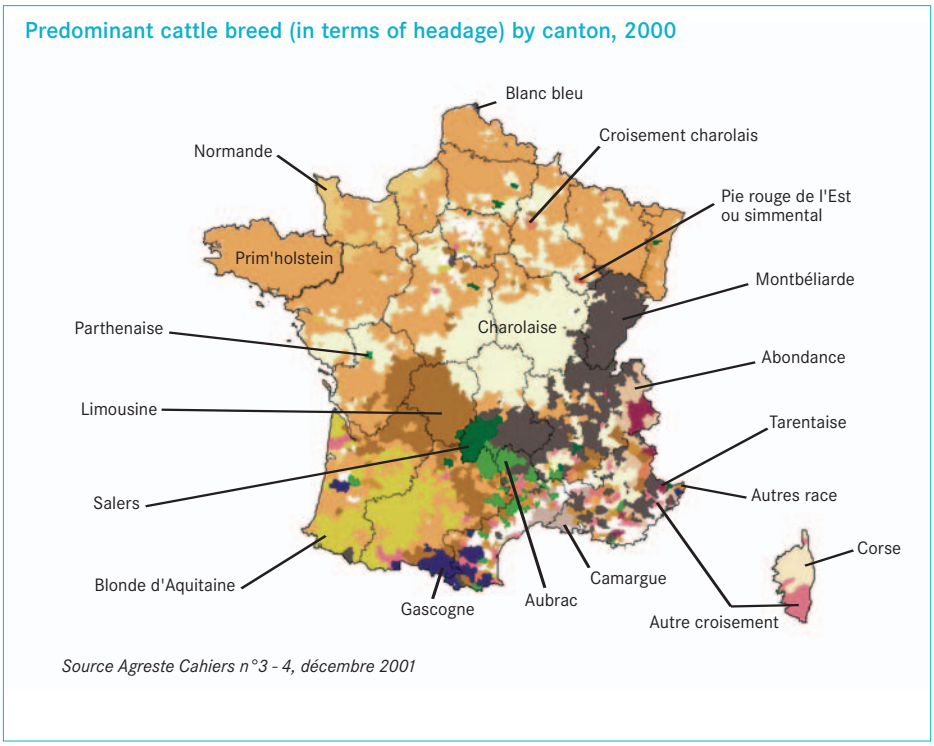
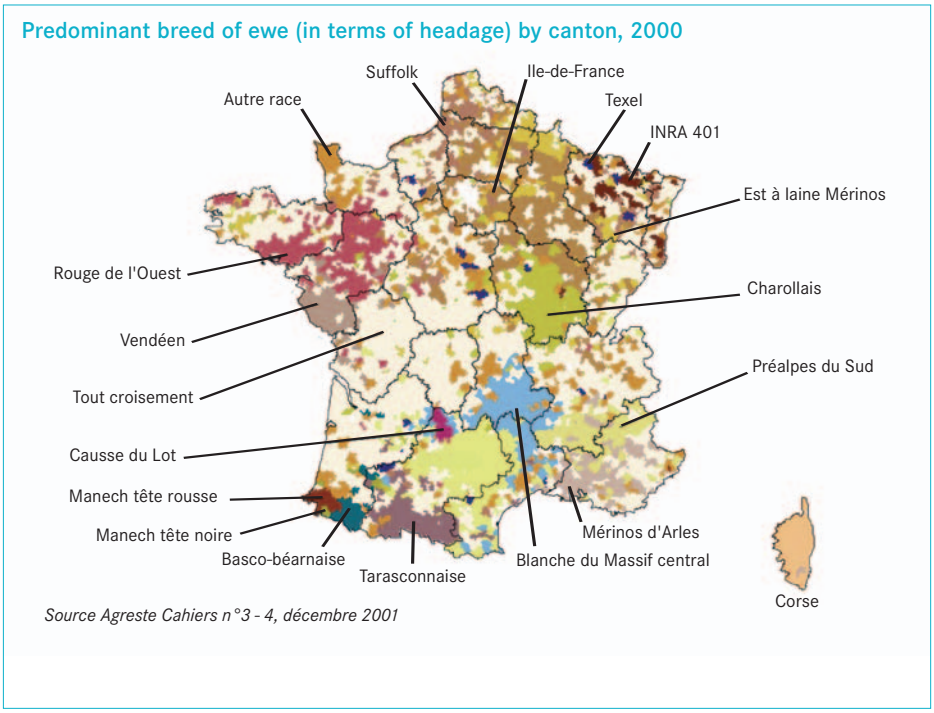


Figure 8 bis.
Distribution of cattle and sheep breeds in France.
(Source Agreste)



4. ALTERNATIVE STRATEGIES FOR PRESERVING AND UTILISING FARM ANIMAL GENETIC RESOURCES

Most strategies now being developed are intended either to diversify products or to find original genetic variants. The overall aim is to produce food while promoting diversity in livestock breeds and their associated husbandry systems, taking account of trends in consumer demand and adapting to new constraints regarding environment, animal welfare and product quality.

4.1 PRODUCT DIVERSIFICATION

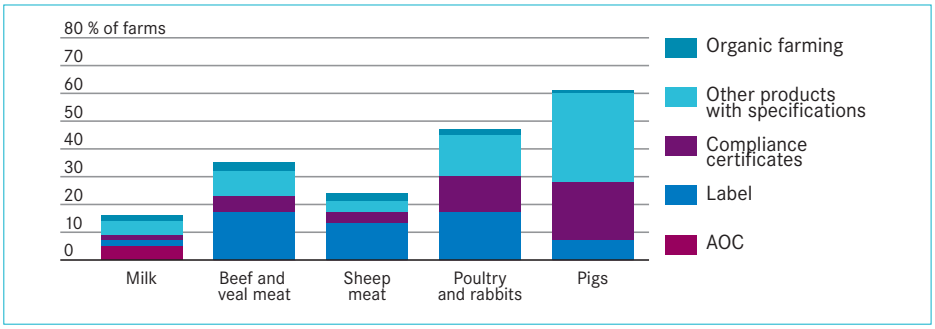
Product diversification is based on the link between a particular breed and a typical product identified by a quality label. The label should be chosen at the start of the project.

A key requirement for making economic use of a breed in this way is to choose a breed with distinctive features - either original genetic features or particular performance characteristics. Pedigree monitoring needs to be introduced, and this means that the population structure must be organised. It may help to use molecular markers, to assess the originality of the breed and as a means of telling whether a given animal belongs to that breed. The ability to verify an animal's breed membership or the connection between a market product and a given breed should be a key feature of specifications for projects of this kind (Photo 7).

Photo 7. Breed diversity in France is reflected in the country's wide variety of cheeses. *(Source: P Xicluna - MAAPAR)*

In many cases a marketing study is run before the decision is taken to launch a product-based project of this kind. The success of the project depends on how well organised it is and what scale of distribution is planned. This in turn will partly depend on the quality label chosen and the farmers' position in the product chain. A subsidy may help get a project off the ground, to be gradually replaced by income from sales to consumers who are ready to pay considerably over the odds for products of this kind.

Figure 9.
Percentage of farms using product specifications as a selling point, by product type and quality label
(Source Agreste 2001)



Whether the project lasts depends on consumer purchasing power, the size of the breed's population at the outset, continued genetic management and - very largely - on the farmers' motivation and economic situation.

4.2 LOOKING FOR VARIANTS

The search for original genetic variants is based on the assumption that because conservation populations are under little selection pressure for traits of immediate economic interest, they may posses specific alleles governing features such as disease resistance which facilitate adaptation to the environment.

This approach has been widely used on plants. It is difficult to apply to animals because detecting such alleles requires an appropriate experimental protocol, a known family structure, a population of several hundred animals, performance measurement and the use of molecular markers. This can only be done on experimental farms like INRA's. These protocols are expensive and are mainly used when field observations suggest that a population does have some special aptitude. Usually they are funded by the French state or the EU, sometimes with additional funding from breeding firms that hope to apply results to their own populations.

Genetic variants found in conservation populations indicate sections of the genome worth studying in other populations, and can be introduced into selectively bred breeds by an introgression programme using genetic markers. Detecting new alleles is only useful if a live source population is available.

In the medium term, with better knowledge of the genome sequences of farm animal species, original genetic features may be sought directly in the genes and not only with the help of anonymous markers. This would mean comparing the sequences for a given gene across a group of populations. The functional consequences of any new alleles would have to be found, but they should be easier to predict with the help of bio-informatics. However, validation in the field would still be needed, and this would require live resource populations or at least embryos or gametes. If the resource population was extinct except for DNA in a bank, the only way to introduce the new allele into a live population's genome would be by transgenesis.

4.3 STRATEGIES COMBINING CONSERVATION AND USE

Genetic diversity in species such as pet dogs, cats and birds is largely maintained through cultural or sporting traditions such as breed shows. Breeders form clubs or federations, use their own resources and make the enterprise pay by selling animals or breeding stock.

With smallholding livestock, breed management is based on keeping to a loosely or precisely defined standard phenotype; pedigree records are rarely kept. Trade or exchange between owners is not always properly recorded or codified. Yet these owners help conserve significant genetic diversity. They raise variable numbers of animals that could be used for a breed revival programme, as has been done with the Géline de Touraine chicken.

However, owners who help revive a breed do not always benefit from the income the programme generates. Assessing genetic variability in these populations is fairly easy with molecular markers, which readily distinguish between the most inbred populations and those that still have more variability. But this work is beyond the financial means of amateur breeders and needs to be subsidised.

Breeds that can be maintained in their traditional environments are local breeds that may attract town-dwellers with a taste for green tourism. Heritage farms, for example, conserve hardy breeds along with their traditional husbandry methods. Some encouragement from the public authorities is usually needed to co-ordinate initiatives and introduce organisation, resources and publicity. While the funds initially come from regional authority subsidies, income is generated from tourist accommodation, sale of farmhouse produce, guided tours etc.

Photo 8. So that's where milk comes from!
(Source: P Xicluna - MAAPAR)

This kind of conservation can be achieved by a small enterprise selling products and services. Care of the countryside (e.g. clearing footpaths) is a service that is hard to evaluate economically, but is a real service nonetheless. Farmyard conservation could also constitute a part-time job alongside some other income-generating activity.

Another approach is to make sure children learn something about farming at school, especially primary school (Photo 8). Town-bred children today have almost no rural roots and many have a stereotyped image – either idyllic or dismal – of livestock farming.

Practical illustration is essential for teaching children about breed diversity and the history of stock farming, and this can be provided by pilot establishments or the agricultural schools' experimental farms. This would not be tourism but educational tours to give children an objective picture of the difficulty of stock farming and the farmer's work. Several agricultural schools are already working to conserve and characterise local breeds.

4.4 BIOTECHNOLOGY AND CONSERVATION STRATEGY

Molecular information can also be used for *in situ* or *ex situ* population management, e.g. to ensure conservation of as many alleles as possible for a given locus in a population, or to establish a mating plan. More research is needed to co-ordinate the use of molecular tools with population management practices, since molecular information is still expensive to obtain.

Reproductive biotechnology now makes it possible to freeze gametes of several species with varying degrees of success, and to freeze embryos of a smaller number of species. Work is needed to increase the number of species these techniques can be used on. Setting up a stock of semen or embryos can be seen both as insurance against the future and as a complement to management of live populations, e.g. by increasing the number of sires available at any given time.

When sexual reproduction is no longer possible or where it is difficult to freeze gametes, a genotype could be reconstituted in almost identical form by somatic cloning. At present this method has a low success rate and cloned animals are still being studied. In the long run, depending on cost, it may become a useful conservation method. However, whereas other conservation methods enable the population to continue to evolve in its environment, cloning can only produce identical animals.

5. POLICIES, STRATEGIES AND NATIONAL PLANS

Harmony needs to be achieved between consumer demand, environmental obligations and the need to be competitive internationally. This means reconciling constraints connected with changes in stock farming systems, environmental protection, genetic resource conservation, product quality and animal welfare.

Public health is a government policy priority. Policy is based on a clear separation between different aspects of risk assessment and management and between advice and support measures and control measures. Measures taken will only be effective and sustainable if they are clear and the decision-making system is open and transparent.

There is also the European directive of November 2002 on assessing animal welfare so as to design farm management systems that ensure animal welfare. Quality and traceability are covered by the law of 1 January 1998 on strengthening health monitoring of products for human consumption. Government measures to reshape and strengthen the public health monitoring system include the creation of a national food safety agency (AFSSA). The agricultural orientation law of 9 July 1999 strengthens government control throughout product chains.

In the past ten years, breeding objectives for all farm species have become more diverse, to aid farm modernisation. In addition to feed conversion efficiency, output and product composition, breeding plans now lay considerable emphasis on fertility, longevity, disease resistance and other functional aptitudes.

III. Current state of national capacities and future needs for capacity building

I. CURRENT STATE OF NATIONAL CAPACITIES

I.1 LIVESTOCK FARMERS

Management of genetic variability in farm breeds is of interest to all farmers, because animal breeding to meet future consumer demand will need varied genetic material to work with. A high proportion of France's 350,000 stock farms belong to organisations that can help them with some aspect of genetic resource management. These include the national breed promotion units (UPRAs), agricultural cooperatives, AI cooperatives, milk recording and growth monitoring associations, departmental livestock establishments, health protection groups and producers' groups.

While rare breeds represent a tiny percentage of the national herd total (0.3% of cattle, for example, and 2% of sheep), the percentage of farmers keeping rare breeds is higher: 0.7% of cattle farmers, and 5% of sheep farmers. Regardless of species, a basic characteristic of farmers who keep rare breeds is that they run small to medium-sized herds. Many work in difficult regions where intensive systems cannot be made economically viable. Many of them have promoted sustainable farming, and they play a vital role in maintaining economic activity in remote areas.

Rare breed farmers fall into several groups. There are still a few traditional farmers who continue to rear «their breed», and many a local breed has been saved by farmers doggedly continuing with their traditional stock at a time when breed conservation was not considered important. Another category is amateurs keeping a few animals for pleasure and to help conserve a breed, with the main focus on breeding them true to type. These are people who have another job and derive little or no income from farming. This group includes most of those who raise rare-breed poultry, many who keep horses and donkeys and some who raise other species. Educational farms and conservation farms, most of which concentrate on local breeds, can be counted on the fringe of this group. Most farmers who want to earn their living from local breeds have projects for high-value-added products, sold either through short product chains or on closely-targeted niche markets. For projects like these, the entrepreneur must be stock farmer, processor and salesman all in one.

I.2 DECISION BODIES

Professional organisations

The breed associations play a crucial part in bringing together farmers who have understood the value of conserving genetic variability in farm animals. France UPRA Sélection co-ordinates and supports the activities of its 70 members, the breed promotion units (UPRAs). These organisations represent 400 breeds and 36,000 farmers (not including pet breeders). They are organised in seven sections, by species: cattle, sheep, goats, pigs, horses and donkeys, dogs and cats. France UPRA Sélection works in close liaison with research, administration and professional organisations. Its two main missions are:

– to represent the UPRAs on all relevant decision bodies;

– to promote the concepts of breed and product quality. This means developing the notion of quality, forging links with the downstream end of the product chains, and promoting the image of French breeds in France and abroad in partnership with other structures.

The artificial insemination (AI) centres, scattered throughout the country, are in charge of progeny testing programmes for ruminants and pigs. They also play a part in the genetic management of all breeds, including the rarest, for which sires are collected in order to ensure a good distribution of genetic material in the population. The also provide the AI service itself, so distributing genetic progress and variability among large numbers of herds and flocks.

The inseminators' job also includes advising farmers on their mating plans, mainly so as to avoid inbreeding and optimise the effects of heterosis.

In 2002, at the initiative of the professional organisations and under the aegis of the Ministry of Agriculture, a bovine anomalies monitoring unit was set up. It organises monitoring and coordinates the activities required to efficiently manage any anomalies that emerge. One of its goals is to initiate a policy of eradicating genetic anomalies.

Ministries

The Ministries responsible for handling the Convention on Biological Diversity are the Ministry for the Ecology and Sustainable Development and the Ministry for Foreign Affairs.

The Ministry of Agriculture, Fishery and Rural Affairs is the regulating authority for livestock farming.

Within the agriculture ministry, the Directorate of Economic and International Policies (DPEI) is responsible for livestock farming, animal products and animal genetics, except for horses and donkeys, which are managed by the Directorate General for Forestry and Rural Development.

Within the DPEI, the Office of Animal Genetics is specifically responsible for designing, implementing and assessing policies and instruments for developing farm animals' genetic potential (mainly genetic improvement and genomics). It has a role in defining and implementing policies to encourage farm animal biodiversity. For example, it is the regulating authority for the livestock Technical Institutes and oversees their work, and it represents the Ministry of Agriculture in dealings with this sector's professional organisations. It also runs the secretarial office of the Commission Nationale d'Amélioration Génétique (CNAG) (Figure 10).

The agriculture ministry's Directorate General for Education and Research establishes national policy on agricultural training and research. Its Directorate General for Food is responsible for animal health and welfare.

At the Ministry of Education and Research, the Technology Directorate draws up and enforces policy on technological development and innovation. It plays a part in designing programmes funded by the European Union and monitors their implementation. The Research Directorate works out policy on research, research-based training and employment in science, and oversees implementation. It is the regulatory authority for pure research organisations and higher education. It co-ordinates the civilian research and technology development budget.

Regional and departmental structures

The regional and departmental authorities (Conseil régional and Conseil général) are also involved in the conservation of AnGR. They run, for example, the Aquitaine Breeds Conservation Centre, the Midi-Pyrénées Regional Biological Heritage Conservation Centre, the Pays-de-Loire Animal Breeds Conservation Centre, the Poitou-Charentes and Nord-Pas de Calais Genetic Resources Conservation Centres, the Pays de Rennes Heritage Museum, the Normandy Conservation Centre and regional nature parks in Brittany, the Grands Causses and the area of the Auvergne volcanoes. The following three examples illustrate the success of these initiatives.

The Midi-Pyrénées regional authority created the Midi-Pyrénées Regional Biological Heritage Conservation Centre in 1989, with support from INRA, to catalogue, conserve, assess and optimise the use of over 15 animal breeds.

The Marais Poitevin inter-region nature park houses the Genetic Resources Conservation Centre for that region (Centre-Ouest Atlantique), which links all the local breed associations. It is funded by the Poitou-Charentes and Pays-de-Loire regional authorities and some departments and communes. It helps breeders of seven breeds including the Baudet du Poitou donkey and Marans chickens.

After saving the Nantais and Maraichin cattle breeds, the Pays-de-Loire regional authority set up a conservation centre called CRAPAL in 1998. CRAPAL manages more than twenty local breeds.

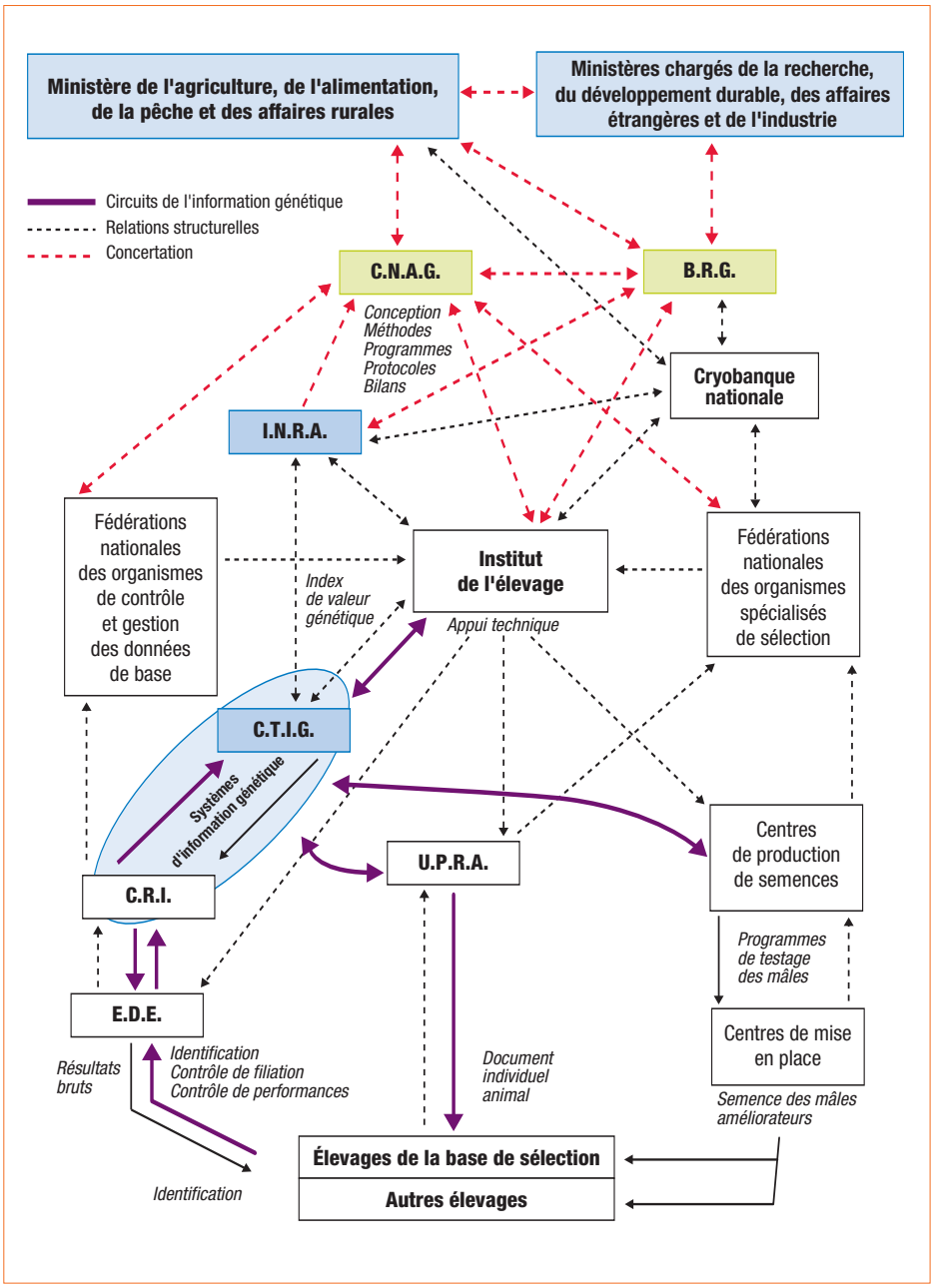
Non-profit bodies are also involved in actions of this type. One example is the ESPACE network for the use of extensive stock grazing to maintain and preserve countryside. This network is run by the Federation of Regional Nature Parks, whose members may have need of hardy breeds for this purpose. Another example is the Société d'Ethnozootechnie (livestock ethnology society), membership of which is open to anyone with an interest in livestock production and products. Its main purpose is to promote the exchange of methods, results and ideas and to stimulate collaboration among people, teams and local areas. Its main activities are organising conferences and task forces and producing publications.

Policy co-ordination bodies

The CNAG, which has equal numbers of members representing government bodies and professional organisations, advises the agriculture ministry on measures to improve the country's livestock. The commission is thoroughly representative (administration, research, education, development, breeding organisations, farmers' federations and users of animal genetics) and has become recognised as the pivotal organisation for defining policy on livestock breeding.

It was the CNAG, for example, that took the decision to set up the national cryobank, the monitoring unit on anomalies and the national breeding programme to eradicate scrapie in sheep. It also assesses the effectiveness of measures taken: for example, some structures responsible for breed supervision may receive state aid on condition that they comply with a certain set of criteria, including genetic variability.

FIGURE 10.
CNAG and BRG are national consultation bodies involving the public authorities and research and professional organisations, with a view to improving the design of public policy on livestock breeding.



French policy on genetic resources is worked out on an inter-ministerial basis, under the tutelage of the Bureau des Ressources Génétiques (BRG) and with the Ministry of Agriculture playing a central role.

The BRG was founded in 1983, and since 1993 has had the legal status of a «partnership of scientific interest» (GIS or groupement d'intérêt scientifique). At 1 January 2002, the partnership had 13 members: six ministries and seven scientific organisations.

A steering committee of representatives of the six ministries defines general policy on genetic resources. All thirteen partners are represented on the governing council, which lays down guidelines for the Bureau's activities. There is a scientific council which the governing council consults on implementation of the guidelines, and which is also responsible for scientific intelligence on issues relevant to the Bureau's mission.
The strategy underpinning the BRG's missions is threefold:
– develop strategic thinking and organise national consultations;
– promote research, encourage knowledge transfer, inform and communicate, support training;
– make its scientific expertise available to government institutions for the purpose of representing France on European and international decision bodies.

The BRG can call on the expertise of more than 150 stakeholders, managers and scientists. For example, there are scientists on three committees dealing respectively with animal, plant and micro-organism genetic resources.

The BRG asked many of its partners to draw up the broad lines of a national charter for genetic resources management, based on existing initiatives. The resulting assessment of current activities highlighted shortcomings and suggested additional strategies. The discussions took into account the country's international commitments in this field, as regards both policy and technical cooperation.

The national charter covers species of agricultural, industrial, economic, scientific or social interest that are managed and used by humans. It focuses on genetic diversity in domesticated species and species undergoing domestication, diversity in these species' pathogens and symbionts, and diversity in their wild relatives. It therefore focuses more on the species than on its environment. More ecological approaches linked to ecosystem conservation do not fall directly within the scope of this charter, having more to do with conservation biology and protecting biodiversity.

In territorial terms, the national charter covers all areas for whose genetic resources France is responsible, i.e. metropolitan France and its overseas dependencies.

On the livestock side, national strategy is set out for each species or group of species by a «pilot group» and taken into the field by the stakeholders involved in breed management.

The pilot groups have several tasks:
– cataloguing and characterising genetic resources;
– helping to organise the management of genetic diversity within each breed;
– helping to raise the funds needed for the work.

So far there are four pilot groups, on ruminants, pigs, poultry, and rabbits.

In 1990, the FAO launched the process for a global strategy for the management of farm animal genetic resources. At the FAO's request, the French interministerial committee on food and agriculture appointed the BRG to act as National Focal Point for animal genetic resources, and appointed one member of the Bureau as national coordinator.

In 1997, France agreed to act as facilitator for the European Regional Focal Point set up under the FAO's global strategy. The purpose is to improve co-ordination among the European countries. The Focal Point became a reality in 2000, when ten countries agreed to finance its activities.

I.3 ORGANISATIONAL FRAMEWORK

Research

Much of the AnGR research that concerns metropolitan France is conducted by INRA (National Institute for Agricultural Research), a state-funded institution.

INRA's Animal Genetics department works to extend knowledge and develop tools for genetic improvement of domestic animals and for adapting animal breeding to new issues. Since it was formed, it has been involved with the livestock farming organisations in designing modern breeding programmes; the 1966 livestock law specified its role in this field.

Photo 9. Flemish Giant rabbit. *(Source: BRG)*

Current research covers genomes, analysis of genetic variability in livestock performance, assessment of breeding stock and management of animal populations. Characterisation and management of AnGR is approached through a combination of statistical methodology and molecular biology. The teams involved are linked through a Genetic Resources network of which the BRG is also a member.

Some projects also concern livestock production in tropical regions, mainly from the standpoint of genetic diversity and disease resistance. To take better account of the distinctive features of the overseas dependencies, INRA works closely with the livestock department at CIRAD (International Centre for Cooperation in Agricultural Research for Development).

Research work on conservation biotechnology is conducted by INRA's animal physiology department, and geneticists are modelling the impact of such technology on breeding and

conservation programmes.INRA and CIRAD take part in international research networks and many European programmes. They are often asked to do consultancy work on AnGR management, in France and elsewhere.

Private organisations conduct livestock genetic resources research on an ad-hoc basis. Some tender for research projects; the BRG, for example, calls for research tenders every two years. The private agricultural school ISARA and a breeding company are involved in a European RESGEN programme to freeze genetic material from local rabbit breeds. They can also submit «innovative actions» for partial funding by the Ministry of Agriculture. Private organisations also contribute financially to R&D partnerships such as Labogena and AGENAE, some of whose research or applications advance the genetic resources field (e.g. molecular characterisation of breeds). The artificial insemination branch has formed the basis of an R&D department at UNCEIA (National Union of Livestock Farming and Artificial Insemination Cooperatives), which works closely with INRA teams.

Education, training and public awareness

There are 860 agricultural teaching establishments in France, covering the whole territory, plus 30 higher education establishments of which 19 are state-funded (the National Agronomy Institute (INA), national agronomy colleges, veterinary colleges, etc.). Teaching on animal genetic resources is generally dispensed in courses on genetics and biodiversity in general, or livestock breeding courses. There are few higher education courses on genetic resources as such, for lack of subsequent career possibilities.

Some forty of the country's agricultural schools and professional training establishments have local breeds on or near their farms. A «local breeds – animal biodiversity» network has been set up at the initiative of teachers and farm managers. Its objectives are as follows:
– catalogue, describe and publicise actions conducted at technical and higher agricultural education establishments,
– develop a multidisciplinary approach to biodiversity,
– develop and distribute teaching material,
– provide teacher training,
– create and consolidate activities with French and European partners,
– promote general discussion of biodiversity issues in agricultural teaching establishments.

Photo 10. Vocational training in dairy industry skills at an agricultural high school. *(Source: K. Beck - MAAPAR)*

Genetics is a fast-growing discipline and regularly generates some new tool or method applicable in livestock farming. This creates a considerable need for in-service training. Existing structures are gradually addressing the new needs and advances in the genetic resources field.

The Bergerie Nationale (National Sheep Farm) in Rambouillet has always played a special role, holding a two-yearly international livestock festival with a symposium on endangered breeds. At present it also houses the artificial insemination school.

Development

The Technical Institutes (Institut de l'Élevage, Institut Technique du Porc and Institut Technique de l'Aviculture) and the Haras Nationaux play a major part in the management of AnGR in France.

With poultry, breeding of commercially raised poultry is based on research by the fish and poultry breeders' federation SYSAAF (Syndicat des Sélectionneurs Avicoles et Aquacoles Français). SYSAAF manages its members' performance databases and is developing new breeding methods in collaboration with the animal genetics department at INRA. It is also involved in joint research projects with INRA. In recent years it has been working to develop product chains using local poultry breeds, chickens particularly.

The Institut de l'Élevage, the Institut Technique du Porc and to a lesser extent the Institut Technique de l'Aviculture) play a major part in the management of AnGR in France. Twenty years ago the Ministry of Agriculture made the Institut de l'Élevage responsible for initiating and monitoring conservation programmes for rare breeds of cattle, sheep and goats. The Institut Technique du Porc has a similar mission for pigs, in close collaboration with the herdbook association for local pig breeds. The Institutes also have the task of validating breeding procedures, in collaboration with INRA.

Each department in France has a livestock structure, the Établissement Départemental de l'Élevage (EDE), accredited by the Ministry of Agriculture. The EDEs cover all organisations concerned with livestock production. Their mission is to identify animals, record pedigrees and conduct performance testing, develop and disseminate the most suitable production methods for local conditions, etc. As such the EDEs can be useful partners for monitoring rare breeds and some of them are involved in conservation programmes in their own right (e.g. the Sarthe EDE for Saosnois cattle and the Isère EDE for Villard de Lans cattle).

Performance testing in France is handled by professional organisations that are independent of the herdbook associations, UPRAs, artificial insemination producers and producers groups. The performance testing organisations may be independent associations of one kind or another or services run by the chambers of agriculture. Either way they are directly managed by farmers elected by their membership. Their narrow geographical scope makes them valuable partners for identifying farmers keeping local breeds.

The AI centres are indispensable partners for ensuring that *ex situ* conservation programmes run smoothly. Semen from local breeds is collected and frozen by accredited centres in compliance with the regulations on public stud, with funding from central or regional government. The AI centres help with semen collection, charging for this service at cost price and agreeing to take on animals that are not true to morphological or behavioural type (the same health guarantees apply to these animals as to males of selectively bred populations). The AI centres often deposit biological material with the national cryobank, mainly cattle and goat material from both endangered breeds and selectively bred breeds. Some AI centres are secondary cryobanks for the national cryobank.

These activities help to make people more aware of the value of conserving the animal heritage, but much remains to be done before the nation as a whole is aware of the issue.

2. NATIONAL REQUIREMENTS FOR RESEARCH, TRAINING AND COMMUNICATION

2.1 TRAINING

Strategic needs are as follows:
– adapt training to the new health and environmental requirements;
– strengthen social sciences, economics and legal studies to improve understanding and prediction of trends in social demand;
– adapt the teaching at higher education establishments to the European context.

To achieve these goals, curricula should be well-structured and coherent. Innovation, research and development, the three main strands, must be planned coherently with common in-service training, a prospective watch function for careers and competencies, and an approach consistent with other countries.

In this way the French system would retain its scientific, technological and professional character while becoming more transparent, coherent, flexible and efficient.

2.2 RESEARCH

Recent changes in the farm and food sector have highlighted the importance of maintaining a strong capability for research and technology transfer.

Organising research is mainly the responsibility of state bodies: AFSSA, Cemagref, Ifremer and INRA. The agricultural higher education establishments should fit into the system by organising collaborative work with these organisations.

Under the agricultural orientation law of 9 July 1999, contributing to development, experimentation and applied research is one of the five missions of state-funded professional training in agriculture. However, it must not become cut off from the more conventional forms of training linked to research.

The Research Ministry has announced a set of measures to compensate for the handicaps French research suffers from compared to other countries with a high R&D potential:
– improve the governance of state-owned bodies, defining priorities, methods and qualitative and quantitative objectives,
– develop project-based funding subject to transparent evaluation,
– introduce effective human resource management,
– strengthen the links between state-funded bodies and private enterprise,
– take into account the reality of the European research area now taking shape.
It also stresses that to achieve the goal of spending 3% of GDP on R&D by 2010, funding by central government, regions, departments, the European Union and private enterprise must be complementary. This will optimise innovation and investment by private companies.

Postgraduate training must be developed further, to satisfy demand from young graduates and make advanced agricultural science training more attractive. This should generate major progress in agricultural research. In this connection it would be a good idea to facilitate exchanges between teachers and researchers in the same discipline, by organising joint research projects. There should also be more interdisciplinary exchanges in the curricula.

2.3 INFRASTRUCTURE, CAPITAL EQUIPMENT AND TECHNOLOGY

The role of science and technology continues to expand and diversify. R&D as an economic sector is putting greater pressure on science to become more competitive. This translates as a closer linkage between training and research, increased interaction between privately-funded and state-funded research, and increasing stress on technology, whose rate of change is a driving force for progress in science and industry.

An organisation was needed to handle routine identification and parentage testing of breeding stock (about 80,000 ruminants, horses and donkeys a year have to be tested) and, more recently, to identify certain genetic anomalies by a simple diagnostic test and conduct genotyping on a large scale (the marker-assisted breeding programme for dairy cattle requires about 350,000 genotypings a year). A GIE partnership called Labogena was set up to address this need. Its member partners are INRA, the Haras Nationaux, the national organisation of chambers of agriculture, France UPRA Sélection, the Institut de l'Elevage and UNCEIA. Its mission is to turn discoveries made by molecular genetics research laboratories into routine analyses that can be used on a large scale.

AGENAE (Analyse du Génome des Animaux d'Élevage) is a GIS partnership formed in 2002 at INRA's initiative. Its mission is to develop analytical and bio-informatics tools combining gene mapping and functional genomics, for cattle, pigs, chickens and trout. It has a biological resources centre in Jouy-en-Josas, responsible for maintaining and distributing DNA clones, and a network of genotyping and functional genomics platforms at various INRA centres, some of which are linked to regional genetics centres. AGENAE will support two types of research: generic projects to establish new tools, and applied projects that will routinely involve partners from the various sectors.

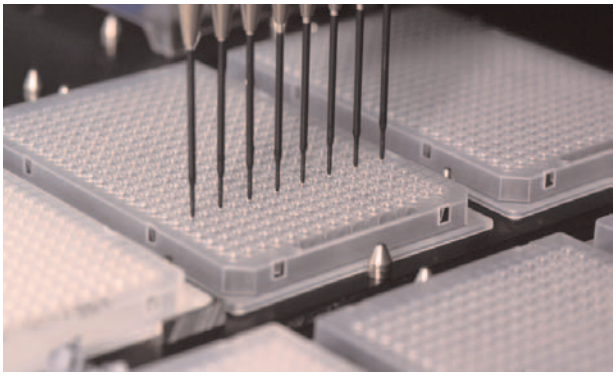


Photo 11. Labogena was responsible for the wide-scale application of molecular tests for genotyping and parentage testing).
(Source: B. Nicolas - INRA)

AGENAE partners include INRA, CIRAD, the cattle sector represented by the Apisgene company, and the aquaculture sector represented by CIPA (Comité Interprofessionnel des Produits de l'Aquaculture). The pig and poultry sectors should soon join the partnership.

Running a structure of this kind raises new questions for human resource management, and depends on continued funding.

2.4 INFORMATION AND COMMUNICATION SYSTEMS

The new information and communication technologies are changing teaching methods and the relationship between teachers and students. It is vital to develop virtual teaching of the life sciences, but it takes considerable intellectual and material resources.

Given how fast technology is advancing and international competition increasing, existing structures are adapting (training sessions posted on the Internet, widely-disseminated information, animal identification) and are investing heavily to provide the necessary data processing resources for running programmes (identification, training, etc.), circulating information and finding applications for scientific and technological results.

2.5 NON-PROFIT SECTOR

Some regional authorities are helping to optimise the use of their living heritage in various ways:
– specific structures for conserving and utilising local resources (conservation centres, regional genetic resources centres);
– projects in partnership with such organisations as regional nature parks, national botanical conservation centres, the Technical Institutes and chambers of agriculture);
– introducing heritage management into an existing structure, e.g. an agricultural school, agricultural museum or heritage museum.

The Nord - Pas de Calais regional council, for example, supports a regional genetic resources centre which acts as facilitator for a network of farmers' associations providing methodological support and help for developing product chains (e.g. for the Trait du Nord heavy horse).

The Aquitaine regional council supports the Aquitaine Breeds Conservation Centre, a voluntary body that works with various partners to save twenty endangered breeds in the region.

The agricultural schools and higher education establishments are involved in regional development through their science and technology activities, the training they provide and the information they circulate.

2.6 BIOLOGICAL RESOURCE CENTRES

The idea for Biological Resource Centres (BRCs) emerged from global studies by the OECD. Since 2001, France has been leading the task force working on BRCs and how to implement them world wide. We are now finalising the precise definition of a BRC and the exact conditions for its operation.

The approach has been a gradual one. Some research projects have obtained funding through calls for proposals connected with the BRC concept, but they do not yet meet all the criteria (including accreditation) to be called BRCs in the OECD's meaning of the term. However, the organisations involved are working to organise their collections in line with a BRC type approach.

The BRC work, with research ministry support, focuses on quality, traceability, reliability and openness, and is entirely in line with the goal of maintaining existing collections. It is essential to standardise and regulate trade in biological resources internationally.

3. TRENDS AND PRIORITIES

France has the human resources and material infrastructure to work effectively for optimum use of animal genetic resources. This is due to the strongly structured approach the nation has developed over centuries of experience and which has enabled France to tackle numerous challenges. Resource management instruments have been developed or have adapted: the BRG, the national cryobank, the BRC approach. The system still needs considerable improvement to become fully efficient.

Insufficient use is made as yet of the available resources and associated knowledge. Close co-ordination must be maintained between the various branches of the agriculture ministry and the other public and private bodies involved. This would enable the government to take better account of the work done by the livestock farmers' associations, which are the backbone of conservation work on France's genetic heritage and related skills and knowledge.

In practice, this means better design of research programmes for sustainable management of AnGR. To achieve rational use of the elements that make up the agricultural system, a better balance must be found between humans, animals and the environment. The BRG is working towards this, and its role in coordinating research is likely to be strengthened. So will the role of those who manage animal populations.

A great deal of information may be gathered in the course of a farm animal's life: barn atmosphere, environment, production system, the animal's identity, AI data, prophylactic measures, health checks, performance, milk recording, breeding stock testing, semen and embryo collecting, deposits at cryobanks, participation in research programmes, characterisation, genotyping, etc. This would be more cost-effective if the data were better aggregated. With more human, material and data processing resources it should be possible to factor in existing data and documents so as to plan more effectively for future needs. A documentary resource centre could be set up to cover all the organisations directly involved (ACSEDIATE, AFSSA, BRG, Cryobanque Nationale, France UPRA Sélection, INRA, Institut de l'Elevage, Haras Nationaux, etc.).

If the national cryobank is to achieve its goals it needs to be expanded. It should be in a position to monitor the national collections and take responsibility for them. Government commitment is still needed to make sure activities are sustainable and ensure a proper balance between *in situ* and *ex situ* conservation.

In situ conservation relies heavily on non-profit bodies, which have worked hard to maintain traditional breeds. But they are small-scale organisations and they need help to continue their work and align themselves with the new legal framework (help for establishing herdbooks and implementing health measures). The need is particularly pressing in the poultry sector. *In situ* conservation should receive support from existing structures.

Since funds for research and for the public sector are limited, human and material resources need to be used efficiently. If they are properly co-ordinated, the research required to develop new tools can take place and conservation actions can develop over the long-term.

In France, agricultural training is an integral part of the national education service. The teaching is of high quality, is recognised as such by farmers, and enables students to make a good start their careers. But it must evolve in line with social demand.

It must respond to new ideas on rural development, natural heritage utilisation and territorial change. In responding to these priorities, the agricultural training courses will also contribute to the conservation and use of AnGR.

This is becoming ever more vital now, as farming and other rural occupations are changing fast, generating new training needs. These needs now concern not only production but also consumer demand for food safety and environmentally friendly farming methods.

In broad terms, France is already managing its livestock breeds. However, it is now essential to work closely with other European countries to establish joint management of the common breeds, exchange experience and develop joint research programmes. The BRG played a major part in setting up the European Regional Focal Point for the management of animal genetic resources . This initiative has led to excellent European coordination and should become a permanent feature.

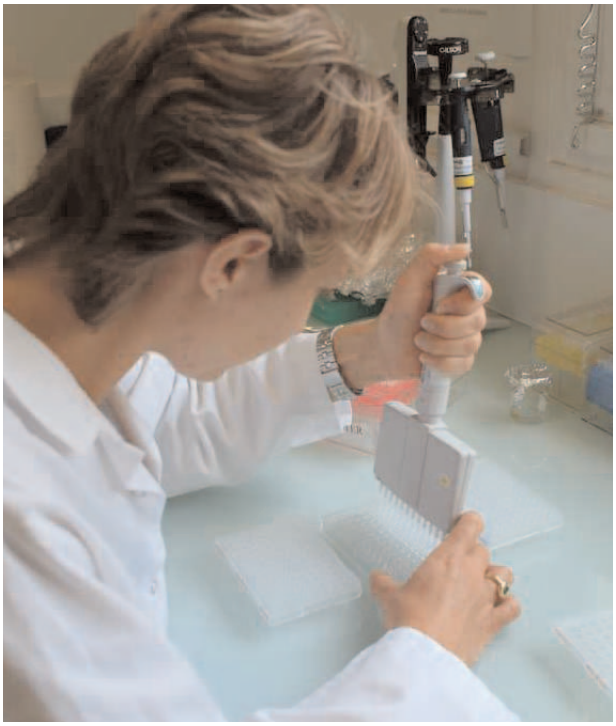


Photo 12. Research-based training is a priority for developing skills. *(Source. B. Nicolas – INRA)*

To meet all its commitments, France will have to do more to help developing countries. Long-term measures to promote cataloguing, characterisation and management of local breeds are crucial - particularly help with animal identification, farm monitoring and setting up genetic improvement programmes. The BRG's experience in setting up the European Focal Point could be an asset in this regard, continuing the work begun by the FAO.

IV. National priorities for the conservation and use of farm animal genetic resources

The French system for managing farm animal genetic resources involves a large number of stakeholders: R&D institutions, breed associations and breeding organisations, nature parks, conservation centres and farmers. Such a varied set of stakeholders is an asset, and reflects the level of awareness of AnGR in the country, but efficiency can also be undermined by differences in strategy between the different stakeholders.

National policy is mainly based on the guidelines set out in the national charter for genetic resources. This has been designed to address the management of AnGR in its broadest sense and covers a wider area than conservation of endangered breeds.

I. LEGISLATIVE AND REGULATORY ASPECTS

The genetic resources management system is based on a combination of EU regulations and national laws and regulations.
The EU regulations come under three headings:
– health regulations and directives laying down the health conditions for trade in live breeding stock, sperm and embryos;
– texts laying down the zootechnical conditions for trade in sperm, ova and embryos from purebred breeding stock. As a corollary, EU regulations also aim to harmonise the conditions under which herdbooks are kept and the methods used for evaluating the genetic value of breeding stock;
– texts on the conservation and use of animal genetic resources.

There are two main EU instruments on genetic resource management. They are Regulation 1750/99, defining the principle for special payments to farmers keeping endangered local breeds, and Regulation 1467/94, setting out the objectives and implementation conditions of EU policy on the conservation, characterisation and use of genetic resources in agriculture (support for research and application studies) (this regulations is due for renewal in the coming months).

French national laws and regulations on animal breeding (health and zootechnical conditions) make up a special section of the Rural Code. This specifies the organisational and regulatory framework for animal breeding.

The result is a highly structured system and a clear definition of the missions of each organisation concerned. French regulations define:
– the rules for keeping herdbooks;
– parentage testing methods;
– methods for assessing the genetic value of breeding stock (performance testing protocols and indexing rules);
– health and zootechnical conditions for approving stud animals for AI, mainly based on progeny testing;
– conditions for the practice of artificial insemination;
– the structure for consultation between the different stakeholders for defining breeding goals for each breed;
It is the agriculture minister who authorises each organisation's missions and activities.

The government aims for synergy among the different organisations. In animal genetics it is crucial that breeding objectives and working methods remain stable over a long period. This collectively designed system gives all farmers access to genetics and makes sure that resources and commitments are lasting.

2. MANAGEMENT OF FARM ANIMAL GENETIC RESOURCES

Animal genetic resources management systems must be assessed for their relevance and efficiency.

There best model for managing an animal population may depend on the type of breed: local breeds which may or may not have a market niche, international breeds for which there is a large-scale trade in breeding stock or semen. Different models may be suitable depending on the kind of organisation running the programme: state-owned organisation, Technical Institute, breeding unit, conservation centre etc. The first step is to decide whether the genetic material is worth preserving, which mainly means whether it is sufficiently original. Then the effectiveness of the programme must be assessed.

This requires:
– a single evaluation procedure that allows for a variety of programmes;
– a list of breeds or populations of agricultural interest and therefore worth including in the national strategy for AnGR. This means that a large number of rare breeds must be characterised, either by quantitative genetics or by molecular genetics.

3. CONCERTED STRATEGY

A concerted strategy for AnGR management should be introduced, including a monitoring system and increased focus on managing genetic variability. Efforts would then include not only the common breeds (where competition between breeds can in itself generate short-term genetic progress) but also the relatively rare breeds which constitute a cultural and genetic heritage that is worth conserving. The network of scientists and engineers trained with this concept in mind will be maintained and developed in direct relationship with the breed managers. Education, training and raising awareness of animal biodiversity should be strengthened, not only in the agricultural science colleges but targeting all concerned, including livestock farmers and the «users» of these resources.

Strategy should aim to strengthen institutional links, uniting stakeholders around a common project, applying the principles of the genetic resources charter and achieving greater consistency between national and local actions and complementarity between *in situ* and *ex situ* conservation programmes.

Pursuant to the recommendations of the Commission Nationale d'Amélioration Génétique (CNAG), France runs a cryoconservation programme for animal genetic resources. The purpose of this is to have available genetic combinations that are either original or representative of the current state of farm animal populations. The programme needs to be strengthened (with continued government funding) and should be viewed within the context of the BRC initiative.

Ex situ conservation cannot replace *in situ* conservation, which is the only way to improve populations and transmit the technical and cultural heritage. Technical supervision of programmes and, for the most seriously endangered breeds, economic aid for rearing the stock, are still priorities for government action.

4. MANAGEMENT TOOLS

The existing tools for coordinating management and development activities and research and communication projects need to be strengthened and developed.

Research, especially public sector research, has already provided some solutions, but work must continue if we are to understand how much emphasis breeding programmes should lay on genetic variability.

The purpose of current strategy is to:
– increase the supervision and enablement capacities of the co-ordination bodies, especially the Bureau des Ressources Génétiques. The CNAG should continue to be the structure for defining breeding policy;
– make the national databases currently run by the BRG more exhaustive and interactive. They should be capable of raising the alarm if particular breeding programmes pose problems;
– adapt each programme's resources to its implications and difficulties (this requires all programmes to be supervised at the national level);
– ensure long-term survival of genetic resources management projects, since their impact is by nature a long-term affair. This requires official recognition for programmes in the regulations, and providing stable national lines of credit tailored to individual cases.

A proper balance must be struck between *in situ* and *ex situ* conservation. In collaboration with the national cryobank, the organisation of the overall system must made sufficiently stable and reliable to win the confidence of all stakeholders, from the scientists to the farmers' associations and AI centres that manage the resource.

5. SUSTAINABLE DEVELOPMENT

Endangered breeds, and genetic variability in livestock in general, must be managed with a broader view than merely conserving a breed or a set of genes.

Steps must be taken to promote the development of all kinds of economic use: foods sold under quality labels, green tourism, care of the countryside etc. (Photo 13).
This view is also shared by the scientific community, and research programmes are now taking both the horizontal and the vertical approach to biodiversity. Current needs are:
– to integrate the conservation of AnGR into sectoral policies. For example, the endangered breeds premium is an eligible measure under the Sustainable Agriculture Contracts;
– to elicit and support initiatives to optimise economic use of animal genetic resources;
– to promote the use of native breeds that are thoroughly adapted to local conditions. Using marginal breeds can also help to address social and environmental problems.

To move in this direction, there needs to be more harmony between general farm policy regulations, those for management of farm animal genetic diversity and those resulting from public health policy. Special attention must be paid when drawing up such regulations, both nationally and internationally. Prior consultation will always be needed. Particular needs include the following:
– emergency measures to protect particularly rare breeds or lines if an infectious disease breaks out;
– new public health measures that take into account the existence of frozen semen and embryos. This means that all data on the health status of animals providing samples must be stored, as must material such as cells and serums to meet any future needs for analysis;
– particular diseases must be taken into account when setting up conservation programmes, especially diseases whose expression is directly or indirectly related to a genetic marker.

Photo 13. Stock grazing helps to maintain mountain landscapes.
(Source: P. Xicluna - MAAPAR)

6. INTERNATIONAL COOPERATION

Since the introduction of the Common Agricultural Policy, French agriculture has largely focused on the European market. This has made France the world's leading exporter of processed agricultural products and has enabled Europe to make up its shortfall in these products. Close bonds with other European countries have also been forged in agricultural research, educational and training exchanges and, more recently, in animal genetic resources, with the development of a European database and the inventorying of cryoconservation in Europe. Cooperation on the legislative and regulatory aspects could usefully be extended to the international arena to develop international relations in the AnGR field. The following might be considered:
– support and assistance for professional initiatives by European and world organisations and development of associated programmes (developing genetics links between countries, joint testing, etc.);
– stronger French participation in the work of inter-governmental technical organisations and European and international professional bodies (the COPA-COGECA task forces in Europe, ICAR-INTERBULL internationally);
– stronger and broader policy on cooperation with the FAO, CGIAR and OECD;
– participation in discussions to set up BRCs internationally and continue the effort to play a major role in this regard;
– support for the BRG to continue developing the FAO European Regional Focal Point and optimising use of European databases.
– proper consideration of the livestock farming context in the French contribution to negotiations on access to genetic resources and the sharing of advantages acquired through their use (FAO, Convention on Biological Diversity).

Internationally, France will assist developing and emerging countries with increased cooperation, in the following fields particularly:

– sharing experiences, encounters for professional development and sustainable development, helping livestock farmers set up farmers' associations, cooperatives etc. and organise their product chains;

– providing technical assistance for designing, organising and implementing national systems for identification and traceability of animals, animal products and the corresponding information systems;

– strengthening cooperation on methods of genetic comparison between stud animals and mutual recognition of genetic assessment methods and results;

– supporting organisations that might provide help for setting up and monitoring animal improvement programmes in other countries (INRA, CIRAD, Technical Institutes and livestock farmers' organisations);

– helping establish material resources for creating and managing national collections and making use of information on animal diversity and its applications;

– helping countries of the South acquire the scientific, technical and organisational skills they need to design effective national and regional policies and manage their animal heritage in line with international agreements like the Biodiversity Convention.

V. Recommendation for closer international coopération on farm animal biodiversity

I. NATIONAL AND INTERNATIONAL COOPÉRATION

I.1 NATIONAL SITUATION

French membership of the European Union has transferred most of the levers of control on French agricultural policy to Europe, though the French Ministry of Agriculture was closely involved in the design, negotiation and implementation of the Common Agricultural Policy.

France currently produces nearly a fifth of the EU's agricultural output, and its trade balance for agricultural products (including forestry and fishery products) is in surplus. In 1998, the trade surplus was 12.9 billion francs, with 71% of exports going to European Union partners.

The Ministry of Agriculture has set up a network of agricultural attachés in countries that are important to the French farm and food sector. In 2000, France exported beef and veal worth 5.6 billion francs and dairy products worth 27.1 billion francs. A relatively small share of these exports go to developing countries, where demand for animal protein is growing fast.

France also exports livestock genetics (all species) to many countries. The other leading exporters are the United States, Canada and the Netherlands. The French genetics sector (live animals, chicks, sperm, embryos and hatching eggs) generated 1.5 billion francs in exports in 1998 and a trade surplus of 1.1 billion francs - 10% of the international genetics trade. The EU market generated 53% of this income; 28% came from exports of day-old chicks, 27% from stud horses, 22% from breeding cattle and 16% from hatching eggs.

I.2 INTERNATIONAL SITUATION

France is a member of:

– the Convention on Biological Diversity [United Nations, Rio, 1992],
– the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) [World Trade Organisation, Marrakesh Convention, 15 December 1993].

It is a member of the FAO's Commission on Genetic Resources for Food and Agriculture (CGRFA). It has played an active part in setting up international structures coordinated by the FAO under its global strategy for the management of AnGR. In particular, the Bureau des Ressources Génétiques is responsible for coordinating actions in this field Europe-wide.

European and international forums and discussion bodies exist, involving the European Union, European Association for Animal Production (EAAP), International Committee for Animal Recording (ICAR) and FAO.

In the French overseas dependencies, under the national charter on genetic resources conservation, the French state is working via its research organisations INRA and CIRAD for better utilisation of local breeds (e.g. goats in Guadeloupe, Brahman cattle in French Guiana). Actions either concern the production plan directly or aim to develop particular traits such disease resistance, particularly to tick-borne diseases like dermatophilosis. From the experience acquired, knowledge is transferred to Africa, Asia and the South Pacific.

The state-owned research institutes CIRAD and INRA both contribute to current thinking on a possible world agricultural research system that would include national systems, the CGIAR system and the major cooperative research organisations. CIRAD and INRA are also involved in consolidating regional research organisations such as WECARD and ASARECA in Africa. They have joined forces to develop animal genetics research of interest to tropical countries. This work covers the genetics of heat tolerance, evaluation of local poultry breeds, the genetics of resistance to gastro-intestinal parasites in small ruminants, and use of molecular tools for characterising cattle breeds. One practical result has been the creation of a portal, GENATROP (Génétique Animale en Milieu Tropical) giving France's research partners access to French competences in this field.

The AGENAE programme on genetic analysis of farm animals, which covers genomics and gene mapping and in which CIRAD and INRA are partners, will be exploring genetic variability in tropical breeds, particularly as regards disease resistance. A major research programme on trypanotolerance is under way. Making optimum use of local breeds often implies setting up cross-breeding strategies that will benefit both breeds, using high-productivity genes. This requires considerable research to work out policies for managing animal populations and structuring production sectors.

The difficulties encountered are due to the complexity of the questions asked, the weakness of the R&D structures in the countries concerned by the research and the drastic cuts in government subsidies in the countries of the South.

There are possible avenues for cooperation, however (e.g. in Asia, and with international research centres like ILRI, CIRDES and ITC), and these programmes are gradually taking shape. France partly finances a biodiversity identification and conservation programme in Vietnam, called Biodiva. This programme is based on a combination of field work (identifying domestic and wild animals with a heritage value) and laboratory work (genetic characterisation of the populations identified). On the French side it involves INRA and CIRAD, and on the Vietnamese side NIAH and CNST. The programme is working particularly on the conservation and use of the endangered Gaur and Banteng breeds of wild cattle and such exceptional and emblematic breeds as the Saola and Kouprey in the highlands of Central Vietnam (Ea So) and the Annamite Cordillera. French teams have also established excellent cooperation links with China, Taiwan and Vietnam which should provide the basis for an international network on tropical pig research.

Photo 14. International technical cooperation: exchange of genetic material and know-how. *(Source: BRG)*

The livestock research unit at INRA's regional research centre in French Guiana also has international ambitions, and the centre is developing consultancy capability to support Caribbean livestock farming.

Developing countries' farmers also need to organise among themselves and so take control of their own development. French livestock sector professionals and technicians have a wealth of practical experience and know-how that could be shared more widely with other countries, especially the developing and emerging countries. In 2002, an international technical co-operation bureau of French ruminant farmers' organisations was created on an initiative by the Confédération Nationale de l'Élevage. It is functionally a part of the Institut de l'Élevage. This illustrates the desire of the French livestock sector to help transfer experience and know-how and develop links with livestock managers in other countries (Photo 14).

2. RECOMMANDATIONS

- Develop joint cooperation programmes by government research bodies (CIRAD and/or INRA) and professional livestock organisations (Technical Institutes, EDE, performance testing organisations, AI cooperatives, UPRAs etc.) encouraging synergy between public sector research and the expertise of the professional sector.

- Strengthen exchange through the international breed federations, and strengthen international technical co-operation projects already initiated by livestock farmers' organisations (for developing performance testing methods, testing sires jointly or in parallel, keeping herdbooks etc.).

- Most developing and emerging countries have widely-used local breeds that are well adapted to local production conditions but which the decision makers in those countries consider far less productive than the improved breeds of developed countries. The result is poorly planned and poorly controlled cross-breeding which in the long run is a threat to the very existence of the native breeds. To manage these countries' farm animal genetic resources effectively, help is needed to set up management systems in the field, with organised programmes for both selective breeding and cross-breeding. Here too, French professional organisations could share their experience, with help from the research institutes for the scientific and methodological aspects.

- Increase international co-operation on designing information systems (for animal identification, pedigree and performance records etc.) and communication networks.

- Lay down principles and methods governing fair trade and safe transport, storage, access and sharing of animal genetic material at the international level.

- Plan an international exchange centre to support co-operation on AnGR; the centre would also monitor and provide funding, depending on the mechanisms (new or existing).

- Develop bilateral, regional, inter-regional and global co-operation, particularly on the trypanotolerant breeds that are essential for the future of stock farming (Lagunes, Bakosi, Namchi, Kapsiki etc.) and on setting up inter-regional animal genetic resource management plans.

- Support national capacity-building efforts.

- Define a policy for co-operation on basic research and on developing and transferring appropriate biotechnology.

3. Order of priority

- Actions will be scheduled collectively with the scientific and technical bodies concerned, the ministries (agriculture, foreign affairs, DREE), financial institutions (Agence Française du Développemment etc.) and any French agricultural organisations in a position to provide support.

- Management plans for livestock populations in developing countries generally require farmers to be organised. They also require organised processing and marketing chains to meet the growing need for animal protein in these countries. A priority will be for French farmers' organisations to share their experience in organising product chains.

- Research is often needed prior to the cooperation programme, e.g. for genetic and performance characterisation of animal populations, population censuses, study of traditional livestock farming systems, and defining the place of livestock farming in ecosystem management.

Appendices

Appendix 1

PROJECT LEADER

Monsieur PLANCHENAULT Dominique. *Bureau des Ressources Génétiques, National and Regional Coordinator for Animal Genetic Resource (FAO).*

NATIONAL CONSULTATIVE COMMITTEE

Madame AUDIOT Annick. *INRA - URSAD*
Monsieur BENTATA Vincent. *Ministère de l'Ecologie et du Développement Durable - DNP*
Monsieur CATROU Olivier. *Ministère de l'Agriculture, de l'Alimentation, de la Pêche et des Affaires Rurales. Bureau de la Génétique animale*
Monsieur GASTINEL Pierre-Louis. *Institut de l'Elevage*
Monsieur LEPLAIDEUR Alain. *Ministère des Affaires Etrangères, de la Coopération et de la Francophonie. DCSUR/Recherche, Agronomie, Environnement, Biodiversité*
Monsieur MARTIN André. *Ministère des Affaires Etrangères, de la Coopération et de la Francophonie. DCSUR/Recherche, Agronomie, Environnement, Biodiversité*
Madame MONIER Marie-Hélène. *Ministère de l'Agriculture, de l'Alimentation, de la Pêche et des Affaires Rurales. Direction Générale de l'Enseignement et de la Recherche*
Monsieur PATIN Stéphane. *France UPRA Sélection*
Monsieur POIVEY Jean-Paul. *CIRAD*
Madame ROUBAN Anne. *Ministère de l'Économie, des Finances et de l'Industrie - DiGITIP 2*
Madame TIXIER-BOICHARD Michèle. *INRA - Génétique factorielle*
Monsieur VERRIER Etienne. *INA-PG. Sciences animales*
Monsieur VICAIRE René. *Ministère de la Jeunesse, de l'éducation et de la Recherche - Direction de la Technologie*

Appendix 2. Abbreviations used

ACSEDIATE	Association pour le Contrôle Sanitaire l'Etude et le Développement de l'Insemination Artificielle et du Transfert Embryonnaire (French association for safety assurance, study and development of artificial insemination and embryo transfer).
AFSSA	Agence Française de Sécurité Sanitaire des Aliments (French food safety agency).
AGENAE	Analyse du génome des animaux d'élevage (Analysis of farm animal genomes).
AI	Artificial insemination.
AnGR	Farm animal genetic resources.
AOC	Appellation d'Origine Contrôlée (controlled appellation of orgin).
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa.
BRC	Biological Resource Centre (OECD initiative).
BRG	Bureau des Ressources Génétioques.
CAD	Contrat d'Agriculture Durable (sustainable agriculture contract).
CBD	Convention on Biodiverisity.
CEMAGREF	Centre national du Machinisme Agricultural, du Génie Rural, des Eaux et Forêts (national centre for water, forest and rural engineering and agricultural machinery).
CGIAR	Consultative Group on International Agricultural Research.
CGRFA	Commission on Genetic Resources for Food and Agriculture (FAO).
CIPA	Comité interprofessionnel des produits de l'aquaculture (inter-profession committee for aquaculture products).
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (French centre for international cooperation in agricultural research for development).
CNAG	Commission Nationale d'Amélioration Génétique (national committee on genetic improvement).
CRAPAL	Conservatoire des Races Animiales en Pays de la Loire (Pays-de-Loire animal breeds conservation centre).
CRI	Centres Régionaux Informatiques (Regional data processing centres).
CTIG	Centre national de Traitement de l'Information Génétique (national centre for genetic information processing).
DCs	Developing countries.
DREE	Direction des relations économiques extérieures (external economic relations department of the Ministry for Finance, the Economy and Industry).
EAAP	European Association for Animal Production.
EDE	Etablissement Départemental de l'Elevage (Departmental livestock authority).
ERFP	European Regional Focal Point for animal genetic resource management (FAO).
ESPACE	Entretien des Sites à Préserver par des Animaux Conduits en Extensive (network for the conservation of vulnerable landscapes by extensive stock grazing).

FAO	United Nations Food and Agriculture Organisation.
FFV	Fédération Française des Volailles (French poultry federation).
GAEC	Groupement Agricultural d'Exploitations en Commun (a group of existing farms that pool their means of production for optimum management).
GDP	Gross Domestic Product.
GIE	Groupement d'Intérêt Economique (partnership of economic interest).
GIS	Groupement d'Intérêt Scientifique (partnership of scientific interest).
IFREMER	Institut Français pour l'Exploitation de la Mer (French institute for marine exploration).
INA-PG	Institut National Agronomique Paris-Grignon (national agricultural sciences institute).
INRA	Institut National de la Recherche Agronomique (national agricultural research institute).
ITP	Institut Technique du Porc (technical institute for pig production).
LABOGENA	Laboratoire d'analyses génétiques pour les espèces animales (laboratory for genetic analysis of animal species).
MAAPAR	Ministry de l'Agriculture, de l'Alimentation, de la Pêche et des Rural affairs (Ministry for Food, Agriculture, Fishery and Rural Affairs).
OECD	Organisation for Economic Cooperation and Development.
PDO	Protected Designation of Origin.
PGI	Protected Geographical Indication.
SYSAAF	Syndicat des Sélectionneurs Avicoles et Aquacoles Français (federation of French fish and poultry breeders).
TRIPS	Agreement on Trade Related Aspects of Intellectual Property Rights.
UNCEIA	Union Nationale des Coopératives Agricoles d'Elevage et d'Insemination Animale (national union of livestock farming and artificial insemination cooperatives).
UPRA	Unité Nationale de sélection et de Promotion de Race (national breeding and breed promotion unit).
WECARD	West and Central African Council for Agricultural Research and Development.

Appendix 3. French domestic animal breeds and varieties

Cattle

Abondance
Armorican
Aubrac
Aurochs (restored)
Bazadais
Béarnais
Belgian Blue
Betizu
Bleue du Nord
Blonde d'Aquitaine
Bordelais
Breton Black Pied
Brun
Casta
Charolais
Corsican Ferrandais
Fighting Bull
French Holstein Friesian
French Simmental
Froment du Léon
Gascon
Guadeloupe Creole
Hereford
Herens
Inra 95
Jersey
Limousin
Lourdais
Maraichine
Marine Landais
Martinique Creole
Mirandaise
Montbeliard Nantaise
Normand
Parthenais
Pie Rouge des Plaines
Raço di bioù
Rouge des prés
Rouge Flamande
Salers
Saosnois
Tarentais
Villard de Lans
Vosges

Sheep

Arles Merino
Aure-Campan
Avranchin
Baregeois
Basco-Béarnais
Belle Ile
Berrichon de l'Indre
Berrichon du Cher
Bizet
Black-Face Manech
Blanc du Massif Central
Bluef Face Maine
Boulonnais
Brigasca
Castillonnais
Caussenard des Garrigues
Caussenard du Lot
Charmoise
Charollais
Clun Forest
Corsican
Cotentin
Dorset Down
Finnsheep
French Alpine
Grivette
Hampshire Down
Ile de France
Inra 401
Lacaune Dairy
Lacaune Meat
Landais
Landes de Brittany
Limousin
Lourdais
Martinik
Merino de l'Est
Merino Précoce
Mourerous
Préalpes du Sud
Raiole
Rambouillet
Rava
Red-Face Manech
Romanov
Rouge de l'Ouest
Roussillon Red
Roussin de la Hague
Solognot
Southdown
Suffolk
Tarasconnais
Texel
Thones-Marthod
Ushant
Velay Black
Vendeen
Xaxi Ardia

Goats

Alpine
Angora
Corsican
Creole
Massif Central
Poitou
Provencal
Pyrenean
Rove
Saanen

Pigs

Basque Black Pied
Bayeux
Blanc de l'Ouest
Carelie
Corsican
Guadeloupe Creole
DRB
DRC
Duroc Selpa
FH012
FH016
FH019
FH025
French Landrace
Gallia
Gascon
Jia-Xing
L1010
L1020
Laconie
Landrace Selpa
Large White dam line
Large White sire line
Limousin
Mei-Shan
Musclor
Penshire
Pietrain
Proligene 121
Proligene 321
Tia Meslan
Willebrand
X20
X30
X70
X80

Horses

Anglo-Arab
Appaloosa
Arab
Ardennes
Auxois
Barb
Boulonnais
Breton
Camargue
Castillon
Cob Normand
Comtois
Connemara Pony
Dartmoor Pony
Fjord
French Saddlebred
French Saddlebred Pony
French Trotter
Haflinger
Henson
Highland
Iceland Pony
Landais
Lipitsa
Lusitanian purebred
Merens
New Forest Pony
Northern Ardennes
Percheron
Poitou
Pottok
Purebred
Quarter Horse
Shagya
Shetland Pony
Trakehner
Welsh Pony

Donkeys

Âne du Cotentin
Âne Grand Noir du Berry
Ane du Bourbonnais
Âne Normand
Âne de Provence
Âne des Pyrénées
Baudet du Poitou

Rabbits

Argenté de Champagne
Belgian Hare
Bélier Français (Lop)
Blauwe Viener
Thuringer
Fauve de Bourgogne
Black and Tan
Bouscat
Flemish Giant
French Havana
Géant Papillon Français
Jarres Blancs
Russian
Sablé des Vosges
Zibeline/Martre

Chickens

Breed
Variety

Alsacienne. Black.
Aquitaine. Black.
Ardennaise. Silver salmon. Silver black. Black gold. Silver partridge. Gold partridge. Gold salmon
Barbezieux. Black with green lights.
Bourbonnaise. Silver ermine.
Bourbourg. Silver ermine.
Bresse Blanche. White.
Bresse Gauloise Grise. Grey.
Bresse Gauloise Noire. Blue. Black.
Caumont. Black.
Caussade. Black.
Charollaise. White.
Large Northern Fighter. Silver salmon with silver neck hackles. Silver salmon with gold neck hackles. Blue with silver neck hackles. Blue with gold neck hackles. Gold salmon. Silver wheaten. Gold wheaten. Black with silver neck hackles. Black with gold neck hackles.
Small Norther Fighter
Silver salmon with silver neck hackles. Silver salmon with gold neck hackles. Blue with silver neck hackles. Blue with gold neck hackles. Gold salmon. Silver wheaten. Gold wheaten. Black with silver neck hackles. Black with gold neck hackles
Contres. Silver ermine.
Cotentine. Black.
Cuckoo de Rennes. Barred cuckoo.
Cuckoo des Flandres. Barred cuckoo.
Courtes Pattes. White. Cuckoo. Black. Black mottled.
Crèvecoeur. White. Blue. Cuckoo. Black.
Estaires. Black. Black with silver neck hackles. Black with gold neck hackles.
Faverolles Allemande. Dark silver salmon. White. Ermine. Black.
Faverolles Française. Light silvered salmon. Cuckoo.
Gasconne. Black.
Gâtinaise. White.
Gauloise Dorée. Gold.
Géline de Touraine. Black.
Géline de Touraine Label. Black.
Gournay. Black mottled with white.
Hergnies. Grey.
Houdan. White. Pearl grey. Black. Black mottled with white.
INRA DPF-. Short fertile period.
INRA DPF+. Période fertile longue.
INRA ev21.
INRA Fayoumi. Grey.
INRA G .
INRA Jouy 850. Control.
INRA Jouy 851. Fawn ermine.
INRA Jouy 852. Fawn ermine.
INRA M. Thin line.

INRA Mandarah. White and red.
INRA Noé. Numerous mutations.
INRA Nunukan. Kn.
INRA R-. Light reddish brown.
INRA R+. Mahogany.
INRA RI-A. White.
INRA RI-C. White.
INRA RI-P. White.
INRA RI-T. White.
INRA Vilvert. Silver ermine. Silver salmon.
INRA WG. White.
INRA X33. Good growth.
INRA X44 .
INRA Y11. Control line, broiler.
INRA Y33.
Janzé. Black.
La Flèche. White. Blue. Cuckoo. Black.
Landaise. Grey. Black.
Le Mans. Black.
Le Merlerault. Blue. Black.
Limousine. Dirty white. Blue. Black.
Lyonnaise. Black.
Mantes. Black mottled white.
Marans. White. Ermine. Silver cuckoo. Gold cuckoo.
Tawny with black-tail. Wheaten. Black. Copper black.
Meusienne. Dark salmon.
Noire de Challans. Black.
Noire du Berry. Black.
Pavilly. Black.
Pictave. Partridge.
Sans Queue. All colours.

Appendix 4. *Ex situ* breed conservation: the national cryobank

National collections at 25/01/2004

Species	Breed	N° of donors	N° of doses
Cattle			
	Abondance	10	1,200
	Bearnais	1	800
	Blonde d'Aquitaine	7	700
	Brun	6	903
	Maraichine	3	2,400
	Montbeliard	33	6,100
	Normand	56	9,294
	French Holstein-Friesian	52	9,830
	Salers	2	400
	Saosnois	2	400
	Tarentais	13	1,700
	Villard de Lans	1	800
	Total	**185**	**34,927**
Sheep			
	Avranchin	11	1,760
	Berrichon de l'Indre	9	1,560
	Blue-Face Maine	3	552
	Boulonnais	5	580
	Caussenard des Garrigues	8	1106
	Cotentin	4	600
	Lacaune	20	1,830
	Rambouillet	43	2,109
	Merino Precoce	11	1,285
	Charollais	13	2,119
	Vendeen	30	3,078
	Raiole	12	2,136
	Roussillon red	11	1,611
	Rouge de l'Ouest	18	2,866
	Roussin	11	1,680
	Solognot	14	1,235
	Suffolk	11	2,200
	Total	**234**	**28,307**
Goats			
	French alpine	5	110
	Chèvre des Fossés	7	628
	Poitou	19	1,805
	Pyrenean	3	342
	Saanen	8	123
	Total	**44**	**3,128**
Pigs			
	Basque	15	1,154
	Bayeux	13	990
	Gascon	13	1,013
	Limousin	15	1,125
	Blanc de l'Ouest	17	1,219
	Total	**73**	**5,501**
Horses			
	Anglo-Arab	10	58
	Arab	1	6
	Boulonnais	2	81
	Norman Cob	2	80
	Percheron	1	40
	French Saddlebred pony	1	6
	French Saddlebred	31	181
	Breton heavy horse	1	50
	Trait Mulassier	3	133
	Baudet du Poitou	5	427
	Total	**57**	**1,062**
Rabbits			
	Castor Orylag - black mutation	11	74
Poulty *gallus gallus*			
	Golden Leghorn T	8	110
	Y 33	43	1,830
	B 4	20	632
	Total	**71**	**2,572**