The Global Strategy for the Management of Farm Animal Genetic Resources

Executive Brief

Food and Agriculture Organization of the United Nations

Initiative for Domestic Animal Diversity

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FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

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Food security for all

The challenge to achieve food security for all is greater now than it has ever been, with one out of six people in the world underfed.

At the current rate of population growth, the consumption of food and agriculture products during the second decade of the next century will be equivalent to that of the last 10 000 years.

While population rates soar, the amount of arable land is much the same as it was when agriculture was first practised with approximately one human being for every 25 ha of land. Today, human density averages 25 people per hectare and may even exceed 1200 people per hectare in urban centres.

Many developing countries are already exposed to chronic or frequent food shortages. In these countries in particular, food security requires both increasing total production and reducing variability of supply from year to year.

During recent decades, countries such as India have shown how to increase food production and reduce human population growth rates. Indeed, there is potential for increasing food and agriculture production in most developing countries if resources, including genetic resources, can be conserved and used wisely.

Animal genetic resources have been contributing to food and agriculture for more than 12 000 years, providing meat, milk products, eggs, fibre, fertilizer for crops, manure for fuel and draught power.

Animal genetic resources also reduce farmers' exposure to risk, generate employment and even out seasonal farm labour demands.

The total diversity among animal genetic resources contributes in many ways to human survival and well-being. It is estimated that, directly and indirectly, domestic animals supply some 30 percent of total human requirements for food and agriculture.

[Figure 1] The yak produces fat- and protein-rich milk under very harsh high-altitude environments and is used as a beast of burden.

The importance of diversity

Livestock have become important cultural elements, essential in maintaining many traditional lifestyles. Animals such as the yak have made it possible for human communities to inhabit harsh areas where production of crops is virtually impossible. It is not surprising that these animals have become an essential aspect of the cultural, social and religious life of the people who depend upon them.

The total diversity of animal genetic resources available to farmers and the resulting diverse products make it possible for humans to survive in a wide range of environments, from the hot and humid tropics to arid deserts and extremely cold arctic or mountainous regions.

Genetic diversity also enables livestock to adapt to diseases, parasites, wide variations in the availability and quality of food and water, and other limiting factors.

Over the past decades, a few breeds of important farm animal species have been successfully developed to improve one or two production traits under controlled conditions. They produce more meat, milk or eggs as long as they receive ample quantities of high-quality feed and other inputs and are insulated from the harsh weather, pests, diseases and other kinds of environmental stress found in much of the developing world.

Samples of these breeds have been exported around the world, apparently with the assumption that they would quickly adapt and prove cost-effective. But farmers have found that they have to obtain much more feed and dramatically increase other inputs to maintain these breeds.

Imported animals have not reproduced or survived as well as locally adapted breeds. As a result, the life-cycle productivity of these exotic animals, and even of offspring crossbred with local stock, has been disappointing. And because the animals do not live so long, farmers have ended up tending much younger herds and flocks, paying to feed and maintain larger numbers of stock that have not yet reached full production potential.

Global conservation and sustainable use of genetic resources

International awareness of the essential role of animal genetic resources in food and agriculture production and productivity is increasing.

The Commission on Sustainable Development, in developing Agenda 21, emphasized the importance of promoting sustainable agriculture and rural development, and acknowledged the essential need to ensure the conservation and sustainable use of animal genetic resources for agriculture.

Genetic resources for food and agriculture have been discussed at meetings of Parties to the Convention on Biological Diversity.

At their second meeting in 1995, the parties recognized the special nature of agricultural biodiversity and its distinctive features and problems that require specific solutions.

Agricultural biodiversity was the major theme for the third meeting of Parties to the Convention on Biological Diversity in 1996. The parties agreed to develop a programme of work on agricultural biological diversity; strongly endorsed the further development of the Global Strategy for the Management of Farm Animal Genetic Resources; and encouraged parties to develop inventories and consider the status of farm animal genetic resources and measures for their conservation and sustainable utilization.

In providing advice to the Global Environment Facility (the Convention's financial mechanism), the parties indicated that priority be given to supporting efforts for the conservation and sustainable use of biological diversity so important for agriculture.

In November 1996, Heads of State gathered at the World Food Summit in Rome at the invitation of the Food and Agriculture Organization of the United Nations (FAO). They reaffirmed the right of everyone to have access to safe and nutritious food and to be free from hunger.

The World Food Summit resulted in Governments agreeing to a Plan of Action that contains Commitments, Objectives and Actions aimed at addressing food security and rural development. The need to develop and make better use of livestock resources was recognized as a fundamental element of the Plan of Action.

Increasing international awareness of the need to conserve and develop genetic resources for food and agriculture in a sustainable manner, and the roles and values of farm animal genetic resources must now be translated into effective action within countries, and at regional and global levels.

THE NEED FOR A GLOBAL STRATEGY FOR ANIMAL GENETIC RESOURCES

Recognizing the importance of animal genetic resources, the need to use, develop and conserve these essential resources in a sustainable manner, and the poor state of current management, FAO is developing the Global Strategy for the Management of Farm Animal Genetic Resources.

The Global Strategy is necessary to enhance awareness of the many roles and values of animal genetic resources; provide a framework for local, national, regional and global efforts to make better use of, develop and conserve these resources; and mobilize the financial support necessary to develop and implement the Strategy.

The Global Strategy will be a key element in country efforts to use and conserve biodiversity, particularly global agrobiodiversity, in a sustainable manner. Accordingly, it has been designed to complement work under way to implement other international agreements, most notably the Convention on Biological Diversity.

What are Farm Animal Genetic Resources?

Agrobiodiversity OR **agricultural biological diversity:** that component of biodiversity that contributes to food and agriculture production. The term agrobiodiversity encompasses within-species, species and ecosystem diversity.

Ancestors of domesticated species and wild species that have the potential to contribute to food and agriculture are also considered to be components of agrobiodiversity.

Biodiversity OR **biological diversity:** the variety of life in all its forms, levels and combinations, encompassing genetic diversity, species diversity and ecosystem diversity.

Breed: either a subspecific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity.

Farm animal genetic resources: those animal species that are used, or may be used, for the production of food and agriculture, and the populations within each of them. These populations within each species can be classified as wild and feral populations, landraces and primary populations, standardized breeds, selected lines, and any conserved genetic material.

The contribution of domestic animals to agriculture and overall economic development has not been adequately evaluated or appreciated.

Currently almost 2 billion people depend at least partly on domestic animals for their livelihood, and 12 percent of these people depend upon them almost completely.

How much farm animal genetic diversity is there?

Humans have been engaged in the domestication or use of wild plants and animals for at least 12 000 years. However, little use has been made of the earth's total animal genetic diversity. Of 50 000 known avian and mammalian species, fewer than 30 species have been used extensively for agriculture, with fewer than 14 accounting for over 90 percent of global livestock production.

However, the genetic diversity of the domesticated species has been used extremely effectively. Over many centuries, farmers and animal breeders have selected animals for a variety of characteristics, resulting in the development of today's 4 500-5 000 breeds.

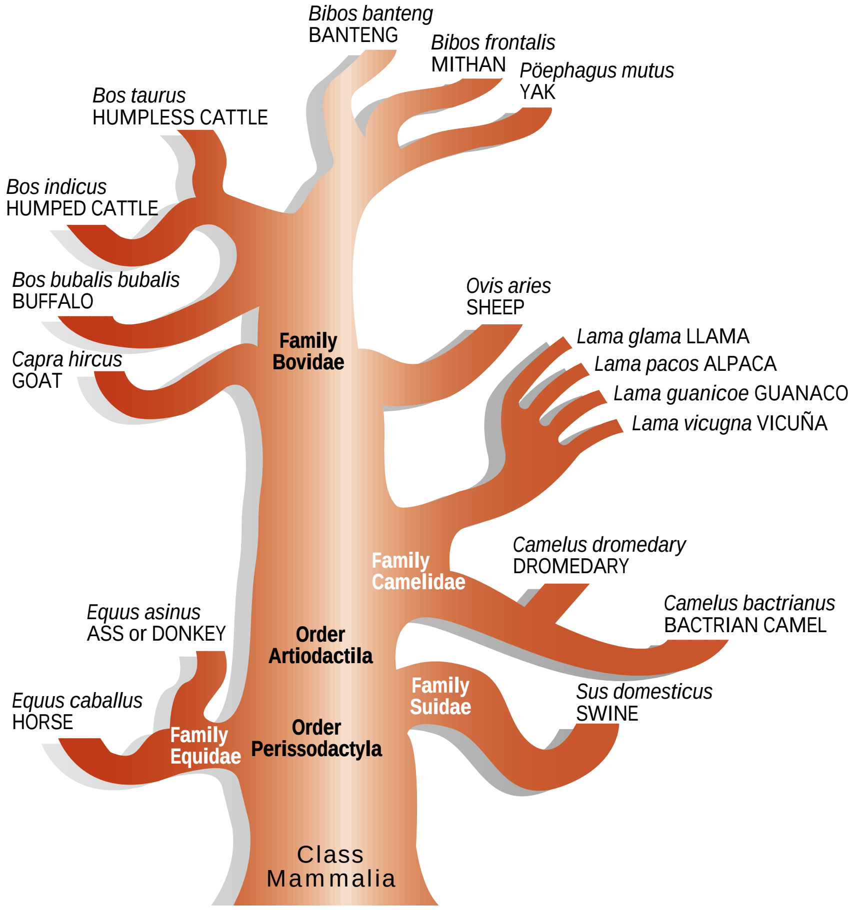
Nine of the 14 most important species (cattle, horse, ass, pig, sheep, buffalo, goat, chicken and duck) may account for as many as 4 000 breeds worldwide.

In the absence of direct measures of genetic diversity, breeds provide the best indication of total farm animal genetic diversity.

FAO has developed a databank that incorporates some basic information on 5 300 breeds representing 35 species. It is estimated from these preliminary data that some 30 percent of the breeds in existence today are at risk of extinction.

Farm animal genetic resources are truly global assets, of value in every region of the world.

[Figure 2] Evolutionary relationship of mammalian species used for food and agriculture.



Where are farm animal genetic resources found?

Human migration and settlement patterns over the millennia together with global sharing of genetic resources have resulted in widespread distribution of most of the important livestock species. However, this was not a sharing of breeds. Rather, locally adapted breeds were developed from each species, according to local environmental conditions and the demands for local products and services.

Market forces and environmental, social and cultural factors have played a significant role in the development of livestock breeds.

Regional conditions and preferences have resulted in the development of locally adapted or indigenous breeds. For example, the Ankole cattle breed is thought to be resistant to East Coast fever, and thus the breed is particularly favoured in areas of Africa where the disease is present.

The yak is an extremely important animal for many people in China and Mongolia. It is valued as a cultural, religious, and social asset, in addition to contributing to agricultural production. The total global population of yaks is estimated at 14 million with about 13 million in China and 0.5 million in Mongolia.

The Min pig in China has been developed and selected because it is a highly prolific breed that can adapt to extreme temperature variation, while providing locally desired products.

The distribution of breeds of livestock is strongly related to production environment characteristics, as is their ongoing development.

Production environments are defined as **all input-output relationships, over time, at a particular location**. The relationships include biological, climatic, economic, social, cultural and political factors, which combine to determine the productive potential of a particular livestock enterprise.

Production environments range from areas where there is very little husbandry or human modification of the environment, to very intensive management systems where feed, climate, disease and other factors are controlled or managed by farmers.

The level of animal husbandry or intervention varies enormously from region to region and from farm to farm. Thus, a common way to classify production environments is to group them according to the level of human intervention as:

high-input production environment: a production environment where all rate-limiting inputs to animal production can be managed to ensure high levels of animal survival, reproduction and output. Output is constrained primarily by managerial decisions;

medium-input production environment: a production environment where management of the available resources has the scope to overcome the negative effects of the environment, although it is common for one or more factors to limit output, survival or reproduction in a serious fashion;

low-input production environment: a production environment where one or more rate-limiting inputs impose continuous or variable severe pressure on livestock, resulting in low survival, reproductive rate or output. Output and production risks are exposed to major influences, which may go beyond human management capacity.

Most agricultural production involving domestic animals in the developing world occurs in stressful, medium-input and high stress, low-input production systems. Locally adapted breeds have been developed for these conditions and are thus still common in many developing countries.

Locally adapted breeds may appear to have modest production capability in comparison with highly specialized breeds that are common in high-input systems. However, they are highly efficient in the use of resources and are sustainable over the long term.

The use, development and conservation of locally adapted breeds in developing countries are essential for continued sustainable exploitation of these higher stress, medium- and low-input production systems.

Locally adapted breeds also tend to retain significant genetic diversity, which provides for adaptability over time to changing environmental conditions and provides options for farmers to select for characteristics in response to changes in the marketplace.

Exotic breeds developed in comparatively high-input, benign production environments are being introduced into developing country high-stress environments, but often fail to produce consistently or even survive.

In the developed world, high-input production systems are common where environmental stress factors are controlled or mitigated. In these production systems, breed selection is based almost entirely on total production or output. The result has been the loss of locally adapted breeds and the development of highly specialized breeds for these new high-input production systems.

While the output from high-input systems is extremely impressive and cost-effective under particular cost, market and policy conditions, there is increasing concern for the resulting reduced genetic diversity.

In short, production environment characteristics have significantly affected the development, distribution and number of breeds around the world. Future use and development of breeds must continue to take environmental characteristics into account.

While the performance of high-input, high-output breeds may be appealing to farmers around the world, the decision to replace locally adapted breeds or to develop them using exotic genetic material must be taken with an understanding of its long-term impact. This requires careful assessment of both the constraints and opportunities imposed by the available production environments.

Continued use and development of locally adapted breeds may be the best choice in many instances, especially in high-stress, medium-input and low-input production systems common over large areas, particularly in developing countries.

Locally adapted breeds will continue to be valuable in developing countries because these countries cannot afford the inputs that are required to sustain breeds that have been developed in low stress, high-input production systems.

What are the roles and values of farm animal genetic resources?

Animal genetic resources have been domesticated throughout the world to meet local or regional needs.

Animals have been selected by farmers for their particular characteristics or cultural value whilst they were also adapting genetically to local conditions, diseases, available feeds, climate, predators and many other persistent variables imposed by the local environment.

The result has been the development of breeds that contribute to local, national and eventually global needs and demands. Some of the most important contributions and values of domestic animals are described in the following sections.

Domestic animals as sources of food

Perhaps the most universal value of domestic animals is their contribution to food production. Domestic animals provide a wide range of food products including meat, milk and eggs and the diversity within each category makes an important contribution to variety in local cuisines.

The role of domestic animals in global food production will increase in future as world demand for animal-produced foods continues to increase at a higher rate than plant-produced foods.

The Arvana-Kazakh dromedary of Kazakhstan is a breed selected for its high milk yield. It is well adapted to a harsh continental desert climate, lack of water and poor feed supply, while producing milk that is extremely nourishing.

Currently, there are fewer than 1 000 surviving animals.

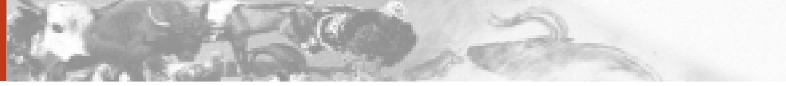
Animal products provide a primary source of protein and essential amino-acids. They also make a significant contribution in terms of total calories, accounting for 30 percent of the calories in human diets in the developed world, and slightly less than 10 percent in the developing world.

Animal products provide an essential source of amino-acids that balance the largely vegetable-based protein diets found in many developing countries. They also provide diverse food products to meet demands for variety in diets.

The Yakut cattle indigenous to the Siberia region of the Russian Federation are highly adapted cattle that can tolerate temperatures as low as -60°C. They survive under poor feed conditions yet yield concentrated milk with a high fat content. They are considered resistant to tuberculosis, leucosis and brucellosis.

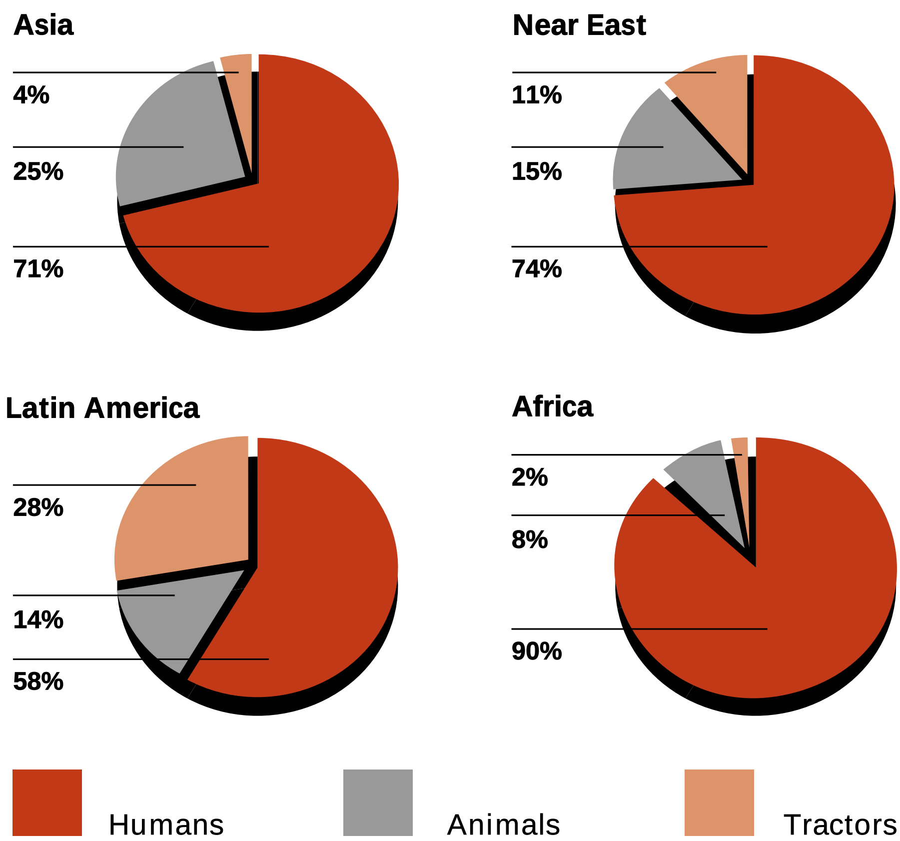
Despite their highly adapted qualities, only 900 individuals are now found in Siberia.

The great variety in quality and types of food products originating from animals also enriches the human daily food intake. Much of this variety results from the development by farmers and breeders of breeds that produce diverse products.



[Figure 3] Animals not only convert otherwise unusable fibrous material into high value products for human consumption but they also provide meaningful employment for society.

Estimated percentage contributions of the three agricultural power sources for the year 2000



Source : FAO, 1987

Domestic animals as sources of energy

Draught power provided by domestic animals is an essential energy resource in many parts of the world. It has been estimated that draught animals are used on 52 percent of land cultivated in the developing world (excluding China). Domestic animals provide draught power to irrigate and harvest crops, transport people and agricultural products and also provide an essential source of power for many non-agricultural activities, such as hauling logs and fuelwood.

Draught animals provide a renewable source of energy to farm operations and avoid the large drain of capital that is required to purchase tractors, spare parts and fuel.

Special genetic qualities or characteristics are needed to provide draught capability and thus many breeds have been developed specifically for draught power.

While draught power is expected to decline slightly by the year 2020, it will remain the most cost-effective power source for small- and medium-scale farms in developing countries.

Domestic animals as sources of fuel and fertilizer

In many countries, livestock waste products are highly valued sources of fuel. Cow, camel, yak and buffalo dung, for example, are widely used fuels for cooking and heating.

This fuel source is renewable and reduces expenditures on fossil fuels and the need to harvest forests for fuelwood. In treeless areas such as the tundra area of Mongolia, dung provides the only available source of fuel.

Biogas production from livestock manure is a proven renewable energy resource. Recently developed plastic biodigesters have made it possible for many more farmers in the developing world to use biogas as a fuel source for lighting, heating, driving machinery and even as an insecticide to control insects in grain storage areas.

Domestic animal waste products also serve as a valuable source of fertilizer and soil conditioner. Nutrient recycling is an essential component of a sustainable agriculture system. Returning manure to croplands serves to integrate livestock and crop production, and reduces waste management problems.

Domestic animals as social and cultural assets

Many communities have traditions and lifestyles that are fundamentally linked to domestic animals. While it is not always possible to assign monetary values to such linkages, the non-monetary values to local community identity are essential.

Social and cultural values are often underappreciated outside indigenous and local communities. However, to many communities, livestock and particular genetic types of livestock are fundamental aspects of social and cultural identity, linked to marriage, religious practices and other community events.

Domestic animals as sources of income

Products from domestic animals provide valuable income in both the developed and developing world. Globally, meat and milk products represent 3.5 times the value of wheat and rice. Animal products such as meat, milk, hides, wool and manure, and fees charged for draught power, make essential contributions at the farm, community and national levels.

Domestic animals are also valuable in providing raw materials for manufacturing and in the development of medicines. Various parts of sheep, for example, are used to make bone china, wax and surgery supplies. Both sheep and cattle are used as a source of insulin for the treatment of human diabetes.

Women play key roles in the management of livestock throughout the world. As farmers they are responsible for selecting and developing breeds, for husbandry activities and for selling produce. As managers of the household, they select and prepare food for family consumption.

[Figure 4] Women shearing sheep in Peru.

At present, developing countries are major importers of animal feeds, meat and dairy products. Price support systems for international marketing of animal products can discourage developing countries from establishing their own food production systems.

Increasing animal production in the developing world will increase food security and reduce foreign exchange costs.

Animal products, such as hides, offer significant opportunities for economic development in both the developed and developing world.

Domestic animals and risk management

Food security strategies require that attention be paid both to absolute levels of production and to reducing severe yearly fluctuations in levels of production and income.

Domestic animals provide economic security by acting as a direct food resource in the case of crop failure. They reduce the vulnerability of farmers to significant variations in production and incomes, and are therefore essential components of farm risk management strategies, especially for small farm operations.

Small ruminants and monogastrics are particularly valuable as food and economic safeguards, since farmers are able to keep them in larger numbers than animals such as cattle, buffalo and camels.

Livestock also serve as liquid assets and are sold or traded to purchase or acquire seeds and other goods and services.

What is the status of farm animal genetic resources?

Agrobiodiversity is being lost at an accelerating and unacceptable rate as a result of human population and development pressures and the rapid transformation of traditional agricultural systems. However, traditional systems still account for 75 percent of production in the developing world.

Loss of animal genetic resources has been greatest in developed countries, where there has been a tendency to concentrate on a few high-output breeds. This has had the unfortunate consequence of completely displacing locally adapted breeds.

Genetically uniform breeds are highly productive in high-input, high-output production strategies in countries with favourable climates, and when high levels of inputs can be maintained. Animal husbandry and management practices must be intensive to achieve high levels of consistency over time in the production environment.

Animal genetic resources are also being eroded in developing countries where traditional agricultural systems are being rapidly transformed. This transformation often includes the indiscriminate use of exotic animal genetic resources, which is now the primary force contributing to the loss of livestock breeds in developing countries.

The latest information available from the World Watch List for Domestic Animal Diversity published by FAO, indicates that 30 percent of the world's domestic animal breeds are at risk of extinction.

In India, 50 percent of the indigenous goats face the threat of extinction, and an estimated 80 percent of all poultry produced are now from exotic breeds.

China is home to the vast majority of the world's pig breeds; however, these are now very rapidly being replaced by exotic breeds, which have very different feed requirements, reproduction rates and meat qualities.

FAO has established a classification system to report on the status of livestock breeds. Seven categories are used: extinct, critical, endangered, critical-maintained, endangered-maintained, not at risk, and unknown.

These categories are based on overall population size, number of breeding females and males, and trends in population size, i.e. whether the population is increasing, decreasing or stable.

[Figure 5] A Betizu bull. Native to the Basque country, Spain, the Betizu feral cattle breed is one of the most endangered and ancient in Europe.

The guidelines or criteria used to categorize the status of breeds are:

Extinct breed: a breed where it is no longer possible to recreate the breed population. Extinction is absolute when there are no breeding males (semen), breeding females (oocytes), nor embryos remaining.

Critical breed: a breed where the total number of breeding females is less than 100 or the total number of breeding males is less than or equal to five; or the overall population size is close to, but slightly above 100 and decreasing, and the percentage of pure-bred females is below 80 percent.

Endangered breed: a breed where the total number of breeding females is between 100 and 1 000 or the total number of breeding males is less than or equal to 20 and greater than five; or the overall population size is close to, but slightly above 100 and increasing and the percentage of pure-bred females is above 80 percent; or the overall population size is close to, but slightly above 1 000 and decreasing and the percentage of pure-bred females is below 80 percent.

Critical-maintained breed and endangered-maintained breed: categories where critical or endangered breeds are being maintained by an active public conservation programme or within a commercial or research facility.

Breed not at risk: a breed where the total number of breeding females and males is greater than 1 000 and 20 respectively; or the population size approaches 1 000 and the percentage of pure-bred females is close to 100 percent, and the overall population size is increasing.

What are sustainable use and sustainable intensification of animal genetic resources?

Sustainable use is defined in the Convention on Biological Diversity as the use of the components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

Sustainable intensification for food security

As the number of people on the planet grows from about 6 billion to almost 10 billion by the middle of the next century, pressure on water and land and other resources will also increase. Feeding 4 billion more people without stretching these resources beyond the breaking-point will require gains both in agricultural production (the volume of food and other commodities) and productivity (the amount produced in relation to the resources required).

During most of this century, agriculturists - including farmers, researchers, trainers and consultants - have not concerned themselves greatly with the availability and degradation of resources. Instead, they have concentrated almost exclusively on one side of the equation - output. And even there they have tended to focus only on the main products consumed directly by human beings, such as milk, meat or fibre.

Frequently they have neglected the other important contributions that animals make to farming communities - such as draught power for cultivation and transport, or manure for fuel and fertilizer - as well as their economic value in creating employment and representing "on the hoof" savings.

No system, whether biological, social or economic, can be intensified sustainably without taking the full range of costs and benefits for both inputs and outputs into consideration.

The sustainable intensification of animal production systems is the manipulation of inputs to, and outputs from, livestock production systems aimed at increasing production and/or productivity and/or changing product quality, while maintaining the long-term integrity of the systems and their surrounding environment, so as to meet the needs of both present and future generations.

The development, implementation and maintenance of sustainable use and intensification policies and programmes for animal genetic resources must:

- consider the short- and long-term implications in designing and implementing livestock policies and programmes;
- respect the needs and aspirations of local and indigenous people, especially farmers and rural communities;
- conserve natural resources, including irreplaceable genetic resources, which sustain agro-ecosystems and other ecosystems; and
- be guided by an understanding of the roles and values of both locally adapted and exotic animal genetic resources.

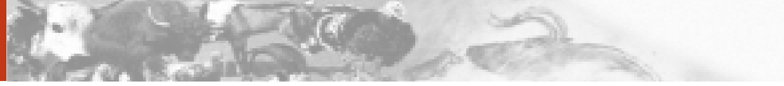
The sustainable use and sustainable intensification of animal genetic resources are not a question of competition between modern and traditional agricultural practices. Nor do they favour indigenous over exotic animal genetic resources. Rather, they require a systematic approach to understanding, using and developing animal genetic resources to contribute to food security, while also maintaining future use and development options. The very nature of biological mechanisms enables this to be done through good management.

Sustainable intensification of livestock systems must be based on achievable sustainable production levels and utilizing available inputs in the best manner, without long-term depletion, thereby also increasing productivity.

Great potential exists to achieve rapid genetic improvement in locally adapted breeds in many areas of medium- to low-input farming. Frequently other measures have been introduced to improve animal production - such as providing more feed and water, improving prevention and treatment of disease and parasites and managing reproduction better - before attempting genetic improvements.

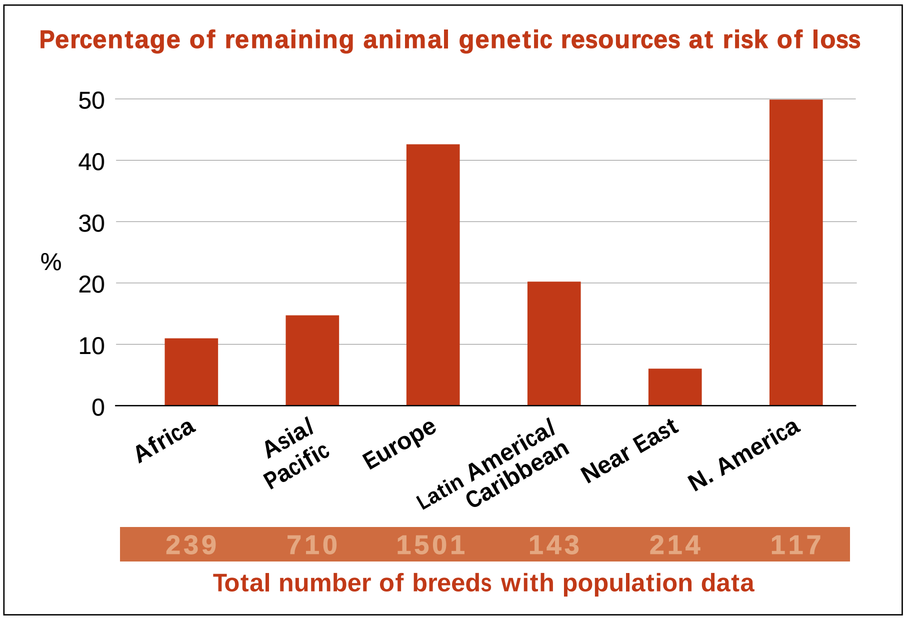
The most rational and sustainable way to conserve animal genetic resources is to ensure that locally adapted breeds remain a functional part of production systems. This requires identification of their economically important and unique attributes.

But considerable variation in ability to use environmental inputs, survive, reproduce and produce exists within locally adapted breeds, irrespective of whether inputs are scarce or plentiful. So increased productivity can be achieved and maintained more effectively by improving inputs, environmental conditions and genetic resources in conjunction with each other, rather than independently.



What is being done to conserve breeds at risk?

The conservation of farm animal genetic resources refers to all human activities including strategies, plans, policies, and actions undertaken to ensure that the diversity of farm animal genetic resources is maintained to contribute to food and agricultural production and productivity, now and in the future.



[Figure 6] Conservation programmes are lacking for over two-thirds of breeds at risk of loss (less than 1 000 breeding females or less than 20 breeding males), without which small populations are destined to become extinct. Extinction results in permanent loss of unique combinations of genes and characteristics. For the vast majority of breeds for which population data are available, lack of sound, *in situ* conservation programmes means that these animal genetic resources remain largely underdeveloped and underutilized.

Mechanisms for conserving animal genetic resources

There are two basic conservation activities, which may be defined as *in situ* conservation and *ex situ* conservation.

***In situ* conservation of farm animal genetic diversity:** all measures to maintain live animal breeding populations, including those involved in active breeding programmes in the agro-ecosystem where they either developed or are now normally found, together with husbandry activities that are undertaken to ensure the continued contribution of these resources to sustainable food and agricultural production, now and in the future.

***Ex situ* conservation of farm animal genetic diversity:** all conservation of genetic material *in vivo*, but out of the environment in which it developed, and *in vitro* including, *inter alia*, the cryo conservation of semen, oocytes, embryos, cells or tissues. Note that *ex situ* conservation and *ex situ* preservation are considered here to be synonymous.

Growing recognition of the roles and values of animal genetic resources over the past 20 years or so has led to the initiation of conservation efforts. Many countries have attempted, or are attempting, to conserve some of their most important breeds using both *in situ* and *ex situ* conservation measures.

Non-governmental organizations, communities and individual farmers are also playing a key role in conservation efforts. Organizations such as Rare Breeds International, which was formed in 1991, are promoting the need for conservation and undertaking breed rescue and maintenance projects. They are also promoting awareness of the roles and values of locally adapted breeds.

Ex situ conservation efforts for animal genetic resources lag far behind conservation efforts for plant genetic resources. Long-term storage of animal germplasm using cryoconservation is possible for many, but not all, of the important animal livestock species.

Storage of germplasm provides an insurance policy to prevent the loss of some breeds, especially those that are already at a high risk of extinction.

Unfortunately, *ex situ* storage is not being adequately used. Results of an FAO global survey show that almost no high-risk animal genetic resources are stored in genomebanks (genebanks) at present.

Storage of genetic material is common for commercial breeds, but collection and storage are not directed at ensuring the conservation of the full range of animal genetic resources.

However, some countries have established storage facilities for genetic material and are storing material for important breeds and breeds that are at risk of extinction.

A survey undertaken by FAO indicates that many breeds at greatest risk are in developing countries that have limited resources for designing and implementing conservation programmes.

This is a serious situation, since developing countries are often the very regions most likely to have unique genetic types, partly because of the greater range of production environments and partly because of the need for animals to adapt to combinations of intense stresses such as disease and drought if they are to survive and reproduce.

Despite the valuable efforts of individuals, governments and non-governmental organizations, animal genetic resources continue to become extinct.

Local, national and global activities and actions are required to conserve animal genetic resources. Conservation efforts must be well planned to be cost-effective, and collaboration among agencies and government and non-governmental organizations is required.

Conservation of animal genetic resources is not an end in itself. Rather, it is a means to an end. The role of conservation is to ensure that unique genetic resources are available to farmers and breeders. Thus, conservation is part of an overall strategy to use animal genetic resources in a sustainable manner to meet current and future human needs.

It is not likely to be feasible or even necessary to conserve all populations not currently of high interest to farmers. The Global Strategy incorporates the opportunity for a coordinated research activity known as project MoDAD (Measurement of Domestic Animal Diversity), which would provide a basis to identify those breeds that differ most in average genotype. This would provide a foundation from which to establish cost-effective conservation projects.

Future development of animal genetic resources must be based on long-term sustainability strategies commonly referred to as sustainable intensification.

A wise development strategy will ensure that the full range of a country's animal genetic resources are maintained using both *in situ* and *ex situ* conservation. Conservation should not be viewed as an attempt to restrict or reduce development. Rather, integration of use, development and conservation of animal genetic resources is required, so that countries manage their animal genetic resources in a manner that maintains future options, not reduces them.

Summary of information stored on mammalian species in the FAO Global Databank for farm animal genetic resources

1. General information
   - Species (alpaca, ass, bactrian camel, buffalo, cattle, dromedary, goat, guanaco, horse, llama, pig, sheep, vicuña, yak)
   - Breed or breed variety
   - Geographical location
   - Name (in English or if not available most common name), local names and synonyms (as described by Mason, 1988)
   - Information source

2. Breed origin and development
   - Origin
   - Wild or primitive breed
   - Recent immigrations to the breed (either from other breeds within or outside the country)
   - Population size (actual or approximate) and structure
   - Trend in number of females (increasing, stable or decreasing)
   - Risk status (extinct, critical, endangered, critical or endangered maintained, not at risk, unknown)
   - Artificial insemination usage, and storage of semen and embryos

3. Breed description
   - Coat colour
   - Number and description of horns (for bovids and caprines)
   - Hair and/or wool type
   - Adult size and weight
   - Genetic characteristics, e.g. mendelian, documented chromosomal aberrations

4. Breed uses and special qualities
   - Main uses
   - Special qualities (claimed/demostrated), e.g. disease resistance, adaptability to environmental stressors

5. Management conditions
   - Type of management, housing period, feeding

6. Performance trait information
   - Estimates of genetic distances from other breeds
   - Analysis of genetic material (DNA or allozyme data)
   - Description of conservation programmes in operation

Summary of information stored on avian species in the FAO Global Databank for farm animal genetic resources

1. General information

   Species (cassowary, chicken, domestic duck, domestic goose, emu, guineafowl, muscovy duck, ñandu, ostrich, partridge, pheasant, pigeon, quail, others)

   Breed, variety, line or strain

   Country (and region in country)

   Name (in English or if not available most common name), local names and synonyms. Classification of stock: indigenous, middle level, fancy, feral, industrial or laboratory stock

2. Population data

   Population size and structure (actual or estimated range)

   Trend in number of females (increasing, stable or decreasing)

   Risk status (extinct, critical, endangered, critical or endangered maintained, not at risk, unknown)

   Origin of population

   Source of population data

3. Description of the breed (and proportion of breed expressing each characteristic)

   Plumage pattern

   Pattern within feather

   Skin colour

   Shank and foot colour

   Comb type

   Egg shell colour

   Any other specific visible traits

4. Uses, management conditions and performance

   Main uses

   Management conditions under which flock is usually kept

   Age of maturity for each sex

   Live body weight (at maturity) for each sex

   Average number of eggs laid per year

   Special qualities, e.g. disease resistance, adaptability to environmental stressors

5. Person or organization providing information

What impact will the loss of farm animal genetic resources have?

The loss of animal genetic resources has both short- and long-term implications. The loss of breeds means that farmers and breeders will be less able to respond to change. They will have reduced capability to breed animals for desired characteristics such as resistance to disease, or have fewer options to respond to changes in consumer preferences. They will also have available fewer breeds containing subsets of genes already in a suitable combination for use in responding at low cost and in a short time to a particular new challenge.

In the developing world, indiscriminate use of exotic animal genetic resources and poorly designed breeding schemes are the major reasons for the loss of animal genetic resources.

Animal breeds that have evolved as breeding populations in diverse systems and environments now represent unique combinations of genes. These genes define not only the productive qualities of each breed but its ability to adapt to local conditions, including food, water availability, climate, and pests and diseases.

Because they have evolved to survive and thrive in the prevailing environment, local breeds tend to be highly productive, when productivity is measured correctly.

It is also common to find large variations in productivity among individual animals within local breeds. By breeding the best of these animals that have already adapted to local conditions, farmers can achieve sustainable genetic improvements, reaping the benefits for generations to come without further investment.

The loss of locally adapted breeds will have long-term negative implications, and, in most instances, will reduce food security rather than ensure it.

The loss of animal genetic resources can occur in a very short time. The situation of the world's cattle population is an example of how rapidly changes can occur. There are currently 500 different cattle breeds. However, if the rapid changes in this sector continue, the world's cattle population will consist of fewer than 20 main breeds in the near future. This transformation will occur within one human generation, and will significantly reduce genetic diversity and result in the loss of unique adaptation and production characteristics.

The loss of indigenous breeds adversely affects community identity and structure and reduces the ability of local communities to maintain their traditional lifestyles.

Moreover, dependence on exotic breeds reduces the interdependence of communities and countries as they become more and more dependent on obtaining resources from outside interests.

Rapid transformation of traditional agricultural systems can also significantly affect regional biodiversity by increasing pollution and encouraging the conversion of natural landscapes to produce livestock feeds. Additional predator control programmes may also be required to protect exotic animals.

Perhaps the greatest impact of the loss of animal genetic resources is the reduction in overall global food security. Maintaining a set of breeds for each species that is capable of producing a range of products of varying quality and doing this sustainably for each of the broad range of existing production environments, means being well placed to respond to short-term human needs, through continued development of these resources. It also ensures that genetic flexibility is retained to respond to future changing needs.

High-input, high-output breeds will continue to be essential assets where farmers have the resources to maintain and improve them. However, maintaining locally adapted breeds that produce in a sustainable manner under stressful, medium-input and high stress, low-input production systems, which are extremely common in the developing world, will enhance global food security.

Locally adapted breeds can also be further developed to increase their total contribution to food production.

While it is difficult to predict the future, it is certain that environmental stress factors such as insufficient feed and water, disease, pests and climate change will continue to affect food and agriculture production and productivity significantly.

It is also certain that consumers will continue to demand a variety of agricultural products and that, by the year 2050, food production from animals will need to double in order to meet demand.

The small number of commercial breeds that are suited to high-input production systems do not offer an adequate genetic reservoir to provide farmers with the resources to meet present or future needs and demand in quantity and qualities of agricultural products.

In addition, consumers are increasingly seeking more natural products and more variety in products that can be developed from diverse animal genetic resources.

In the past, the ability to respond to environmental and market changes was possible because farmers had access to an enormous animal gene pool in both natural ecosystems and agro-ecosystems. These reservoirs or genetic insurance policies must be maintained if farmers are going to retain their capacity to respond to future needs and demand effectively.

What can be done to ensure that animal genetic resources are used wisely and conserved for future use?

Responding to the loss of farm animal genetic resources

In 1992, most nations of the world signalled their awareness of the loss of biodiversity and the need for action by signing the Convention on Biological Diversity. The Convention rapidly came into force in 1993, an indication of the high priority that countries place on conserving biodiversity, using biological resources sustainably, and adopting measures to share the benefits arising from the use of genetic resources equitably.

Recognition of the significant contribution that animal genetic resources make towards global food security and community identity, and the accelerating decline of these resources, led FAO to initiate development of a global strategy for the management of farm animal genetic resources in 1993.

The Global Strategy began as a technical programme within the Animal Production and Health Division of FAO, but is now evolving under the direction of an intergovernmental mechanism.

Countries will help shape and further develop the Global Strategy to provide a comprehensive framework for the sustainable use, development and conservation of their animal genetic resources for food and agriculture.

The intergovernmental process for animal genetic resources was made possible as a result of FAO's Commission on Plant Genetic Resources emphasizing the need to broaden the mandate of the Commission to cover all genetic resources relevant to food and agriculture in 1994.

In 1995, after deliberations by FAO's governing body, it was agreed that:

- the mandate of the Commission on Plant Genetic Resources would be broadened to cover all components of biodiversity relevant to food and agriculture;
- the Commission would be known as the Commission on Genetic Resources for Food and Agriculture; and
- implementation of the broadened mandate of the Commission would be carried out on a step-by-step basis, beginning with animal genetic resources, in a manner that does not adversely affect the negotiation of the International Undertaking on Plant Genetic Resources.

[Figure 7] Local camel and horse breeds in the Niger, used for transport and festivities.

Why develop a Global Strategy for animal genetic resources?

The rationale and role of the Global Strategy

The Global Strategy provides a framework for establishing national, regional and global policies, strategies and actions, and can serve to facilitate and coordinate the activities of many independent organizations that have an interest in animal genetic resources within sustainable agricultural and rural development.

The most important role of the Global Strategy is to assist countries in developing their capacity to manage their animal genetic resources for food and agriculture. To do this, they need to plan, design and implement sound livestock production systems properly, so that these are sustainable and cost-effective over time.

The Global Strategy is also necessary to promote the establishment of cost-effective approaches to conserving animal genetic resources, which are not at present of interest to farmers. The large number of currently threatened animal genetic resources requires a global strategy to ensure an adequate and effective response. The magnitude of this crisis cannot be solved by one or a few nations acting independently.

Further development and implementation of the Global Strategy will:

- provide a focal point and framework to discuss, debate and design international policies and programmes for animal genetic resources aimed at achieving the sustainable use of these resources as part of efforts to achieve global food security, and to fulfil international commitments to conserve biological diversity;

- help mobilize international financial support which is vital to ensure the wise use and conservation of these breeds, 70 percent of which are in developing countries;

- increase global awareness of the roles and values of animal genetic resources;

- facilitate the design of cost-effective conservation programmes to prevent the further loss of animal genetic resources;

- establish a mechanism to monitor and report regularly on the status of animal genetic resources for food and agriculture;

- establish priorities for capacity building to ensure within-country capacity to manage animal genetic resources and make use of appropriate technologies; and

- promote collaboration and cooperation among countries, regions and international organizations and non-governmental organizations that have interests in animal genetic resources.

What is the status of the Global Strategy?

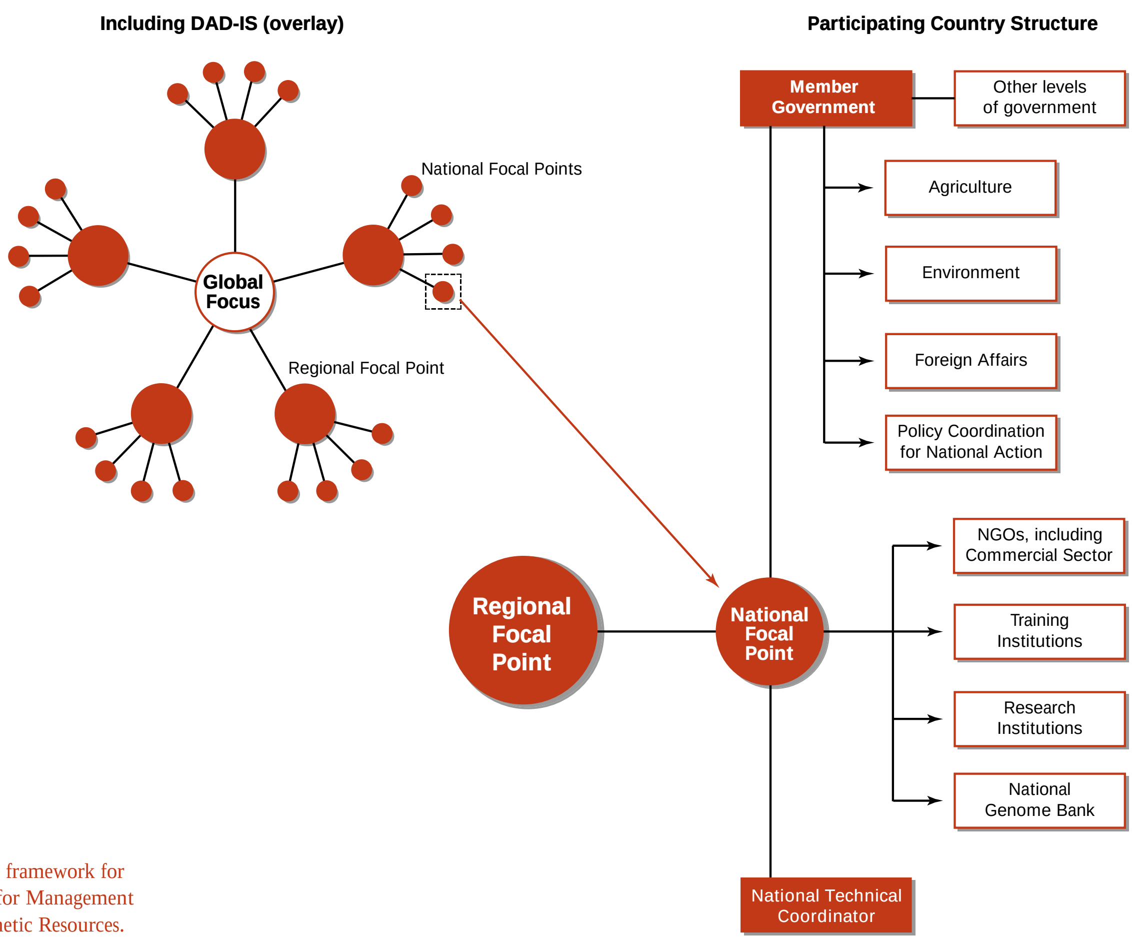
Development of the Global Strategy

Since 1993, development and implementation of the Global Strategy have primarily taken place at two levels: at the global level, and through a Regional Pilot Project in Asia.

A global focal point was established at FAO headquarters in Rome, to develop the framework for the Global Strategy, and to initiate development of its essential constituents, such as the country-based global infrastructure, the information and communication system, the early warning system, and comprehensive technical guidelines to assist countries to characterize animal genetic resources.

The developing Global Early Warning System for Domestic Animal Diversity currently describes 5 300 breeds, comprising 35 species. This information was used to produce the *World Watch List for Domestic Animal Diversity*, as a public record of domestic animal diversity. Two editions of this publication have now been produced, the latest in 1995.

Guidelines to assist countries to manage their animal genetic resources have been developed under the guidance of the global focal point and are being distributed for widespread use.



[Figure 8] Structural framework for the Global Strategy for Management of Farm Animal Genetic Resources.

In 1993, a five-year project, “Conservation and Use of Animal Genetic Resources in Asia and the Pacific”, involving 12 countries, was established with generous financial support from the Government of Japan.

This project has demonstrated the essential role of a regional focal point to coordinate regional activities, and provide technical support to countries.

The project has increased the awareness of the roles and values of animal genetic resources in the Asian region, and has supported the initiation of 11 country action plans for the improved management of animal genetic resources.

Progress is being made in establishing other regional focal points and national focal points throughout the world.

In 1995 FAO’s Council supported the Global Strategy, and further development and implementation of the Strategy will be coordinated by the Commission on Genetic Resources for Food and Agriculture, assisted by its Intergovernmental Technical Working Group for Animal Genetic Resources. The 27 member Country Working Group met for the first time in 1998 and made the following recommendations:

“Acknowledging the work already done by countries, stakeholders and non-governmental organizations in animal genetic resource management, and recognizing the work already done by FAO in developing the animal genetic resources global strategy, the Intergovernmental Technical Working Group makes the following recommendations to the Commission, in order further to develop and increase activities in the field of animal genetic resources:

(i) that FAO continue to shape more clearly the framework, and further develop the constituent elements, of this global strategy for the management of farm animal genetic resources, and continue to provide core programme budgetary support, and that all stakeholders seek to mobilize extra-budgetary support, from all sources, for the conservation and sustainable utilization of animal genetic resources;

(ii) that countries that have not already done so urgently identify National Focal Points/Coordinators and, where appropriate, Regional Focal Points; and

(iii) that FAO coordinate the development of a country-driven *Report on the State of the World’s Animal Genetic Resources*, that would provide an assessment of countries’ animal genetic resource programmes and the state of domestic animal resources.”

What are the constituents of the Global Strategy?

The Global Strategy has been designed to provide a comprehensive framework for the management of farm animal genetic resources. It consists of several inter-related components and elements.

The major components are: the **intergovernmental mechanism** to ensure direct government involvement and continuity of policy advice and support; the **planning and implementation structure**, providing the enabling framework for country action and regional and global support; the **technical programme of work**, aimed at supporting the effective management of animal genetic resources at the country level; and the **reporting and evaluation** component to provide the critical data and information required for guidance, cost-effective planning and action, and to report on the state of diversity, the state of country capacity and the state of the art, to ensure that development and implementation of the Global Strategy are successful.

[Table 1] Constituents of the Global Strategy for the Management of Farm Animal Genetic Resources.

Components:	Intergovernmental Mechanism	Country-based Planning & Implementation Infrastructure	Technical Programme of Work	Reporting & Evaluation
Elements:	The Commission on Genetic Resources for Food & Agriculture	Global Focal Points	**National Management Plans for AnGR**	First Report State of the World's AnGR
			Sustainable Intensification	Country Reports
	Intergovernmental Technical Working Group on Animal Genetic Resources	Regional Focal Points	Characterization	
			Conservation	Country & Global Monitoring
	National Governments	National Focal Points	Communication	
			Emergency Plans & Response	
		Donor & Stakehol-ders Involvement Mechanism		
		DAD-IS		World Watch List - Early Warning System

Capacity Building:	Training & Education	**Guidelines**	Data & Information Management
	Technology Transfer	Research	Communication & Coordination

Technical Assistance:	FAO Experts	Informal Panel of Experts	Cadres of Experts
	Expert Meetings	Advanced Data & Information Software	
	Research		

The **intergovernmental mechanism** is essential to ensure governmental and stakeholder involvement in the further development, implementation and monitoring of the Global Strategy.

The Commission on Genetic Resources for Food and Agriculture is the intergovernmental mechanism for the Global Strategy. The FAO Council gave the Commission the coordinating role for policy, sectoral and cross-sectoral matters relating to the conservation and sustainable use of food and agriculture.

The Statutes of the Commission provide for the establishment of sectoral working groups and, in 1997, the Commission accordingly decided to establish the **Intergovernmental Technical Working Group on Animal Genetic Resources for Food and Agriculture.**

The Working Group reviews the Global Strategy and issues related to animal genetic resources, in order to make recommendations to the Commission on the further development and implementation of the Global Strategy.

The **country-based planning and implementation infrastructure** is a key component of the Global Strategy. It includes five structural elements: the global focal point, regional and national focal points, the donor and stakeholder involvement mechanism, and the Domestic Animal Diversity Information System (DAD-IS).

The country-based planning and implementation infrastructure is necessary to communicate and coordinate activities, set priorities, develop and implement strategies, plans and projects, and for reporting purposes.

The **global focal point** at FAO headquarters leads the planning, development and implementation of the overall Global Strategy; develops and maintains the information and communication system; oversees preparation of guidelines; coordinates activity among the regions; prepares reports and meeting documents; facilitates policy discussions; identifies training, education, and technology transfer needs; develops programme and project proposals; and mobilizes donor resources.

Regional focal points facilitate regional communications; provide technical assistance and leadership; coordinate training, research and planning activities among countries; initiate development of regional policies; assist in identifying project priorities and proposals; and interact with government agencies, donors, research institutions and non-governmental organizations.

National focal points lead, facilitate and coordinate country activities; identify capacity-building needs; develop project proposals; assist with the development and implementation of country policy; and interface with the range of country stakeholders, including the country focus for biological diversity, and with the regional focal point and the global focal point.

The **donor and stakeholder involvement mechanism** mobilizes the range of stakeholders and is intended to develop and maintain broad-based support for the Global Strategy. It provides a means to ensure that donors and stakeholders have opportunities to influence the design and implementation of the Global Strategy at the global level.

At the national level, each country is responsible for determining their own stakeholder involvement mechanisms.

Exotic breeds often lack resistance to local diseases and climatic conditions, produce poorly and lack persistency without considerable high-quality feed and management.

The **domestic animal diversity information system (DAD-IS)**, functions as the clearing house mechanism for the Global Strategy and is a widely available and easily accessible global data and information system. DAD-IS is being developed by FAO to provide countries with an advanced information and communication tool for their use. It will provide an essential capacity to link farmers, scientists and others to ensure their effective participation in the development and implementation of country animal genetic resources strategies, plans and activities.

DAD-IS allows the rapid and cost-effective distribution of guidelines, reports and meeting documents; and provides a mechanism to exchange views and address specific information requests, by linking farmers, scientists and policy-makers.

A key feature of DAD-IS is that it provides country-secure storage and communication of animal genetic resources data and information.

The DAD-IS breeds database, which is the basis of the Early Warning System for Animal Genetic Resources, makes it possible to produce the world watch list for domestic animal diversity, and enables countries to use their data and information in an effective and efficient manner.

The **technical programme of work** consists of several elements. **Guidelines** have been developed at the global focal point to assist countries undertake several elements of the technical programme of work. Key elements of the technical programme of work include:

The preparation of national management plans for farm animal genetic resources is one key element. Management of a country's animal genetic resources is technically complex, requiring the participation of farmers and breeders, policy-makers, scientists, technicians, local and indigenous communities, and other stakeholders.

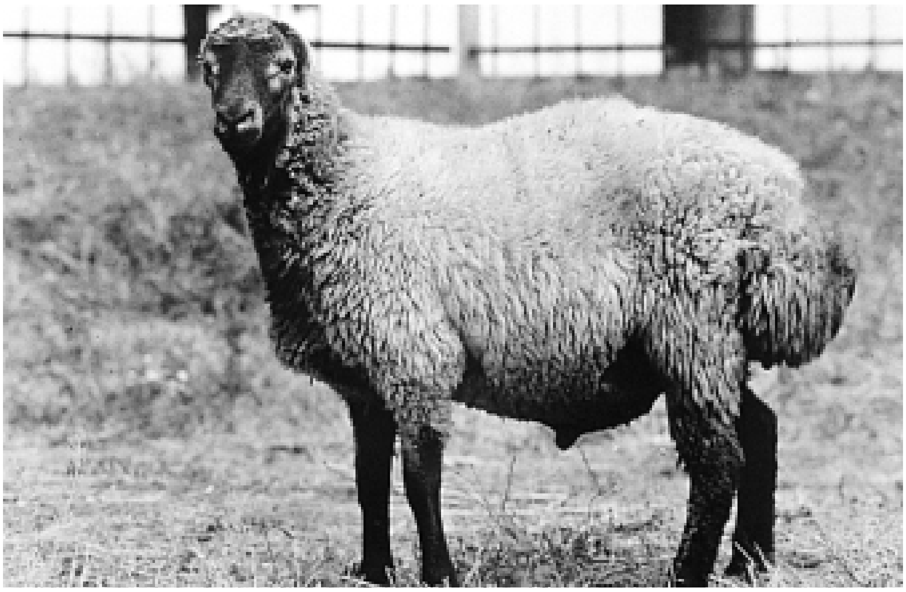
The preparation of national plans will help countries to establish further directions for sustainable livestock development for their food and agriculture production systems; assess their needs and priorities; increase awareness of the roles and values of farm animal genetic resources, including locally adapted genetic resources; target better and increase the cost-effectiveness of management activities; and, for developing countries, provide a basis for donor assistance.

To assist countries in preparing their national strategies and action plans, the global focal point has prepared the *Primary Guidelines for Development of National Farm Animal Genetic Resources Management Plans.*

Characterization, or understanding the extent, distribution, basic characteristics, comparative genetic qualities and performance, value and current state of a nation's animal genetic resources, is an essential element of the technical programme of work.

Necessary activities include identification and inventory of the different breeds; a detailed description of each breed, and of the production environments to which it is adapting and in which it is being developed; comparative breed descriptions for the main performance and adaptive traits; evaluation of the global importance of breeds; and monitoring changes in breed populations.

In addition to these activities, comparative molecular descriptions, incorporating portfolios of standard molecular markers for each livestock species, are required to assess breed genetic diversity reliably to assist in better targeting conservation efforts, and to contribute to establishing a sound basis for breeding strategies.



[Figure 9] Domestic animal genetic resources represent a wide range of adaptations which enable productivity and the assurance of food under harsh environments. Fat-tailed sheep are able to produce under very dry, arid conditions. Privation is avoided by calling on this fat reserve.

The global focal point has initiated the preparation of a detailed proposal for measuring domestic animal diversity which is called *project MoDAD, the measurement of domestic animal diversity*. Global coordination for project MoDAD would be provided by the global focal point, with staff in the regional and national focal points participating in field activities, research coordination and training.

Blood or other tissue samples would be collected from breeds of the most important livestock species. DNA would be extracted from the samples and analysed using microsatellite marker techniques. This would provide a basis for establishing within- and between-breed genetic diversity.

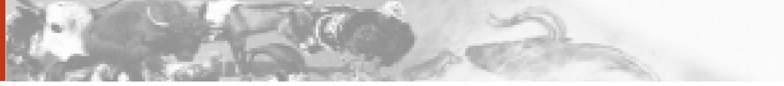
Active, sustainable use and development of livestock breeds is the single most important element of the technical programme of work and perhaps the most important aspect of the Global Strategy.

Recent research and development have tended to concentrate on relatively few domestic breeds of animals. However, the potential to achieve sustainable increases in productivity is not limited to highly industrialized farming systems.

Indeed, working with breeds that have already been adapted to environmental conditions can enable breeders and scientists to focus only on those genes directly involved with productivity and product quality. With sound planning, this approach can ensure that genetic improvement will be sustainable and will complement conservation of domestic animal diversity.

This wise use of the animal genetic resources approach is the most cost-effective means of conserving these irreplaceable resources.

Sustainable use and intensification of farm animal genetic resources require significant capacity-building, especially for developing countries. Increased capacity is required to



establish animal performance recording and evaluation systems, develop breeding objectives and breeding strategies, and to make best use of both traditional and modern technologies and methodologies.

One of the key priorities for implementation of the Global Strategy is to enhance methods and institutional mechanisms for animal performance recording to support breed development.

Recording systems are well established within high-input production systems of the developed world. However, animal performance recording systems and breeding strategies for the medium-input to low-input production systems that are common in developing countries, are generally absent or poorly developed.

The global focal point has prepared draft Guidelines for *Animal Recording for Medium-Input Production Environments*, to assist in the development of animal performance recording systems.

[Figure 10] The Saddleback pig (United Kingdom) has good grazing, mothering and fat characteristics. These necessary qualities have been nearly lost when moving to more extensive systems as has been required lately in some countries in Europe.

Conservation of farm animal genetic resources is an essential element of the technical programme of work because so many breeds are in danger of becoming extinct.

Guidelines for the Management of Small Populations at Risk have been developed to assist countries to identify options and technical requirements for the management of populations at risk of extinction.

Conservation programmes are lacking for over three-quarters of breeds at risk of extinction.

The imperatives for the sustainable use and conservation of domestic animal genetic diversity are to:

- identify and understand those unique animal genetic resources, which collectively comprise the global gene pools for each of the important domestic animal species used for food and agriculture;

- develop and properly utilize animal genetic resources to increase production and productivity through sustainable intensification to meet demands for specific product types;

- monitor particularly those animal genetic resources that are currently represented by small populations of animals; or that are otherwise being displaced by other breeds;
- conserve unique resources that are not currently of interest to farmers using cost-effective measures;
- train and involve more people in the management of animal genetic resources, including training in the use of advanced sustainable use and conservation technologies and methodologies;
- communicate the need to sustainably use and conserve animal genetic resources for future use and development.

[Figure 11] The native Pastoreño goat of the Oaxaca region in Mexico is traditionally fattened for slaughter at Christmas and produces a special dried meat product called Chito.

Communication is a fundamental element of the technical programme of work, and is one of the most important pillars of the Global Strategy.

Farmers, breeders, local and indigenous communities, scientific and technical people, laypersons, policy-makers, research institutions, intergovernmental organizations and non-governmental organizations must be informed about the Global Strategy, and be involved with effects to achieve the sustainable use and conservation of animal genetic resources at the national level.

The global focal point has developed communication material to enhance understanding of the importance of animal genetic resources and the need for the Global Strategy. It has also prepared guidelines to assist countries in preparing their own national communication strategies.

The final key component of the Global Strategy is to put mechanisms into place to **evaluate progress in the implementation of the Global Strategy**, and to **monitor and report on the status of animal genetic resources**.

A periodic *Report on the State of the World's Animal Genetic Resources for Food and Agriculture* has been recommended by a Panel of Experts and the First Session of the Intergovernmental Technical Working Group on Animal Genetic Resources. The Report would play a crucial role in advancing the Global Strategy, as part of efforts to achieve global food security and sustainable rural development by:

- providing the Commission on Genetic Resources for Food and Agriculture with regular systematic information on the state of animal genetic resources for food and agriculture, as the basis for its policy and management decisions;

- establishing essential baseline data and information on the status of animal genetic diversity, which will expose gaps, and help to establish country, regional and global priorities for the management of animal genetic resources, as part of the overall objective of achieving and sustaining global food security;

- assessing national capacity to manage these resources, identifying priorities for national capacity building;

- examining the methodologies and technologies that are being employed, or are available to use, develop and conserve these resources in a sustainable manner;

- increasing awareness of the many roles and values of animal genetic resources, and thereby promoting their better use, development and conservation;

- promoting collaboration and cooperation among governments and non-governmental organizations involved in the management of animal genetic resources;

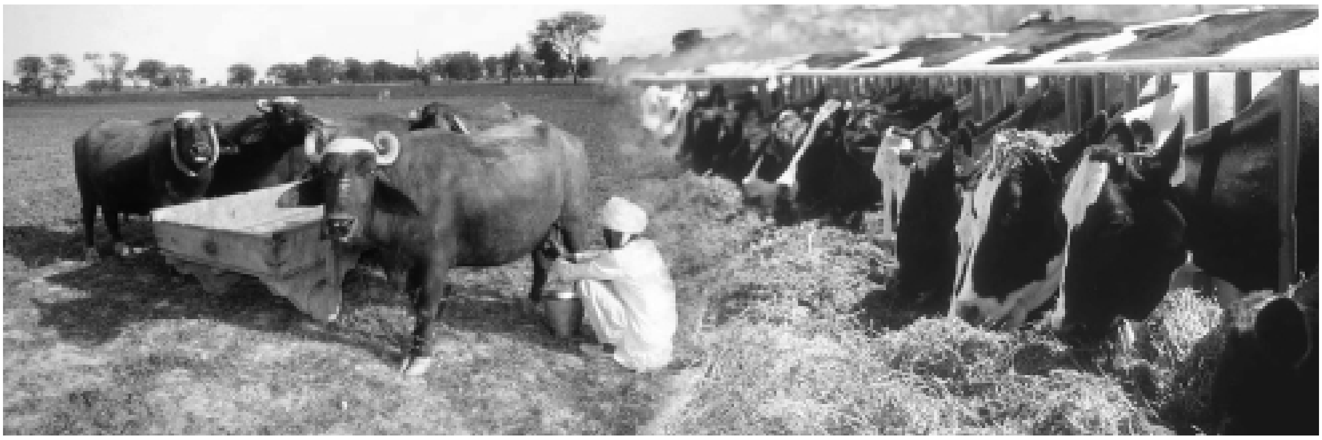
- assisting in the identification of animal genetic resources that can increase production and/or productivity across the full range of available production environments;

- improving understanding of the status of breeds that are currently not of value to farmers, and of wild relatives of domesticated animals, to firm up the foundation for the Early Warning System for Domestic Animal Diversity at risk of being lost, and identify opportunities for the future use of these resources;

- identifying situations where an emergency response could be considered to prevent the loss of animal genetic resources at risk;

- providing the essential data and other information required for the development of a country-driven and costed Global Plan of Action for Animal Genetic Resources;

- establishing the capacity and the information base for long-term monitoring and regular reporting on the state of animal genetic resources. This information will also be made available to the Conference of Parties to the Convention on Biological Diversity, thus providing a basis to harmonize future reporting on genetic resources in different international fora.



[Figure 12] With their production of high quality milk and their ability to utilize lower-value feed resources buffaloes compete well with introduced cattle breeds, particularly in smallholder settings.

Summary

International awareness of the roles and values of animal genetic resources, and concern for their rapid loss, must be translated into effective action at the local, national, regional and global levels. Management activities in the next few decades will, to a large degree, determine the future role and contribution of animal genetic resources towards global food security.

Sustainable development of production systems will involve mixing species, breeds and animals with the desirable qualities. Defining development objectives and the desirable qualities for achieving them is essential for cost-effective, sustainable development of the animal genetic resources involved.

In addition to identifying the preferred types of animal genetic resources, the development objective will lead to identifying the desirable types of animal recording and breeding strategies for developing the production system.

Sustainable development invariably has important socio-cultural aspects and requires clarification of policy and operational issues. The most important of these issues are how best to involve farmers and to realize continuity of breeding activities.

Systematic and effective planning is required, as is increased capacity building, especially in developing countries where most of the world's animal genetic resources are found, in order to ensure that these irreplaceable resources are conserved, used and developed to contribute to country and global food security and rural development.

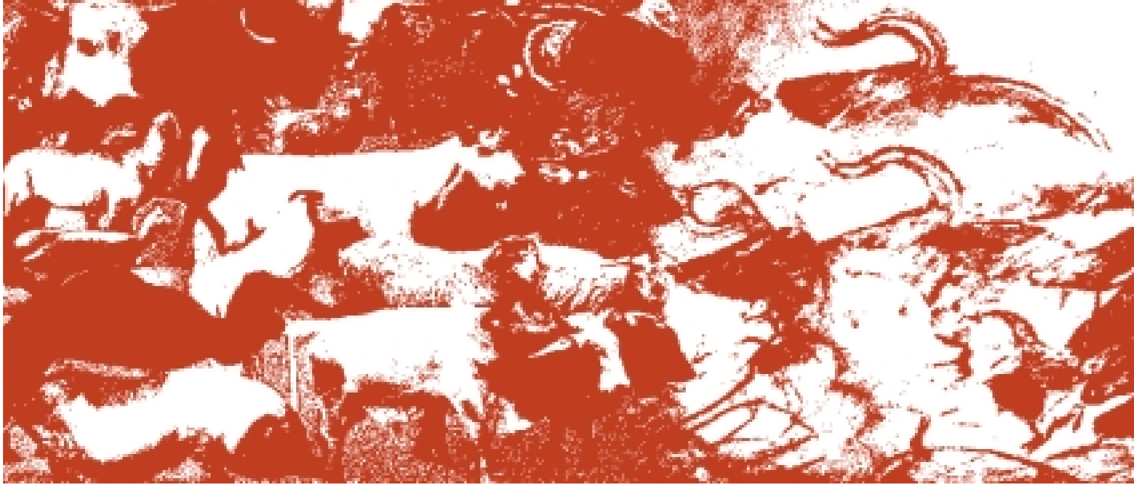
New technologies - such as information technologies, powerful tools for statistical analysis, and emerging biotechnological tools - will increase the ease and speed of further development of animal genetic resources. These technologies will not replace, but will complement traditional approaches to genetic improvement. The challenge will be to ensure that the technologies employed to intensify food and agriculture production and productivity are appropriate to the particular production system.

Immediate national and international action is required to conserve breeds that are at high risk of loss, and to develop adapted genetic resources more sustainably and rapidly to respond to the food and agriculture imperatives of the twenty-first century. Response to the global loss and decline of domestic animal genetic resources, and to the lack of recent development of most of these resources, must be comprehensive and integrated.

The Global Strategy will provide the necessary forum and focal point to discuss and debate policies and programmes and provide the mechanism for global reporting on the state of animal genetic resources. This focal point is necessary to coordinate the many activities that are required to manage animal genetic resources, and to mobilize financial and other resources that are necessary to build capacity in livestock management in developing countries.

The Global Strategy will function to ensure that the required range of animal genetic resources is developed and maintained in order that they may contribute to the development of new foods and foods products, new medicines and manufactured goods, and other important goods and services. This will ensure that these resources are fully used to respond to current food security and that they continue to contribute to human development and well-being.

[Figure 13] Interpopulation/breed variability is often used to create new genotypes to suit specific production conditions, e.g. modern chicken synthetics. This variability is also used to design crossbreeding systems to meet certain demands and/or to make better use of available resources.



Glossary

The following draft definitions are the
current versions of those being developed by the Panel of Experts
assisting FAO to detail the Global Strategy.

Glossary

Adaptation traits: complex of traits related to reproduction and survival of the individual in a particular production environment. Adaptation traits contribute to individual fitness and to the evolution of animal genetic resources. By definition, these traits are also important to the ability of the animal genetic resource to be sustained in the production environment.

Agrobiodiversity OR agricultural biological diversity: that component of biodiversity that contributes to food and agriculture production. The term agrobiodiversity encompasses within-species, species and ecosystem diversity.

Animal genetic resources databank: a databank that contains inventories of farm animal genetic resources and their immediate wild relatives, including any information that helps to characterize these resources.

Animal genome (gene) bank: a planned and managed repository containing animal genetic resources. Repositories include the environment in which the genetic resource has developed, or is now normally found (*in situ*) or facilities elsewhere (*ex situ* – *in vivo* or *in vitro*). For *in vitro*, *ex situ* genome bank facilities, germplasm is stored in the form of one or more of the following: semen, ova, embryos and tissue samples.

Biodiversity OR biological diversity : the variety of life in all its forms, levels and combinations, encompassing genetic diversity, species diversity and ecosystem diversity.

Breed: either a sub specific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity.

Breed at risk: any breed that may become extinct if the factors causing its decline in numbers are not eliminated or mitigated.

Breeds may be in danger of becoming extinct for a variety of reasons. Risk of extinction may result from, *inter alia*, low population size; direct and indirect impacts of policy at the farm, country or international levels; lack of proper breed organization; or lack of adaptation to market demands. Breeds are categorized as to their risk status on the basis of, *inter alia*, the actual numbers of male and/or female breeding individuals and the percentage of pure-bred females. FAO has established categories of risk status: critical, endangered, critical-maintained, endangered-maintained, and not at risk.

Breed not at risk: a breed where the total number of breeding females and males is greater than 1 000 and 20 respectively; or the population size approaches 1 000 and the percentage of pure-bred females is close to 100 percent, and the overall population size is increasing.

Characterization of animal genetic resources: all activities associated with the description of AnGR aimed at better knowledge of these resources and their state.

Characterization by a country of its AnGR will incorporate development of necessary descriptors for use, identification of the country's sovereign AnGR; baseline and advanced surveying of these populations including their enumeration and visual description, their comparative genetic description in one or more production environments, their valuation, and ongoing monitoring of those AnGR at risk.

Glossary

Critical breed: a breed where the total number of breeding females is less than 100 or the total number of breeding males is less than or equal to five; or the overall population size is close to, but slightly above 100 and decreasing, and the percentage of pure-bred females is below 80 percent.

Clone: a genetic replica of another organism obtained through a non-sexual (no fertilization) reproduction process.

Cloning by nucleus transfer involves the transfer of a donor nucleus from (cultured) cells of embryonic, fetal or adult origin into the recipient cytoplasm of an enucleated oocyte or zygote, and the subsequent development of embryos and animals. These clones usually have different mitochondrial genomes.

Conservation of farm animal genetic resources: refers to all human activities including strategies, plans, policies and actions undertaken to ensure that the diversity of farm animal genetic resources is being maintained to contribute to food and agricultural production and productivity, now and in the future.

Critical-maintained breed and endangered-maintained breed: categories where critical or endangered breeds are being maintained by an active public conservation programme or within a commercial or research facility.

DNA (deoxyribonucleic acid): the long chain of molecules in most cells that carries the genetic message and controls all cellular functions in most forms of life.

DNA bank: storage of DNA, which may or may not be the complete genome, but should always be accompanied by inventory information. (*Note:* at the present time, animals cannot be reestablished from DNA alone.)

Domestic animal diversity (DAD): the spectrum of genetic differences within each breed, and across all breeds within each domestic animal species, together with the species differences; all of which are available for the sustainable intensification of food and agriculture production.

Endangered breed: a breed where the total number of breeding females is between 100 and 1 000 or the total number of breeding males is less than or equal to 20 and greater than five; or the overall population size is close to, but slightly above 100 and increasing and the percentage of pure-bred females is above 80 percent; or the overall population size is close to, but slightly above 1 000 and decreasing and the percentage of pure-bred females is below 80 percent.

Evaluation: measurement of the characteristics that are important for production and adaptation, either of individual animals or of populations, most commonly in the context of comparative evaluation of the traits of animals or of populations.

***Ex situ* conservation of farm animal genetic diversity:** all conservation of genetic material *in vivo*, but out of the environment in which it developed, and *in vitro* including, *inter alia*, the cryoconservation of semen, oocytes, embryos, cells or tissues. Note that *ex situ* conservation and *ex situ* preservation are considered here to be synonymous.

Extinct breed: a breed where it is no longer possible to recreate the breed population. Extinction is absolute when there are no breeding males (semen), breeding females (oocytes), nor embryos remaining.

Glossary

Farm animal genetic resources (AnGR): those animal species that are used, or may be used, for the production of food and agriculture, and the populations within each of them. These populations within each species can be classified as wild and feral populations, landraces and primary populations, standardized breeds, selected lines, and any conserved genetic material.

Gene: the unit of heredity transmitted from generation to generation during sexual or asexual reproduction. More generally, the term "gene" may be used in relation to the transmission and inheritance of particular identifiable traits.

Alleles: the variant forms of each gene.

Genetic distance: a measure of the genetic similarity between any pair of populations. Such distance may be based on phenotypic traits, allele frequencies or DNA sequences. For example, genetic distance between two populations having the same allele frequencies at a particular locus, and based solely on that locus, is zero. The distance for one locus is maximum when the two populations are fixed for different alleles. When allele frequencies are estimated for many loci, the genetic distance is obtained by averaging over these loci.

Genetic distancing: the collection of the data on phenotypic traits, marker allele frequencies or DNA sequences for two or more populations, and estimation of the genetic distances between each pair of populations. From these distances, the best representation of the relationships among all the populations may be obtained.

Genome: the complete set of genes and non-coding sequences present in each cell of an organism, or the genes in a complete haploid set of chromosomes of a particular organism.

***In situ* conservation of farm animal genetic diversity:** all measures to maintain live animal breeding populations, including those involved in active breeding programmes in the agro-ecosystem where they either developed or are now normally found, together with husbandry activities that are undertaken to ensure the continued contribution of these resources to sustainable food and agricultural production, now and in the future.

Management of farm animal genetic resources: the sum total of technical, policy, and logistical operations involved in understanding (characterization), using and developing (utilization), maintaining (conservation), accessing, and sharing the benefits of animal genetic resources.

Production environment: all input–output relationships, over time, at a particular location. The relationships will include biological, climatic, economic, social, cultural and political factors, which combine to determine the productive potential of a particular livestock enterprise.

- **High-input production environment:** a production environment where all rate-limiting inputs to animal production can be managed to ensure high levels of survival, reproduction and output. Output and production risks are constrained primarily by managerial decisions.

- **Medium-input production environment:** a production environment where management of the available resources has the scope to overcome the negative effects of the environment on animal production, although it is common for one or more factors to limit output, survival or reproduction in a serious fashion.

Glossary

- **Low-input production environment:** a production environment where one or more rate-limiting inputs impose continuous or variable severe pressure on livestock, resulting in low survival, reproductive rate or output. Output and production risks are exposed to major influences which may go beyond human management capacity.

Production traits: characteristics of animals, such as the quantity or quality of the milk, meat, fibre, eggs, draught, etc. they (or their progeny) produce, which contribute directly to the value of the animals for the farmer, and that are identifiable or measurable at the individual level. Production traits of farm animals are generally quantitatively inherited, i.e. they are influenced by many genes whose expression in a particular animal also reflects environmental influences.

Sustainable intensification of animal production systems: the manipulation of inputs to, and outputs from, livestock production systems aimed at increasing production and/or productivity and/or changing product quality, while maintaining the long-term integrity of the systems and their surrounding environment, so as to meet the needs of both present and future human generations.

Sustainable agricultural intensification respects the needs and aspirations of local and indigenous people, takes into account the roles and values of their locally adapted genetic resources, and considers the need to achieve long-term environmental sustainability within and beyond the agro-ecosystem.

Utilization of farm animal genetic resources: the use and development of animal genetic resources for the production of food and agriculture.

The use in production systems of AnGRs that already possess high levels of adaptive fitness to the environments concerned, and the deployment of sound genetic principles, will facilitate sustainable development of the AnGRs and the sustainable intensification of the production systems themselves. The wise use of AnGRs is possible without depleting domestic animal diversity. Development of AnGRs includes a broad mix of ongoing activities that must be well planned and executed for success, and compounded over time, hence with high value. It requires careful definition of breeding objectives, and the planning, establishment and maintenance of effective and efficient animal recording and breeding strategies.

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