

Country report on animal genetic resources for food and agriculture in Sweden

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1. Tables

Executive summary

The purpose of the present country report, compiled at the instruction of the Swedish Government, is to serve as a basis for Sweden's contribution to a global report on animal genetic resources for food and agriculture planned by the UN Food and Agriculture Organisation (FAO). The report was requested by the FAO, which, with the help of corresponding input from some 160 countries, aims to draw up a First Report on the State of the World's Animal Genetic Resources.

The present work opens with a general section on Swedish agriculture and animal husbandry, including a short historical account of the development of the genetic resources and animal breeds in the country, plus a description of breeding practices and the organisation of breeding activities in Sweden today. The section touches on production systems and animal material and their significance for food production in Sweden. It examines the organisational structure of these systems, from public authorities to private animal breeders' associations. The section also includes a survey of education and research in this sphere, public information activities and Nordic and international cooperation.

The report asserts that all forms of livestock and food production are in need of continuous development. Commercial food production must be cost-effective if it is to survive. More locally adapted and diversified operators must also keep in step with the changing demands of local consumers. It may also prove necessary for livestock farmers working with threatened breeds to develop new approaches aimed at encouraging active, sustainable use of their breeds that will attract new owners and generate new income opportunities.

An assessment of future needs and trends make up the latter part of the report. This section presents several production scenarios and outlines a number of socially beneficial schemes involving domestic animals, along with genetic resources required for their fulfilment. It is proposed that a number of measures be given priority and more concrete form in the Swedish Board of Agriculture's new Government-commissioned national programme for the coming five-year period. The need to further develop effective utilisation of existing genetic resources, breeding activities, targeted conservation work and the dissemination of information is emphasised in connection with the proposed strategies. The report contends that sustainable management of genetic resources is predicated on good cooperation between government and industry.

Also addressed is the issue of responsibility with regard to the conservation, development and utilisation of animal genetic resources for food and agriculture. The report stresses the need for greater clarity on this issue as well as the importance of clearly allocating responsibility between the Government on the one hand and other interested parties on the other. It also identifies a number of shortcomings and further needs in the fields of education, research and the dissemination of information.

As work on the report neared completion, the Board of Agriculture solicited the views and comments of relevant breeders' organisations and associations. The final report, along with these views and comments, will mainly serve as background material for the national programme, which will be prepared and compiled in the latter half of 2002.

The assignment

In June 2001, the Swedish Government commissioned the Swedish Board of Agriculture (Government Decision No. 15 (Jo2001/1701) 20 June, 2001) to compile material to be used as supporting data for Sweden's contribution to the FAO report the State of the World's Animal Genetic Resources. The commission was to be undertaken after consultation with the Swedish University of Agricultural Sciences (*SLU*) including the Swedish Biodiversity Centre (*CBM*), the Swedish Environmental Protection Agency, Nordens Ark and other zoos, as well as societies for the conservation of livestock breeds. The Board was required to present its findings by 31 May, 2002.

The FAO report, which is expected to be completed by December 2005, will contain an assessment of the respective countries' programmes for the conservation of animal genetic resources for food and agriculture, and provide a global view of the state of these resources. Sweden will contribute to the FAO report by preparing and submitting its own country report.

National reports should include an inventory of animal material in the broader sense, a survey of development trends and threats, and a characterisation and evaluation of existing breeds. As data on the identification and inventory of breeds are available elsewhere, e.g. from the FAO's Domestic Animal Diversity – Information System (DAD-IS) database, these issues will not be dealt with further here.

Thus the report should contain proposals of a general character highlighting needs and deficiencies and defining priorities with respect to the conservation, utilisation and sustainable development of the collected domestic animal genetic resources in the country. The country report must also serve as the basis for a national action plan.

How the report was compiled

The working group responsible for the report comprised the following members:

Agneta Brasch, Swedish Board of Agriculture

Anders Dahlin, Swedish Board of Agriculture

Britta Danell, Swedish University of Agricultural Sciences

Per Ericson, Swedish Museum of natural History

Jan-Åke Eriksson, Swedish Dairy Association

Mats Höggren, Swedish Biodiversity Centre

Sven Jeppsson, representing Swedish societies for the preservation of animal breeds.

Elin Linnarsson, Swedish Environmental Protection Agency

Harriet Rehn/Ulrika Tjälldén, Ministry of Agriculture

Eva-Marie Stålhammar, Swedish Board of Agriculture.

The working group held meetings every month either by telephone or in person. In April, the group held a two-day meeting at a residential study centre in Hållsta, Sweden. Contact was established with a number of organisations in the agricultural industry. In the final stages of its preparation, the material in the report was circulated for comment to societies for the preservation of animal breeds and to breeding organisations.

1. Agriculture and livestock farming in Sweden

Sweden covers an area of 450,000 square km. It spans 14 degrees of latitude (55N-69N), 14 degrees of longitude (10E-24E) and is approximately 1,800 km long from north to south. Although part of the country thus lies above the Arctic circle, the land is arable even in the northernmost counties. Sweden borders on Norway in the west and Finland in the northeast. Although mainly coastal, the climate in the northern and central parts is more continental in character with cold winters, and snow lying on the ground for extended periods during the winter months. Annual precipitation is normally between 500 and 1,000 mm.

In 2001 the population of Sweden was 8,861,000. Between 1990 and 1999, the number of inhabitants rose by 210,000. This increase was almost entirely due to immigration. The rural population of Sweden has declined continuously since people began migrating to urban areas in search of employment over a century ago. The average population density is 20 people per square km. However, the population density is considerably higher in the County of Skåne (Skania), the area close to Stockholm and large parts of the south-west coast.

Sweden also has an autochthonous population, the Sami, who number between 15,000 and 20,000. Although only some 10 per cent of the Swedish Sami population are involved in reindeer husbandry, it is regarded as an essential part of Sami culture and by Swedish law may only be practised by Sami in the specially designated reindeer herding regions.

A mere 7 per cent of Sweden's total area – 2.7 million hectares concentrated in the flatlands of central and southern Sweden – is under cultivation. Some 85,000 people (2 per cent) are employed full time in primary agricultural production. Approximately the same number are employed part time in agriculture and livestock farming.

In 1999, Sweden's total GDP was SEK 2,004,651 million, to which agriculture contributed SEK 11,603 million, or 0.6 per cent. Livestock production accounted for some 60 per cent of all agricultural income.

1.1 Livestock production

Agriculture and livestock production are carried on throughout Sweden. Due to the more favourable climatic conditions in the southern parts of the country, however, both primary production and breeding of raw materials for the food industry are heavily concentrated in southern Sweden. Sweden has attained a high degree of self-sufficiency in food from animal products. Although family farming remains the predominant mode of agriculture, rationalisation has drastically reduced the number of smaller holdings. We are seeing the same development in livestock farming and dairy and piglet herds have increased substantially in size. Large units are to be found in the poultry and pig slaughtering industries.

The dominant primary commodities in the food industry originate from cattle, pigs and poultry. The production of lamb and reindeer meat is of some importance. Animals such as goats, horses, rabbits, fish, ostriches, bees and fenced-in deer play only a small part in Swedish food production, although they have other roles in the community and can be a significant source of food at local level. Examples of new husbandry techniques and animal types used in food production include fish breeding, fenced-in game and ostrich farming.

The level of self-sufficiency in animal food production in Sweden fell somewhat in the 1990s. Sweden was virtually 100 per cent self-sufficient in all animal product areas. By the end of

the decade this was true only of dairy products. From having been a net exporter of beef, Sweden imported 25 per cent of all beef consumed in 2001. In the same year, imports of sheep, pig and poultry meat totalled 55, 10 and 12 per cent respectively of volumes consumed within the country. Milk production in Sweden has been restricted by a quota system since the country's accession to the European Union. Sweden has a quota of 3,300 million kg of milk, which is wholly used up. In the case of beef production, premium rights (suckler cows) have been granted for 155,000 beasts, of which some 90 per cent are utilised. Sheep farming has been granted 180,000 premium rights, some 90 per cent of which have been claimed.

1.2 Production systems and production approaches

Milk production plays a central role in the meat and dairy industry. Major structural rationalisation and intensive breeding have led to a substantial reduction in the number of dairy cows and dairy companies in the country. Dairy farming remains largely family-based with most units supporting herds of 35 to 40 cows. Just under one third of all Swedish dairy cows are now kept in open housing systems while indoors. Some 3,290 million kg of milk were produced in 2001.

Beef is produced partly in intensive rearing systems heavily reliant on feed concentrates and partly under more extensive regimes based mainly on coarse fodder and grazing. The bulk of production is based on dairy cattle breeds or hybrids. 143 million kg of beef were produced in 2001.

Sweden produces relatively little mutton or lamb. The figure for 2001 was 4 million kg. Sheep farming in Sweden is practised on a very small scale, often as a hobby.

Swedish pig stocks are divided into breeding herds, hybrids, piglets and pigs for slaughter. Integrated piglet and slaughter pig production is increasing rapidly as is also the use of so-called sow pools, a system where sows are inseminated in a central unit before rejoining the satellite herds to give birth to their litters. From the end of the 1980s to the early 1990s, Sweden was more than self-sufficient in pork. Pork production reached its highest point in 1998. The figures for 2001 were approximately 276 million kg.

Egg production is undergoing radical restructuring following the mandatory introduction of enriched battery cages with nesting material, dust baths and perches. Free-range and enriched cage systems are becoming increasingly common. Egg production in Sweden fell by 10 per cent in the 1990s. 100 million kg of eggs were produced in Sweden in 2001. Poultry meat is mainly produced in specialised broiler units. Turkey, ostrich and goose meat account for only a small share of total poultry meat production, which amounted to 100 million kg in 2001. The production and consumption of poultry meat have not only undergone the most radical transformation of any process in the recent history of Swedish food production; they have also increased substantially.

Approximately 3 million kg of honey are produced annually in Sweden from some 80,000 bee colonies. In the 1990s honey production rose from 10 kg to approximately 30 kg per colony.

1.3 Farmers' organisations

Swedish agriculture is based almost exclusively on private ownership. While different forms of collective or cooperative ownership may be found, these are relatively uncommon.

Swedish farmers are represented by local cooperative organisations affiliated to the Federation of Swedish Farmers (LRF). Livestock owners are also represented by respective breeders' associations. Some of these associations, or organisations, are national bodies with responsibility for registration, the keeping of herdbooks and breeding evaluation.

1.4 Sustainable use and conservation of animal genetic resources for food and agriculture

Biological and genetic diversity in domestic livestock are an irreplaceable asset and as such an essential condition for the sustainable development of agricultural production and rural areas. The long-term sustainable use of genetic resources should be the goal of livestock breeders working with breeds currently used in the production process. According to the Government's biodiversity strategy, promulgated in 1993 (Govt. Bill 1993/94:30, Committee Report 1993/94:Jou 9, Government Communication 1993/94:87), Sweden shall assume responsibility for the country's existing plant and animal genetic resources in accordance with the Convention on Biological Diversity. The strategy also requires that special conservation plans be drawn up for all domestic animal breeds for which Sweden may be regarded as having special responsibility.

Although the Government has entrusted the Swedish Environmental Protection Agency with overall responsibility for biodiversity, the Board of Agriculture has been made responsible for domesticated plants and animals, both as regards monitoring of their use and the implementation of necessary conservation measures. Previously, the Board's responsibility in this sphere only extended to food-producing animals. A special EU regulation (445/2002/EG) entitles Sweden to set up a special programme under which financial compensation may be awarded to livestock owners who rear domestically threatened breeds of cattle, horses, sheep, goats, pigs and poultry.

1.5 Trends in animal husbandry and breeding

Swedish agriculture is currently undergoing a radical rationalisation process involving extensive restructuring in a range of areas including animal farming. Commercial enterprises are becoming fewer, larger, more specialised and increasingly concentrated in the best farming areas. The growing trade in live animals, including breeding material, increases the risk that diseases which have not previously found a foothold in Sweden will be introduced into the country.

Policy objectives such as sustainability, the mainstreaming of environmental concerns, food safety including traceability, and good animal care should serve as a guide to future development. Animal care and ethical concerns in connection with livestock production have aroused intense controversy and debate both among the general public and within the producers' own associations. There have been vigorous, concerted calls for improvements in animal care and supervision. Specially targeted by the tougher new demands are the transportation of live animals, the treatment of animals in slaughterhouses and of animals bred for fur production. Breeding activities involving active breeds of the various animals used in livestock production are carried on by an increasingly small number of companies in the country. The opposite applies in the case of domestic social and pet animals and threatened domestic breeds. Divergent objectives are giving rise to increasing numbers of breeders' associations.

1.6 Internationalisation

International exchange in connection with most domestic animal breeds is intensive and widespread. Breeding material is regularly imported by dairy cattle breeders. Thanks to the activities of Interbull, breeders have been able to compare bull material from several other countries. Cooperation between Nordic breeders, particularly in connection with dairy cattle, has a long tradition and is currently being stepped up. Despite powerful outside influence from international breeders via imports of animal material, dairy cow breeders are still affected by domestic practices. Swedish breeding practices, which focus on health and functionality, are of interest to foreign livestock breeders. For example, semen doses of Swedish Red and White bulls (*SRB*) have been exported to Argentina and New Zealand.

Pig breeding is currently the subject of internal debate and a cooperative venture between Swedish and Danish breeders is under inquiry.

Sheep production is practised only on a very modest scale in Sweden and exchanges with other countries are limited.

Poultry breeding (eggs and broiler chickens) has been international for a considerable time and all the grandparents of birds used in broiler production are now imported.

The concentration of breeding activities in the larger breeders' associations and the trend towards international cooperation have rapidly changed the character of the industry, from an enterprise which was wholly national to one that has become more or less dependent on other countries.

2. Livestock farming and the need for genetic resources

2.1 The development of livestock production

Livestock farming and the meat and dairy industry in Sweden underwent profound changes in the last century. The development of effective breeding techniques, technological improvements, better animal environments and improved feed and feed management along with the introduction of new breeds have resulted in vastly increased yields and production from individual animals. The turnover of live animals has also increased as a result of efficiency enhancements and the resulting culling of dairy cows and sows at a low average age. Laying hens are culled after a single laying period.

During the first quarter of the 20th century, breeders of food-producing domestic animals were most concerned with external conformation, animal type and pedigree. While herd books were kept and various types of classification criteria were applied for all important breeds of horses, cattle, sheep and pigs, performance evaluation received little attention from livestock owners. However, the growing commercialisation of agricultural products contributed significantly to the increased importance attached to selection for increased production. The first decade of the 20th century saw the emergence on a significant scale of associations of livestock farmers with similar interests.

Responsibility for monitoring and recording yields and pedigrees and for conducting breeding evaluations of dairy cattle breeds rested with the government. This was transferred to the appropriate organisations by act of parliament in 1976. The same change with respect to other animal genera in the livestock farming industry was made in 1985.

In the last decade, breeding of all commercial livestock breeds has become more efficient. Factors contributing to this development are recording, artificial insemination and more coherent breeding programmes using refined selection techniques. For public health reasons, concerted efforts are currently being made to widen present breeding goals for all production breeds. Widespread support for performance and health tests developed in recent decades has ensured effective, successful cooperative breeding and the fulfilment of stringent breeding goals.

Apart from the commercial livestock breeds there are presently some 35 breeds in Sweden classified as endangered. These are mainly domestic, often named native breeds or varieties. Most were out-competed as production breeds during the latter half of the 20th century.

Responsibility is divided between the government and private sector organisations engaged in breeding activities in accordance with the provisions of the 1985 Livestock, etc, Management Act (1985:342). Under the Livestock, etc. Management Ordinance (1985:343) the Board of Agriculture was given responsibility for the supervision of all activities covered by the Act. The Board was also empowered to regulate breeding activities and has drawn up regulations on beef cattle, sheep, pigs and horses. These lay down requirements for organisations and associations responsible for breeding activities and prescribe procedures for the registration and marking of livestock and the performance of genetic value assessments. Since 1995, EU directives and decisions in this area have been periodically incorporated into the regulations. Responsibility for supervision of recording and artificial insemination in each county rests with respective County Administrative Boards.

All breeding is carried out on a voluntary basis. Participation parentage and performance recording schemes is not mandatory. Parentage certification is necessary, however, if breeders

and livestock producers are to be eligible for grants for the conservation of endangered livestock breeds. Moreover, all cattle are required by law to be individually marked. Breeding activities are not eligible for government grants. All breeding activities are financed by membership and service fees paid by livestock owners or through their own efforts.

Inter alia these requirements mean that any organisation intending to carry out and be responsible for breeding activities of any kind must submit plans and guidelines on its proposed operations to the Board of Agriculture along with its application. These plans and guidelines must include details of the organisation's structure, decision-making process, breeding goals and breeding material, any breeding evaluation techniques, pedigree requirements and the internal arrangement of herd books.

The Board of Agriculture distinguishes between associations that keep herd books or registers and breeding organisations that conduct breeding evaluations. The latter are subject to stringent requirements with regard to know-how and impartiality. Breeders' organisations may also apply their own internal regulations or codes of practice. Appeals against decisions taken by a breeders' organisation or a registered association may be filed with the Board of Agriculture. The Board keeps itself informed about breeding developments through participation in a number of committees such as steering committee on dairy cow breeding (*Styrgrupp avel för mjölkkor*) and committee on breeding methods for pigs (*Metodkommitté svin*).

Breeding practices that cause suffering to animals are forbidden under the Animal Welfare Act (1988:534). The regulations supplementary to the Act drawn up by the Board of Agriculture forbids organised breeding activities involving animals bearing defects which could cause these animals to suffer. The regulations include a list of those defects, which according to established criteria could entail suffering by the animals that bear them. Breeders attach great importance to health and functional traits, which in turn help improve animal welfare.

Genetic engineering activities are governed by the Environmental Code. The Board of Agriculture is responsible for the supervision of activities involving the use of genetically modified animals and has drawn up regulations governing such activities. At present, such animals only exist for medical research purposes. Similar activities involving food producing animals do not occur in Sweden.

2.1.1 Milk production

Swedish breeds and their development

Swedish Red Cattle (*röd svensk boskap – RSB*) was a numerically large domestic breed of dairy cattle in Sweden in the 1920s. Swedish Friesian Cattle (*svensk låglandsboskap - SLB*) were predominant in the south-west of the country. Swedish-Norwegian Mountain Cattle (*svensknorsk fjällras*) was the most widely used breed in northern Sweden, while the Nordic Red Poll breed (*nordiska rödkullan*) was still common in the more southerly parts of the region. Other local breeds of cattle were gradually pushed out and only remnants remain.

In time *RSB* came under strong competitive pressure from Ayrshire cattle. This led to a merger of the two breeds in 1927 and the creation of a new, Swedish Red and White breed (*svensk röd och vit boskap – SRB*). The Swedish Mountain Cattle and the Swedish Red Poll were merged into a single breed in 1937 and named Swedish Polled Cattle (*svensk kullig boskap – SKB*). However, the representatives of the two breeds failed to agree on the new

disposition and continued to pursue separate breeding activities as before. The Swedish Red Poll Association (*Sveriges Rödkulleförening*) and the Swedish Mountain Cattle Breeding Association (*Svensk Fjällrasavel*) were founded in the 1960s and 1996 respectively.

At present *SRB* and *SLB* occupy a dominant position in the Swedish dairy farming industry. Breed distribution figures compiled in 2001 were as follows: *SRB* 47.6 %; *SLB* 47.0 %, *SKB* 0.5 % and Swedish Jersey Cattle (*SJB*) 0.5 %. *SRB* traits clearly reflect the influence of several other populations as all Red populations in the Nordic region are treated as a single group for breeding purposes. Swedish Holstein Cattle (*SLB*) are similarly affected by imports from American and Canadian Holstein populations. All *SJB* semen is imported. Small populations of domestic breeds of dairy cattle – Swedish Mountain Cattle (*fjällkor*), Swedish Red Poll (*rödkulla*), Väne Cattle (*vänekor*) and Ringamåla Cattle (*ringamålakor*) – may still be found in Sweden. In the case of Swedish Mountain Cattle and Swedish Red Poll breeds, however, some exchange of breeding material has taken place with Norway and Finland.

Breeding practices and procedures

Yield surveys in dairy production were first conducted in 1898. The practice developed rapidly both as regards officially registered cattle counts and average yields. In 2000, 86 per cent of Sweden's total population of 427,000 dairy cows were entered in the official dairy cattle recording scheme. Average yield per recorded cow for the same year was 8,836 kg of energy corrected milk (ECM). Average yield for all cows was approximately 7,500 kg of milk.

The Swedish Dairy Association is the officially recognised breeding organisation in the dairy and beef cattle breeding industry. The Association's most important official tasks include administering the central database for animal pedigrees, recording and processing data from associated herds, calculating breeding values and ruling on breeding goals. Regional livestock owners' associations are responsible for recording pedigrees and yields at individual producer level. Livestock associations are also responsible for the practical aspects of artificial insemination and embryo handling within their own districts, for planning of breeding at herd level and cattle judging. The fact that livestock owners themselves perform the necessary field work in connection with livestock checks is unique to the countries in the Nordic region.

Bull owners and breeders' associations with registered bulls evaluated by daughter group for genetic merit and receiving government grants for bull purchases and grew rapidly during the first half of the 20th century. Artificial insemination in dairy cattle breeding came into use in the 1940s. The new technique spread rapidly and artificial insemination associations with their own bull studs were soon established throughout the country. This represented a major breeding breakthrough. Dairy cattle checks and artificial insemination have been conducted by the same organisation – now known as the Swedish Dairy Association – since 1956.

Today, only two bull studs in Sweden – *Svensk Avel* and *Skåne Semin* – select bull dams, recruit bulls, produce semen and market breeding material. A number of companies also import and market semen. Bull studs also coordinate breeding activities in the field via specially responsible members of regional livestock associations. Use of artificial insemination is extensive by international standards. Approximately 90 per cent of all dairy cows are linked to insemination programmes. Ever since 1956, bull semen from all bulls used for artificial insemination has been collected and kept in a unique sperm bank

Great importance is attached in dairy cattle breeding to the efficient registration of each animal's pedigree and individual phenotypes. The resulting data is stored in a national

database administered by the Swedish Dairy Association. Recorded data include milk yields, fat and protein content and milk cell count figures for each individual cow. The animal's weight, classification, fat cover and any diseases detected are recorded when the animal is slaughtered. Data on insemination, fertility treatments, calving difficulty if any and deformities are also recorded, as are veterinary treatment and causes of culling. Also recorded are some 20 external sub-traits relating to conformation of body, stance and udder as well as to temperament.

2.1.2 Beef production

Until the beginning of the 1950s, dairy producers accounted for virtually all beef production in Sweden. In the ensuing specialisation of Swedish livestock production into single product areas many farms became dedicated beef producers. Starting out with herds composed of surplus calves bought from dairy farms, beef producers in the early 1960s gradually moved over to calf production based on imported animal material from distinctly heavy, fast-growing breeds.

Today the Swedish beef production industry is based on some 10 European beef cattle breeds, of which Charolais cattle make up the largest group. Although a large proportion of dams in beef producing cow-calf operations with own replacement are hybrids of beef and dairy cattle breeds, the bulk of beef production is still based on surplus calves from dairy herds and culled cows. There are approximately 167,000 cows destined for beef calf production in Sweden.

The Swedish Dairy Association is responsible for beef cattle recording. Prescribed tasks such as identity marking and weighing of calves and young animals are carried out in the field by the owners themselves. Spot checks are conducted by regional livestock associations to verify that these tasks have been correctly performed. The Swedish Dairy Association processes the marking and weighing data and provides livestock owners with growth trait values.

Artificial insemination in dedicated beef cattle production units is only practised to a limited extent. Bull calves of all beef cattle breeds are tested at the performance test station and then sold at auction. The Swedish Dairy Association is responsible for calculating growth indexes for beef cattle bulls.

A large proportion of semen from growth-tested beef cattle bulls is used for insemination in dairy herds. It is reserved for cows from which the farmer does not intend to recruit heifers for milk production. Though limited in extent, use of bull semen for this purpose provides the owner with breeding values for the donor bull on calving difficulty and calf mortality.

2.1.3 Pork production

Swedish breeds and their development

Pig farming has undergone some of the most extensive structural changes of all production branches in the last 50 years. Modern pork production is a highly specialised industry, a far cry from the days when pigs were a natural feature of every farm holding. Some 85 per cent of the 3.2 million pigs produced annually for slaughter in Sweden are now reared in specialised grower herds. The pig population includes some 215,000 sows that litter twice a year with an average of 11.4 live piglets per litter or 9.6 weaned pigs per litter.

The native Swedish breeds have satisfactorily met breeding goals established early on, such as good fertility and high growth rates. In the early years of the last century, breeding pigs were

imported mainly from Denmark in order to strengthen native Swedish breeds. The importing of breeding material from native breeds into Sweden continued with the introduction of breeding boars and semen from Norway and Finland.

From the mid-1950s and on breeders have used Yorkshire breeding pigs imported from Canada and Finland in addition to native Swedish stock. Purebred pigs were almost exclusively used in grower pig production until the 1970s. Since then, however, pig production has been wholly dominated by hybrids, initially between Swedish Landrace and Swedish Yorkshire breeds, but subsequently incorporating a third breed – Hampshire or Duroc. The sows used in the production process are native Swedish-Yorkshire hybrids. The growers are three-breed hybrids with Hampshire or Duroc sires. The main reason behind this introduction of new and hybrid lines has been the desire to achieve satisfactory and increased levels of fertility in the maternal lines and improved product quality from the Duroc and Hampshire breeds.

Linderöd Swine is the only breed still extant originating from Sweden. However, their number is now so small that the breed is listed as endangered.

Breeding practices and procedures

Pig premiums and entry in national herdbooks were both introduced at the beginning of 1910. Pig progeny testing was organised in 1923. The then National Swedish Board of Agriculture was responsible for this until 1967, when the task was taken over by the Swedish Pig Breeders' Society (*Svenska Svinavelsföreningen*). In 1928, the Swedish Riksdag (parliament) passed a law making boar inspection compulsory. This was done to support boar breeding associations and breeding work. The inspections were carried out by the local county agricultural societies until 1967 and by the government run regional agricultural boards thereafter. Compulsory boar inspection was abolished in 1987.

Pig-breeding research establishments have given high priority to the genetically determined production capacity of animal material and to the development of healthier animals capable of sustaining high product quality without the use of antibiotics. Antibiotic-free pig rearing is a demanding undertaking as Swedish herd managers must also ensure that annual production of piglets per sow does not lag behind that of other countries.

Breeding evaluation is based on ultrasonic tests of gilts and young boars in the field, sow control (pedigree and fertility data) and boar testing including individual growth and food consumption measurement, assessment of external conformation and tests for osteochondrosis.

The benefits of cross-breeding, particularly in terms of exploiting the favourable effects of crossing for low heritability traits such as fertility and longevity, have encouraged the practice of using only as many pure-bred animals as are needed to carry on breeding activities effectively and for the production of female hybrids. The reproductive capacity of pigs is such that it is possible to keep relatively few pure-bred animals at the top of the breeding pyramid, thereby allowing more in the production process itself.

Quality Genetics is the official Swedish pig breeding organisation. Responsibility for registration of breeding pigs in herd books rests with the Swedish Pig Producers' Association (*Föreningen Sveriges Grisproducenter*). The Swedish Animal Health Service undertakes field work in connection with preventive pig health care, supervises artificial insemination activities and takes part in disease eradication programmes.

2.1.4 Horse rearing

Swedish breeds and their development

Between 1920 and 1970, Swedish horse population declined from about 720,000 to approximately 84,000. Since then the number has risen again, reaching 220,000 in 2000. This steep decline was partly due to growing mechanisation in the farming and forestry industries beginning at the end of the second world war, and partly to the fact that horses were no longer used by the Swedish armed forces.

About 80 per cent of all horses in Sweden used during the second world war were work horses. Most of the draught horses were descended from Ardenners imported into Sweden from Belgium in the latter part of the 19th century. The North Swedish Horse was used extensively as a work and draught horse both on farms and for forestry work.

According to figures compiled by the Swedish Horse Board (*Svenska Hästavelserförbundet*) in 2001, horses in Sweden fell into the following use categories: riding 61 %, harness racing 30 %, horse racing 2 % and forestry work 7 %. Today, most of the horse breeds found in Europe are represented in Sweden.

Horses are normally classified into groups according to the use to which they are put, i.e. work, harness racing, horse racing and riding. The recovery of the horse population in the last 30 years is wholly attributable to the growth in leisure activities and greatly increased interest in different forms of gambling, sports and competitions involving horses. For the last 20 years, equestrian sports have been a favourite leisure activity among young Swedish girls.

Among all the breeds of horses found in Sweden and used for different purposes only three are regarded as being of native origin, or, because they have existed in the country for so long, as genuine Swedish breeds. These are the Ardenner (*ardenner*), the North Swedish Horse (*nordsvensk brukhäst*) and the Gotland Pony (*gotlandsruss*). All three breeds are in serious decline as the demand for their services has all but disappeared.

Breeding practices and procedures

The breeding goals for the just over 30 breeds of horse in Sweden vary with the uses to which the respective breeds are put. By law, all stallions of all breeds used for breeding purposes must be evaluated. This provision does not apply, however, if the stallion is used exclusively to service the owner's own mares.

Warm- and cold-blooded trotting horses are evaluated for pedigree, performance, health and external conformation. Warmbloods are further subjected to a trotting test in harness while coldbloods are given a special driving test. Points are awarded for each stage of the test. The stages are then rated together to arrive at an overall assessment of the stallion's breeding value. The breeding goals are performance, health and external conformation. The official breeding organisation for trotting horses is the Swedish Trotting Association (*Svenska Travsportens Centralförbund – STC*).

English and Arab thoroughbreds are used in horse racing. Here too, the breeding evaluation is based on performance, pedigree, health and external conformation. To pass the progeny test a stallion must have sired at least two crops of the required number of starting foals, the youngest of which must have reached the age of three. The Official breeding organisation for race horses is the Swedish Horse Racing Association (*Svenska Galoppsportens Centralförbund – SGC*).

The Swedish Horse Board (*Svenska Hästavelserförbundet – SH*) is the official organisation responsible for other horse breeds, such as riding horses and workhorses. Much of the administrative work is undertaken by the various breeders' associations themselves. Breeding evaluations are based on pedigree, external conformation, performance and, where data is available, progeny testing. Performance is assessed in a special test adapted to the type of work normally carried out by the breed. The largest group of horses within SH is the Swedish half-blood horse. These horses are bred for performance and widely used in riding schools and for hobby purposes.

2.1.5 Sheep farming

Swedish breeds and their development

Sheep production has never been a major industry in Sweden. At the turn of the 19th century there were some 1 million sheep in Sweden. The population shrank steadily thereafter, reaching a low of 130,000 in the mid-1950s. Since the 1960s, the total number of ewes has varied between 100,000 and 200,000.

The Swedish sheep population is largely made up of two different types of older breeds of native origin. In the early part of the 20th century sheep were mainly bred for products used by the owners' own households and for wool for the textile industry. From 1950 onwards, sheep were mainly bred for slaughter and pelt production. As a result, the Gotland Pelt sheep became the numerically dominant breed in Sweden until the end of the 20th century. Interest in crossbreeding has grown since about 1980. This has mainly involved ewes of very fertile Swedish breeds bred with Texel rams. Hybrid ewes of both breeds are used to produce lambs for slaughter.

In the 1980s, a certain amount of breeding material from dairy sheep breeds was imported into Sweden. This led to the establishment of some 20 dairy sheep herds for the production and direct sale of sheep cheese.

The remaining individuals of a number of older, native breeds have been recorded on a list of endangered Swedish sheep breeds and are included in the national programme for the conservation of endangered breeds.

Breeding practices and procedures

Swedish sheep breeding has a good international reputation. Thanks to suitably adapted breeding programmes, sheep owners have achieved comparatively high production rates measured in lamb weight per recorded ewe. Although lamb is the primary product, wool and pelts contribute to the total revenues accruing to the industry.

Governmentally supervised sheep recording schemes, which included registration of animal identity, pedigree, production values such as wool volumes, wool quality and lamb growth rates, and entry in herd books were introduced in the 1940s. Initially these only applied to specially selected, so-called breedingherds. Since 1957, however, sheep breeding controls have been open to sheep-owners throughout the country. In 1983, overall responsibility for the sheep recording was transferred to the Swedish Sheep Breeders' Association (*Svenska fåravelserförbundet*). In addition to registration and appurtenant breeding evaluation, the Association is also responsible for artificial insemination. Responsibility for sheep health care rests with the Swedish Animal Health Service.

Sheep recording include pedigree registration, recording production values and keeping slaughter records. In recent years, interest in sheep recording has dwindled due to declining profitability in, among other areas, the production of pelts for fur-lined wear from the country's numerically dominant breed, the Gotland Pelt sheep. Another reason for the waning interest in breeding activities is that a large proportion of the earnings accruing to sheep farmers are made up of grants for maintenance of the landscape and general livestock grants. Some 22,000 of Sweden's 217,000-odd ewes are currently registered for pedigree and production testing.

In accordance with overall breeding goals for the industry, breeders now concentrate on lamb growth and carcase quality, fertility, maternal traits for lamb growth, ewe weight and pelt and wool quality. The relative importance of the different traits varies from breed to breed and depends on production aims for the flock in question.

The practical field work, including the marking of new-born lambs and the recording of birth data, identity, lamb growth and wool and pelt quality is normally undertaken by the livestock owner. These data are processed centrally through of breeding organisations. The same organisations perform progeny testing of breeding rams as well as the appurtenant breeding evaluations.

2.1.6 Goat farming

Swedish breeds and their development

Breeding material used in goat breeding in Sweden mainly derives from the original native breed. The Swedish dairy goat is also a native Swedish breed although the Swedish and Norwegian breeds share the same origin. Dairy goat production is now very limited in extent. Most of the 3,000-odd dairy goats recorded are found in some 90 herds in central areas of northern Sweden. Their milk is used exclusively in cheese making managed by the goat farmers themselves. Although goat producers market and sell their products themselves, a small-scale cooperative marketing and selling organisation has been in operation since 1985. In recent years, goat keeping in Sweden has seen the addition of a small number of herds of angora goats for the production of angora wool.

Small numbers remain of two old Swedish goat types: the Göinge Goat and the Jämtland Goat. Both are listed as endangered breeds and are included in the national conservation programme.

Breeding practices and procedures

Despite the very small number of goats and goat producers in Sweden, pedigree and production control are well established. As all controlled goat owners are affiliated to one and the same livestock association, the latter is responsible for carrying out all inspections and tests. Some 20 herds comprising approximately 700 goats are affiliated. Yield assessments are based on dry weight measurement of milk.

In Norway, where inspection and testing are far more extensive than in Sweden, progeny testing of he-goats has been carried out for some 20 years. Norwegian breeding billy-goats are therefore extensively used by Swedish breeders.

2.1.7 Poultry farming

Egg production for household needs, a feature of virtually every Swedish farm until the 1950s, has largely ceased. Since the mid-1950s, egg production has been increasingly restricted to a diminishing number of battery units of steadily increasing size. The population of laying hens is approximately 5.6 million. Breeding has become highly internationalised in response to the demand for high-intensity, efficient egg production. All breeding material for egg and broiler production is now imported and propagated in a small number of Swedish breeding units. Some 200 producers with combined space for 7 million broiler chickens are engaged in the production of poultry meat.

Remains of some ten older local Swedish breeds have been included in the Swedish conservation programme for endangered domestic livestock breeds. The same applies to three farm duck and two domestic goose breeds.

2.1.8 Reindeer husbandry

Reindeer husbandry is carried on for meat production on lands which together make up 40 per cent of Sweden's total surface area. The number of animals varies cyclically over a 20 to 30-year period by $\pm 25\%$ around an average figure of 225,000. The last peak occurred at the start of the 1990s. Tame reindeer are a partially domesticated form of Eurasiatic tundra reindeer, which are found throughout the far north from Scandinavia to eastern Siberia. Adaptation to natural production conditions is important in reindeer husbandry as the animals are not fenced in and their environment cannot be affected.

2.1.9 Beekeeping

Bees are numbered regarded as food-producing livestock even though they differ in a number of respects from other animals human beings have taken into their service. Bees are not kept solely for honey production and wax but are also used extensively for pollination.

Although a number of breeds have been tested for Nordic conditions down the years, only 4 have been found suitable and widely adopted by Swedish beekeepers. These are the Nordic bee, the Italian bee, the Krainer bee and the Caucasian bee. Hybrids between these breeds are also common. The number of Nordic bee colonies has fallen sharply and special conservation measures are being implemented. The Swedish Beekeepers' Federation (*Sveriges Biodlares Riksförbund – SBR*) is the national organisation for beekeeping associations throughout the country.

2.1.10 Rabbit farming

The number of rabbit breeds in Sweden is very large. Rabbit production is mainly a leisure pursuit. In most cases, the animals are bred for showing in accordance with established breeding criteria. Judging takes place at special rabbit shows, organised by the national organisation, the Swedish Rabbit Breeders' Association (*Svenska Kaninavelsförbundet*), or by regional rabbit breeding societies. Commercial production of rabbit meat takes place on a very small scale in Sweden. The total number of breeding animals is not known.

Only two rabbit breeds, the Gotland Rabbit and the Fur Rabbit are native to Sweden. Both have decreased significantly in number during the 20th century and have therefore been placed on the list of endangered Swedish livestock breeds.

2.1.11 New types of livestock used for food production

There are approximately 140 fish farms in Sweden with a combined annual output is just over 5,000 tons of table fish, chiefly rainbow trout.

At present there are just under 600 deer enclosures in Sweden, containing a total of 17,000 red and fallow deer. The population fell sharply during the 1990s as a result of a campaign to combat tuberculosis. Although production is chiefly for meat, the sale of live animals and hunting inside the fenced-off areas are also significant sources of income. Production is similar to that for other grazing animals but without the need for buildings. The animals are fed on pastureland during the winter months.

2.1.12 Conservation of native breeds

There are some 35 native livestock varieties/breeds in Sweden. Most of these succumbed, as commercially viable production breeds, to competition from imported breeds and hybrids during the latter part of the 19th and the beginning of the 20th centuries. As the number of animals in this group has fallen sharply the Board of Agriculture has officially classified these breeds as endangered. The number of registered pure-bred individuals within these threatened breeds ranges from as few as 15 in some cases to approximately 2,500.

The United Nations Conference On The Human Environment held in Stockholm in 1972 resolved that “each state shall be responsible for its own livestock breeds and devote particular attention to those breeds in danger of extinction”. It was emphasised at the conference that the latter could possess traits vital to the development of new products and production systems and that their unique attributes once lost might well be irreplaceable. These breeds are of great historical and cultural value.

In 1978 the Government set up a committee of inquiry to examine the issue of long-term conservation of domestic animal genetic resources. The committee’s report (Ds Jo 1980:6) deals mainly with the origins of the breeds in question, methods for the conservation of genetic resources and possible ways of utilising these resources for the benefit of society.

Government initiatives for the conservation of threatened breeds

Although government work in the field of domestic animal genetic resources is concerned with the country’s total genetic capital, government efforts in the 1980s were aimed primarily at the conservation of highly endangered breeds. In 1984, the Nordic Gene Bank for Farm Animals (*Nordisk Genbank Husdjur – NGH*) was established to coordinate conservation measures in the Nordic countries.

In 1993, the Swedish Riksdag approved a bill proposing a strategy for the conservation and sustainable use of biological diversity (1993/94:30). It was established in the strategy that ultimate responsibility for domesticated animals should rest with the Board of Agriculture.

In 1995, the Board drew up a number of action plans designed to assist in the work of conserving all remaining Swedish domestic animal breeds. The plans were expected to

contribute to the favourable development – both in terms of number and quality – of these breeds. Results were to be followed up and evaluated.

Activities of societies for the conservation of livestock breeds

Livestock owners interested in conserving the remains of older local livestock breeds had recognised early on that conservation work would be easier if they organised themselves into breed-specific associations. This step was completed by the early 1990s.

Individual livestock owners and their associations have taken considerable responsibility for the conservation of endangered domestic animal breeds. Their organisation into societies has manifestly facilitated conservation work and cooperation between government and industry. The societies' revenues and operating assets proceed from membership fees and government funding for the farmers' environmental conservation skills development programme, *KULM (kompetensutveckling av lantbrukare inom miljöområdet)*.

Extensive work involving breed identification and recording numbers of individuals of each breed was carried out between the late 1980s and early 1990s, often at the initiative of the breed societies concerned. In the 1990s, these societies cooperated in a government funded programme involving the collection of semen from beef cattle, sheep and goat breeds both for direct use and for storage in sperm banks. The societies also cooperated in drawing up breeding plans, subsequently approved by the Board of Agriculture, for all endangered livestock breeds.

Other concurrent tasks included registration of the identity and pedigree of individual animals of each breed. Most societies undertake the registration work themselves under the supervision of the Board of Agriculture.

The Swedish position has so far been that livestock belonging to these older, local domestic animal breeds should be kept, used and developed for production as in the past. A small proportion is kept in zoos and open-air museums where they contribute to the dissemination of information to the public about old native livestock breeds and their conservation.

Populations of endangered breeds of cattle, sheep and goats still regarded as viable for production purposes are registered with appropriate breeding organisations that normally carry out performance and pedigree recording and are approved by the Board of Agriculture. The Board of Agriculture has approved the action plans and guidelines of most of the societies for the conservation of livestock breeds. In doing so it has also officially approved them for registration activities under the supervision of the appropriate government authority.

With the organisation of livestock owners into societies, the indexing of purebred animals and the registration of individual identities and pedigrees, the groundwork has been laid for the successful conservation of breeds threatened with extinction. The recently introduced environmental compensation for the conservation of endangered livestock breeds of around SEK 1,000 per kept livestock unit has helped maintain interest in keeping – and the ability to keep – threatened breeds at a reasonably satisfactory level.

2.2 Outcome of breeding activities

Commercial breeds

Livestock production is showing marked development in relation to stated breeding goals. This is the result of sound, well applied, up-to-date breeding programmes, continually

improving techniques and technologies in all areas of production and better trained and educated livestock owners.

The country is adequately supplied with milk and milk products by a national dairy herd only a third as large as it was only 50 years ago. Due to higher average yields per livestock unit of all types, considerably less arable land is needed for the production of livestock feed than in the past.

Major efficiency improvements in the industry means fewer people are now earning a living in agriculture or livestock production. However, this should not be regarded as an unfavourable development as other employment opportunities have always been generated in the past. One price the public has nevertheless had to pay for the sizeable reduction in the number of beef cattle and the concentration of livestock production in the country's flatter regions is fewer areas of open countryside. Increased environmental concern in the form of financial incentives for landowners to keep natural pastureland and coastal meadows free of trees has to some extent counteracted forest encroachment.

Threatened breeds

Breeding and conservation work with endangered livestock breeds has been successful in that the total number of animals of each breed is now known, breeding plans have been drawn up and a registration system for individual animals is now in operation. The goal of the 1995 action plans to numerically strengthen the most endangered breeds has been successfully met in some cases while the threat to other breeds remains acute.

2.3 Production systems and animal genetic resources.

Swedish production systems differ in some respects from those prevailing in other European countries. The differences are partly attributable to the relatively cooler climate in the Nordic countries and partly to the fact that under Swedish animal welfare legislation livestock cannot fully be kept in accordance with European regulations. The minimum living space prescribed for housed livestock is somewhat greater in Sweden than in several other countries.

Under current Swedish animal welfare legislation, hybrid laying hens may no longer be kept in cages of the size traditionally used in most countries carrying on high-intensity production. This has entailed major changes for egg producers who have been obliged to choose between keeping so-called free-range hens or hens in larger, 'enriched' cages more appropriate to the birds' natural behaviour.

The Nordic climate has encouraged the development of well insulated, adequately ventilated buildings for housing livestock. This is essential when it comes to poultry, but with other types of livestock it is equally important to create a tolerable environment for stock minders, ensure effective provision of feed and water and reduce feed costs. Grazing dairy cattle must be given coarse fodder and grain during the grazing period.

In recent decades, Swedish dairy cows have become larger and heavier through breeding, thus increasing the need for indoor living space. In the interests of health and to give animals an opportunity to return to their natural behaviour, the time spent by cattle out of doors during the summer months is also regulated in Sweden. Swedish animal welfare provisions recommend that dairy cattle be kept in free stall systems. As a result of these recommendations and in view of a number of other advantages of loose housing systems,

almost one third of all Swedish dairy cows are now housed in such systems, which allows them greater freedom of movement while indoors.

In larger herds, milking robots are now in evidence. In some dairy establishments, cows are now milked three times a day, not just for the sake of higher yields but also because more frequent milking has been shown to affect yields and udder health favourably. Sow tethering in piglet production is forbidden. Sows are now housed in looser systems that allow greater freedom of movement.

The various production systems in use in Sweden do not require special adaptation to different animal breeds. Choice of breed is mainly determined by the preferences of individual livestock owners and the traditions of any particular area. Only where summer grazing in upland pastures is practised – in the southern areas of northern Sweden (*Norrland*) – can the choice of dairy cattle breed become critical.

A limited number of producers have gone over to organic production methods. The government's policy goal is to have 20 per cent of all arable land brought under organic cultivation by 2005, and 10 per cent of all dairy cows, beef cattle and lambs bred for slaughter in production systems. It is estimated that approximately 5 per cent of all dairy cows, 30 per cent of all slaughter lambs and 10 per cent of all heifers and steers bred for slaughter were already in organic production in 2000. Facilities must exist in organic production for animals to be kept out of doors during the appropriate seasons. This places special demands on the animal material being used for production, particularly in the case of pigs and poultry.

2.3.1 Livestock feed

Sweden is largely self-sufficient with regard to coarse fodder and grain for livestock production. About 85 per cent of all arable land in the country is used for the production of animal feedstuffs. Owing to advances in terms of yields and production due to breeding – above all in the dairy cattle and pig industries – and the attendant rise in demand for high-protein feed, the latter now has to be imported. The Nordic climate is not suitable for the cultivation of soya beans, the raw material for the most widely used protein feed. A new law on livestock feed, passed in 1986, banned the use of antibiotics and chemotherapeutic agents in animal feed for growth-enhancing purposes, as well as the mixing of meat and bone-meal from animal carcasses in livestock feed.

2.3.2 The environmental impact of livestock production

The profound structural transformation sustained by the Swedish livestock production industry over the last few decades, in which a drop in the total number of farms has been offset by a rise in the number of large-scale establishments and higher production levels per livestock unit, is placing an increasing strain on the environment. Thus environmental problems are on the increase in the flatter areas of southern Sweden, where dairy and pig production are heavily concentrated.

It is estimated that Swedish agriculture in general and livestock production in particular are responsible for 90 per cent of all ammonia emissions inside Sweden's borders. The growing strain on the environment, partly caused by agriculture and livestock production, has prompted government measures, including restrictions on the storage and spreading of manure. These rules have now been incorporated in the Environmental Code (1998:808). The

Government has recommended an early changeover to slurry handling at dairy and grower pig facilities.

Animals are also kept because of their potentially favourable impact on the environment and out of a desire to maintain biological diversity. In Sweden there are some 2,500 protected natural areas (national parks, nature reserves and natural habitats). Grazing animals are kept in about 600 of these areas, some 40 of which provide pasture for native breeds of beef cattle, goats, sheep or horses. The aim of this activity is to maintain and manage rural ecosystems of longstanding cultural interest in traditional ways and thereby conserve the biological, cultural and historical assets associated with them. Nature conservation thereby contributes to the conservation and use of these breeds.

Environmental quality objectives

The Swedish Riksdag has approved 15 separate environmental quality objectives (Government Bill 2000/01:130, Committee Report 2001/02:MJU3, Government Communication 2001/02:36). Their purpose is to influence environmental protection and conservation work at all levels in Sweden, in the EU and internationally. The Board of Agriculture is responsible *inter alia* for the objectives embodied in the policy document *A varied agricultural landscape*. To achieve this objective, agricultural land must be cultivated in such a way that biological diversity is maintained and promoted. Similarly, livestock and plant breeding must be pursued in such a way as to conserve genetic variation in domesticated animals and plants.

The aim is to increase the amount of the most threatened types of pastureland under maintenance by 13,000 hectares by 2010. However, this presupposes a sufficient number of grazing animals. According to a comparative study carried out in 1994, half of all municipalities lacked enough grazing animals to maintain the total acreage of pastureland.

Another aim is to have enough individuals of endangered native livestock breeds in existence by 2010 to ensure their long-term survival. The environmental compensation for conserving threatened livestock breeds should contribute to the fulfilment of these environmental quality aims and objectives.

2.3.3 Livestock diseases

The situation as regards the health of the Swedish livestock population is satisfactory. Thanks to a number of disease prevention programmes, initiated by the government and carried out in cooperation with players within the industry, several diseases found in Europe have been successfully kept out of Sweden. Government grants are allocated for the combating of communicable animal diseases. The trend towards ever bigger units and greater livestock density has led to the introduction of a requirement that large facilities be partially sectioned off in order to reduce the pressure of infection. To increase food safety, preventive measures and inspections for salmonella infection and other diseases are already implemented at the primary production stage.

Health inspection programmes

The Livestock Inspection Act and the detailed instructions drawn up by the Board of Agriculture also state that an organisation wishing to operate any form of organised health care service for domestic animals can apply to the Board to have its plan of operation and guidelines approved. A health inspection programme of some kind exists for all types of domesticated animals in Sweden. There are also programmes for the eradication of certain

specific diseases. Organisations that carry on this type of activity are eligible for government support. The Swedish Animal Health Service is concerned with the health of pigs, beef cattle, sheep and deer, while the Swedish Dairy Association is responsible for *FRISKKO* (Healthy Cow), a health programme for dairy cows.

Livestock registration

The Board of Agriculture is responsible for keeping livestock registration records. Although these are mainly intended for use in tracing sources of infection, they can also be used in connection with the payment of government subsidies, grants or compensation. In addition, they allow officials and researchers to follow population trends for different livestock breeds across the country.

The central register for all cattle in Sweden contains details of each animal's identity and breed. The latter is based entirely on the livestock owner's own reports, which are submitted regularly to the relevant breeding organisation.

The swine register contains data on all pig herds, the number of pigs on each farm and the farms' geographical coordinates. As of 2003, there will also be a central register of all egg producers, containing information on the production systems employed in each case. A sheep and goat register is also under discussion in the EU.

The Board of Agriculture has decreed that all horses must have passports as of 2005. This means that every animal will be allocated a unique identity number. The Board of Agriculture has also developed a computerised database, *Vet@*, which will contain records of all veterinary treatment carried out on sick livestock. Some of the data is passed on to the Swedish Dairy Association to be used in breeding evaluation.

3. Organisational structure, know-how and expertise, status and development needs

3.1 Public authorities and organisations

3.1.1 Public bodies

The Swedish Riksdag and the Government

The Swedish Riksdag (parliament) represents the legislative branch of government. The Swedish Government Offices comprise the various ministries which together constitute the executive branch of government. The Ministries of Agriculture and the Environment are ultimately responsible for the supervision of livestock management and the use of genetic resources in Sweden. Sweden differs somewhat from most other countries in that responsibility for implementation of legislations and government decisions is exercised by independent central government authorities instead of by the ministries themselves. Thus the Government issues ordinances and other instruments empowering the relevant central authorities to draw up directives and regulations governing activities in areas indicated or defined in existing legislation.

Swedish Board of Agriculture

The Swedish Board of Agriculture is a central administrative authority responsible to the Ministry of Agriculture. It is the Government's expert authority on agricultural and food policy. The Board's aim in the fields of agriculture and reindeer husbandry is to actively promote the development of a competitive, environmentally sound, animal welfare-oriented food production industry that benefits both producers and consumers. Much of the authority's work is concerned with the implementation of EU regulations and support systems.

As regards livestock, the Board exercises overall responsibility for breeding matters, animal welfare, prevention and control of communicable diseases, feed inspection and control, and the country's district veterinary organisation.

Swedish Environmental Protection Agency

The Swedish Environmental Protection Agency is the central government authority with responsibility for implementation of environmental policy. It is directed by the Government to coordinate environmental conservation measures and be proactive in the environmental field both nationally and internationally. The Agency is responsible for matters arising in connection with the implementation of the Convention on Biological Diversity.

It also seeks to promote the sustainable use of the country's natural resources, including genetic resources, ensure the conservation of valuable natural environments and secure biological diversity in the long term. In pursuance of these duties, it provides guidance to the country's County Administrative Boards, which are responsible for establishing and managing nature reserves.

In 1991, the Agency initiated the project "Native Breeds in Nature Management" (*Lantraser i naturvården*) with the aim of giving managers of nature reserves and others a greater understanding of the importance of conserving older livestock breeds. In the project, the Agency introduced animals of these breeds into selected nature reserves and national parks in order to demonstrate problems and solutions to others who might be interested in native breeds. Grazing animals, some of them old native breeds, are now used in the management of a large proportion of the country's protected areas.

County Administrative Boards and local government authorities

Sweden has 21 County Administrative Boards. These regional level central government authorities are responsible for the supervision of livestock inspections. They also review decisions taken at local government level and supervise the disbursement of EU support funds. The Boards are also empowered to grant other forms of EU support, such as investment subsidies.

The country's 289 municipal (primary tier) authorities are responsible for supervision in the areas of environmental conservation, animal protection and food safety.

The universities

With its education and research faculties for forestry, agriculture, horticulture and veterinary medicine, the Swedish University of Agricultural Sciences (*Sveriges Lantbruksuniversitet – SLU*) is responsible for higher education in a range of areas including animal genetic resources for food and agriculture. Other courses offered by the University include training for livestock technicians who carry out artificial insemination on behalf of livestock associations. This training is provided in collaboration with the Swedish Dairy Association.

Other universities and institutes of higher education also conduct research and training in biodiversity.

Swedish Biodiversity Centre

The Swedish Biodiversity Centre (*Centrum för biologisk mångfald – CBM*), established by act of parliament in 1994, is linked to the Swedish University of Agricultural Sciences and the University of Uppsala. The Swedish Biodiversity Centre was established with a mandate to help promote the incorporation of the Convention on Biological Diversity by initiating and actively participating in crucial research, education, training and information in connection with wild and domesticated biological resources. Through its role as a liaison body, the Centre has built up an extensive contact network embracing universities, public authorities, open-air museums and zoological parks, the WWF, the Swedish Society for Nature Conservation and local organisations within the agricultural sector.

Swedish Museum of Natural History

The Swedish Museum of Natural History organises exhibitions and other educational activities aimed at disseminating knowledge about the origins, history and development of the Swedish countryside. The Museum also carries out extensive research work in a range of fields including biodiversity.

The Museum is also responsible for developing professional expertise in the field and providing training and advice to other natural history museums in the country. Among other activities, it supports cooperation between local and regional museums through NAMSA, an organisation for the promotion of cooperation among natural history museums.

Upper secondary schools specialising in natural resource utilisation programmes.

The country's 30-odd upper secondary schools that offer courses in natural resource utilisation are responsible for providing basic education to young people interested in agriculture and livestock farming. A number of these establishments keep animals belonging to endangered native domestic breeds.

3.1.2 National organisations

The Federation of Swedish Farmers (*Lantbrukarnas riksförbund – LRF*) is a national organisation representing Swedish farmers. It includes a number of local organisations responsible for safeguarding interests in the agricultural and livestock industries. Examples include the Swedish Dairy Association, Swedish Meats, etc.

As its name suggests, the National Association of Smallholders (*Småbrukarnas Riksorganisation*) is an organisation dedicated to promoting the interests of smallholders.

As the professional organisation for ecological farmers, Swedish Ecological Farmers monitors policy on, current research in and regulations governing organic production in Sweden and the EU.

KRAV is a certification organisation for organic farming and production. Its aim is to promote the economic interests of its members through the inspection, control and labelling of organic produce.

The Swedish Demeter Association is an official certification body for bio-dynamic and organic cultivation. It is approved by the National Food Administration and the Board of Agriculture.

There are a number of other organisations concerned with safeguarding consumer interests and disseminating information. These include the Swedish Consumer Coalition (*Konsumenter i samverkan*) and the Swedish Cooperative Union and Wholesale Society (*Kooperativa Förbundet – KF*). The market constitutes an important pressure group in matters relating to food production.

3.1.3 Livestock organisations

Breeding organisations

Breeding activities in Sweden are directed by 6 breeding organisations, all approved by the Swedish Board of Agriculture. These are the Swedish Dairy Association (*Svensk Mjök –* dairy and beef cattle), the Swedish Sheep Breeders' Association (*Svenska Fåravelsförbundet –* sheep), Quality Genetics (pigs), the Central Federation of Swedish Trotting Associations (*Svenska Travsportens Centralförbund – STC –* trotting horses), the Central Federation of Horse Racing Associations (*Svenska Galoppsportens Centralförbund –* thoroughbred racehorses), and the Swedish Horse Board (*Svenska Hästavelsförbundet –* draught and riding horses). These organisations draw up supervision, inspection and breeding evaluation standards, norms and regulations, and are responsible for the orientation and scope of breeding goals. Some are also responsible for all livestock registration and entry into herdbooks, and for advice and information on breeding practices and choice of livestock.

Breeders' associations

There are several kinds of breeders' societies/associations. Some undertake livestock registration and entry in herdbooks while others are more concerned with representing and promoting the 'interests' of a particular breed. Whichever the case, their tasks normally include marketing of and information on the breed in question, and advising and safeguarding the interests of their members.

3.1.4 Other organisations

Open-air museums and zoological parks

Several Swedish open-air museums and zoological parks keep populations of endangered livestock breeds, thereby contributing substantially to the dissemination of knowledge of and interest in their conservation, both as cultural heritage assets and a valuable genetic resource. Although exhibition is normally the primary aim of these establishments, many institutions contribute to the survival of the endangered breeds they keep by breeding and rearing them and through research and education.

Nordens Ark (a zoological park in Bohus county), *Skansen* (an open-air museum and zoological park in Stockholm) and *Skånes djurpark* (Skania's zoological park) are examples of large institutions which keep stocks of endangered native Nordic breeds. However, the fact that the Board of Agriculture has advised against the exchange of animals between zoological parks and livestock farms or breeders due to the risk of infection has made it more difficult for parks to play a larger role as gene banks.

World Wildlife Foundation (WWF)

WWF Sweden has long displayed a strong commitment to old native Nordic livestock breeds. It has supported a number of projects for the conservation of endangered breeds. A series of projects involving applied research and practical measures for the conservation of older livestock breeds are funded annually out of a recently established fund (*Väktarfonden*), set up under the WWF programme for the conservation of open agricultural landscapes. In recent years there has been a tendency to prioritise Swedish breeds and to favour utility values and conservation within a the wider context of rural conservation. WWF has also stated its intention to supplement the support provided by the EU through the Board of Agriculture.

Swedish Society for Nature Conservation

The Swedish Society for Nature Conservation is the country's largest advocacy group in the field of nature and environmental conservation. The Society acts across a broad front to safeguard Sweden's rural areas, plants and animals. Thanks to targeted efforts by the Society, animals belonging to endangered Swedish livestock breeds now graze freely in a number of areas across the country.

3.2 Knowledge, skills and expertise, and continuing professional development

The conservation of genetic resources is predicated on their sustainable use as well as on special measures to ensure that all priority goals are met. All activities require knowledge for their implementation. The present field is no exception. While there is considerable expertise to be found in the fields of conservation and sustainable use of animal genetic resources, there are also perceptible gaps.

3.2.1 *KULM*

KULM, (*KompetensUtveckling av Lantbrukare inom Miljöområdet*) a continuing professional development programme aimed at improving farmers' environmental conservation skills was formally incorporated into the new Environment and Rural Development Programme for Sweden 2000–2006 (the *LBU* programme) on 1 January 2000. *KULM* aims to motivate and train farmers and other people active in the agricultural sector to use production methods that

are environmentally and economically sustainable over time. Particular weight has been attached to training and advisory activities that will help farmers meet their environmental commitments. Owners of threatened domestic livestock breeds are also included in the target group.

Area of Expertise 1 is biological diversity and the cultural environment. Measures include cultural activities of various kinds, advisory activities, the distribution of information material and newsletters. Support from the Board of Agriculture takes the form of further training courses for advisors. Also included here are activities aimed at conserving characteristic properties and genetic variation of endangered livestock breeds, thereby improving their chances of long-term survival. In 2000, approximately SEK 50 million was disbursed, of which SEK 1.4 million went to societies for the conservation of livestock breeds. 25 per cent of all support under the programme is funded by the EU.

3.2.2 Basic training and further training

Training should be provided at all levels. This can be achieved by integrating the subject of genetic resources into existing training programmes on livestock management and livestock breeding at upper secondary schools specialising in natural resource utilisation programmes. The subject should also feature prominently in courses offered by the Swedish University of Agricultural Sciences. Animal genetic resources for food and agriculture should be included as a subject in upper secondary and university courses on the significance, utilisation and conservation of biological diversity.

3.2.3 Research

Effective conservation and sustainable development of domestic animal genetic resources must be supported by research. This applies as much to know-how acquisition and general skills development in genetics and animal breeding as it does to finding solutions to more specific problems. Interplay between genotype and environment, the application of selection and mating strategies to avoid inbreeding, the origins of and kinships between livestock breeds and many other issues are the subjects of contemporary research. Measures are also called for in a number of new areas. These include a more accurate survey of the genetic traits of threatened breeds. This could be obtained by conducting comparative studies of different types of breeds under a variety of conditions. Certainly, better data on the merits of different breeds is a vital necessity. A comprehensive evaluation of the advantages or otherwise of exchanging breeding programmes under Swedish management as opposed to importing genetic resources is another concern, as is the optimisation of efforts in connection with unalloyed conservation measures.

Research is financed in part by permanent funds at the disposal of universities and higher education institutes and partly by special project funds from a large number of potential financial backers. Research involving the characterisation of breed diversity in performance and genetic variation and the development of new conservation methods had never been a priority area, and until recently the problems that needed solving were seen as having little news value in scientific terms. The EU, the Nordic Council of Ministers, the Nordic Gene Bank for Farm Animals (*Nordisk Genbank Husdjur*) and the Swedish Board of Agriculture have all contributed research funds, as has the WWF. Major government investment in biodiversity research starting in 2002 and handled by, among other bodies, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (*Forskningsrådet för miljö, areala näringar och samhällsbyggande – FORMAS*) also makes

provision for work on domestic animal genetic resources. *FORMAS* and the Swedish Farmers' Foundation for Agricultural Research (*Stiftelsen lantbruksforskning*) are the primary sources of funding for research into and development of breeding programmes featuring trait genetics and breeding evaluation methods.

The Swedish Biodiversity Centre (*Centrum för biologisk mångfald – CBM*) coordinates national programmes on ethnobiology (featuring the theme 'human beings and domestic animals') and plant genetic resources, as well as an interdisciplinary research programme on the effect of farming methods on wild and cultivated biodiversity in unimproved pastureland, financed by the Foundation for Strategic Environmental Research (*Stiftelsen för Miljöstrategisk Forskning – MISTRA*).

3.2.4 Advisory services

Responsibility for the advisory services formerly provided by the state-run local agricultural boards has largely been taken over by organisations within the livestock farming industry. The County Administrative Boards provide advice on organic production as part of the farmers' environmental conservation skills development programme (*KULM*) and in connection with drives, like the open countryside campaign, in which grazing animals play an important part. Many organisations in the agricultural industry themselves provide advice and information on a wide range of matters relating to livestock breeding and production. For example, the Swedish Dairy Association offers a number of packaged courses on feed, milk and beef production and economics, management and accounting for milk producers. Quality Genetics and the Swedish Animal Health Service provide advice to pig farmers. Swedish Meat organises courses on meat production. The various breeders' associations are in contact with many interested livestock owners and provide extensive advice on rearing different livestock breeds and breeding matters.

3.3 Information and communication

Djuridiken, a bimonthly newsletter on livestock rearing is issued by the Swedish Board of Agriculture's livestock division, which also publishes a newsletter entitled *SJV-info Biologisk mångfald-husdjur* (Swedish Board of Agriculture – Biodiversity-livestock), which is distributed to livestock conservation societies 4 times a year. The Board's website also features a separate section on livestock and veterinary issues. A brochure, 'Swedish Livestock Breeds', which is also available in English, has been published as part of the series 'Biodiversity in the Agricultural Landscape'.

Every livestock organisation publishes its own trade journal. Examples include: *Husdjur* (Cattle), *Svinskötsel* (Pig), *Gris* (Pig), *Fårskötsel* (Sheep) and *Fjäderfä* (Poultry). The same applies to all livestock conservation societies. The vast majority of these organisations also publish information on their own websites. The fact-sheets and information leaflets published by the Swedish Society for Nature Conservation also play an important role. The Swedish Biodiversity Centre publishes a quarterly magazine called *Biodiverse*. Collaboration between the Centre and WWF recently resulted in a report (publ. 2002) on Swedish livestock breeds as a genetic resource and cultural asset.

Open-air museums and zoological parks play an important part in the dissemination of knowledge and information to the general public. They not only exhibit different livestock breeds but also inform visitors about ongoing conservation projects. Of particular interest are

establishments that can exhibit animals in their proper context by combining traditional animal husbandry practices with the conservation of older cultural environments. Local and regional museums can also provide additional information about native livestock breeds.

4. International cooperation

4.1 Nordic Council of Ministers

The Nordic Council of Ministers, formed in 1971, is the forum for inter-governmental cooperation. It is involved in many areas of activity and policy including the promotion of a sustainable Nordic region in the widest sense. The Council of Ministers has adopted a *Strategy for the Sustainable Conservation of Genetic Resources in the Nordic Region for 2001–2004*. It covers genetic resources in agriculture and forestry as well as livestock farming. The vision behind the strategy is the establishment of a high-profile Nordic platform for the conservation of genetic resources.

Nordic Gene Bank for Farm Animals

In 1984, Denmark, Finland, Iceland, Norway and Sweden established the Nordic Gene Bank for Farm Animals (*Nordiska Genbanken Husdjur – NGH*). The gene bank is a centre of competence whose brief includes the documentation and conservation of genetic variation in farm animals. It is required to promote research and technological projects such as analysing the genetic profiles of livestock breeds, the development of appropriate conservation measures and sustainable breeding programmes.

In recent years, the gene bank has attracted increasing attention, particularly in response to its action programmes for 1998–2000 and 2001–2003. The growth in the number and scope of its activities has led to a significant increase in the size of its budget.

In its first year of activity, the bank launched a series of genetic resource-related projects in the Nordic countries. These were mainly aimed at older, local, often endangered livestock breeds. However, its two latest strategy documents focus more closely on problems in the active populations in the Nordic region. Its present strategy has four main objectives, namely to:

- provide more information on the importance of conserving and sustainably developing animal genetic resources
- promote proactive networks that embrace scientific institutions and committees, breeding organisations and government bodies engaged in promoting the sustainable use and conservation of animal genetic resources
- promote research and development in the field as a whole
- improve the politically determined economic preconditions for sustainable use and conservation of animal genetic resources in the Nordic countries.

The gene bank cooperates closely with Estonia, Latvia, Lithuania and Poland on animal genetic resource issues such as research, information and discussions in the form of regional conferences.

4.2 EU

The Environmental and Rural Development Programme is a result of current EU investment in rural development, which in turn forms part of Agenda 2000 and the reform of the Common Agricultural Policy. The regulations governing rural development measures are set out in Commission Regulation 445/2002/EG.

Promotion of research is covered by Council Regulation (EG nr 1467/94) on the conservation, characterisation, collection and use of genetic resources in agriculture. The regulation also provides for a 5-year action programme allowing research projects to share in a total annual allocation of € 10 million. The projects in question must be transnational in character and concerned with the characterisation and evaluation of plant and animal material.

4.3 UN Food and Agriculture Organisation

Along with many other countries, Sweden submits regular reports to the FAO's Domestic Animal Diversity – Information System (DAD-IS) database, where information on all the countries' livestock breeds is constantly being updated. The Swedish Board of Agriculture has been designated national coordinator for all FAO-related work on genetic resources in Sweden.

4.4 European Association for Animal Production (EAAP)

EAAP, which has a committee on genetic resources, was behind the creation, in Hannover, of the first information database on domestic animal genetic resources in Europe. European cooperation in the genetic resources field is currently being strengthened. The annual meetings of the national coordinators have provided a forum for exchanges of information and experience.

4.5 International Committee for Animal Recording (ICAR)

ICAR, which was founded in 1951 is now a global organisation responsible for establishing rules and standards for the purpose of identifying animals, the registration of their parentage, and recording their performance and evaluation. ICAR seeks to improve performance recording and evaluation through the establishment of common definitions and standards for measuring characteristics having economic importance.

Interbull

Interbull, a sub-committee within ICAR, was set up in 1983 following a Swedish initiative. Its secretariat is located in Uppsala, Sweden. Interbull's activities are financed out of EU funds (€ 60,000 per year) and charges paid by participating countries.

The committee is responsible for the development and standardisation at international level of breeding evaluation of beef cattle. This is achieved through coordinated international communication and research. Interbull offers services to participating countries.

5. Analysis of future needs and trends

The following section contains a summary of developments to date and an account of present-day conditions for livestock. This is followed by an attempt to predict the future shape of livestock keeping and the needs domestic animals will fill.

5.1 Important features of development

The early development of livestock husbandry was determined by a number of factors which can be summarised as environment, market and migration. The environment was often a limiting force, and the most obvious limiting factor was the need to provide animals with feed in the winter months of the year. Markets existed even at that stage and demand, including that generated in response to local needs, changed as time went by. Animal migration occurred as livestock and owners moved around together. Not long afterwards the first planned imports took place, quite simply in response to the desire to acquire through exchange animals which people regarded as better than the ones they had. Conscious efforts were made to improve agriculture and livestock production, particularly from the middle of the 19th century onwards.

The period between 1950 and 2000 saw extremely rapid progress in the development of breeding and production techniques for all food-producing animal breeds. The period was also marked by structural rationalisation, ever larger farming and livestock units, internationalisation at all levels of production, industrialised food production and competitive prices. But this was not the whole picture: those 50 years also witnessed increasingly widespread concern for the environment, animal welfare and ethical issues, and the development and implementation of policy programmes in areas such as sustainable development, biodiversity conservation including the conservation of genetic resources, food safety and the prevention of infectious diseases in livestock husbandry, to name a few of the more prominent trends.

Down the ages, domestic animals have contributed a whole catalogue of products and services to human society. These included products such as milk, meat, fibre, skins and hides, manure for crops, warmth, traction, capital and status. In our latitudes, animals were essential if anything edible was to be reaped from the land available for cultivation. Dogs and cats were perhaps the only animals allowed to retain their natural traits as hunters and guardians. Otherwise our domestic animal stocks have always been bred as much for traits that made them easy to keep and feed as for their useful qualities. This remains the case today; as needs change the genetic composition of our livestock population will alter as a result of expansion, exchange or breeding activities, in descending order of result over time.

A very pronounced change in Swedish animal husbandry over the last half century is the shift from livestock with generalised traits to highly specialised animals, bred for very specific qualities. This is due to many factors, the most important of which are probably the development of production methods aimed at profitability, our own and market demands for uniform products (standardised assortments), marketing considerations, price competition, etc.

5.2 The future of domestic livestock farming

An attempt should also be made to examine the factors that will determine the extent of livestock rearing and production of animal foods in the foreseeable future. Food from animal products will continue to be highly prized. Our diets contain a high proportion of animal food and no substantial change in this pattern is expected. The total quantity of food is increasing as the population rises, and the relative proportions of different products produced and consumed are changing. While the volume of milk consumed in dairy products of different kinds has remained fairly constant, chicken has displaced different types of meat on most household shopping lists. The demand for animal fibres, hides and skins is declining.

Though our horses and other livestock may have played out their part as draught animals, there has been a dramatic rise in the number of horses used for sport and in connection with other leisure activities. There is widespread interest in keeping livestock for other than commercial food production.

An important issue for the development of livestock production is the supply of animal feed. What kinds of feed will be available for livestock production in the future, and where will it come from? A precondition for organic production is feedstuffs produced locally, preferably on the same farm. There are a number of factors limiting the choice of feed. Competition with food cultivation for direct human consumption has not restricted the production of feedstuffs, as use of much of the land under cultivation would be uncompetitive for any purpose other than feed production.

Many farms today have no livestock at all, while others have too little land to manage their manure output satisfactorily. So far such imbalances are small in comparison with countries where animal density is higher. Although there is ample evidence of the beneficial biological effects of close integration of livestock and crop farming, the trend towards greater specialisation is moving development the other way. Nor has crop rotation been an issue for several decades. Beekeeping is another example of the interplay between animal husbandry and crop cultivation.

The environmental impact of livestock farming is at once beneficial and detrimental. Adverse effects include unpleasant smells from large pig production units and ammonia emissions from animal manure. The effect of livestock on the physical appearance of the countryside, biodiversity and the living environment are adduced in its favour. Animal waste from culled and slaughtered animals is a growing problem. There are technical solutions in sight but what was once a source of income in livestock farming has now become a cost.

The care, health and welfare of animals are now important issues for politicians and the general public. Existing animal welfare regulations have been tightened up and are now a limiting factor in certain respects compared to conditions in other countries. The ban on unenriched cages for battery hens has already been introduced and will be implemented by 2004. Large scale livestock production, highly intensive systems and systems that restrict animals' natural behaviour are being called into question. Public attitudes and failing markets have led to a sharp drop in the production of animals bred for fur in both in Sweden and abroad.

So far, the outbreaks of bovine spongiform encephalopathy (BSE), swine fever and foot and mouth disease which have disrupted livestock production in many parts of Europe in the past few years have not reached Sweden. The risk of outbreaks in this country have nevertheless

led to increased surveillance and control. The increasing segregation of livestock herds from outsiders and the general public is one obvious effect of such measures.

Economic conditions for livestock production are a function of agricultural policies. Today, we seem to be moving towards an unfettered international trade regime without protective tariffs or direct subsidies. There can be no doubt that unhindered development in this direction would totally alter conditions for domestic livestock production. A new agricultural policy, with the emphasis on rural and regional development is currently under discussion. A study published by the Ministry of Agriculture entitled *A New Task for Farmers (Bondens nya uppdrag)* has been presented. Fulfilment of these visions could have a profound effect on Swedish agriculture. However, estimates as to whether and when this will come about vary considerably. Their realisation would probably require a transition period of ten years or longer.

Modern livestock farming is dependent on a range of infrastructural services. These include veterinary services, purchasers, markets and transportation. Without them livestock farming would cease to exist. The maintenance of any given service in turn presupposes a minimum livestock density in that region. Animals belonging to endangered breeds must therefore have access to the same services as those available to commercial livestock farmers who keep animals from the active breeding population, which requires that the former are held in the same areas of the country as the latter.

Anyone wishing to keep livestock must of course comply with the provisions of the Animal Welfare Act. However, there are other laws and ordinances, which must also be observed by livestock farmers. Some of these can entail significant economic burdens for small-scale farmers, especially when livestock is used for food production. Manure processing plants, water supply systems, cooling systems, etc. can be expensive. Milk producers are now subject to a milk quota.

5.3 Development scenarios

In order to relate the discussion more closely to future needs in terms of genetic resources and measures for their conservation, a number of development scenarios for livestock production are set out below. These should be seen as possible avenues for development. While not mutually exclusive they could vary individually in terms of actual scope. Although the scenarios are open-ended it is important to keep them in mind when considering how an action plan for the conservation of animal genetic resources might look.

The term 'multifunctionality' refers here to multiple-use farming as variously illustrated in scenarios 2–7 below. It is difficult to predict how this phenomenon will develop or how efficient this type of livestock husbandry will be required to be. However, the degree of adjustment and space required for this kind of operation will determine the level of interest in different varieties, species and breeds of animal material.

1. Continued specialisation, internationalisation and concentration of livestock production

This scenario assumes the continued development of large units competing directly in the international market and using highly uniform production systems; 'concepts' featuring everything from animal material to technology.

Certification programmes designed to guarantee food hygiene standards enable them to compete successfully in the global market. Companies will develop best where conditions for production are most favourable. At present it is difficult to predict to what extent such enterprises will flourish in Sweden. Consumer choice – between domestic and imported food – will be a decisive factor in the development of production in Sweden.

The demand for animal material in this scenario will be much the same the world over despite the need to adapt to climatic conditions and other environmental factors, and the different demands associated with different types of product.

A handful of international breeding companies will compete to supply the best animal material. For economic reasons, producers will be unable to refrain from using the best animal material available. We have already seen a comparable trend in the broiler chicken and layer hen breeding industry and development in the pig farming sector is moving rapidly in the same direction.

Dairy cow breeding is already global in the sense that breeding material is traded and compared internationally. Milk production cannot be standardised in the same way as broiler meat and pork production because feed and fodder production is more dependent on local conditions. Moreover, the product itself – milk – is a bulky, fresh commodity that cannot be stored or transported indefinitely. This scenario also assumes a wholly homogeneous market, which is unlikely to develop fully. We can also expect a trend towards contracted production, with guaranteed throughput from producer to retailer, aimed at a wide range of different markets. This leads us to Scenario 2.

2. Commercial production aimed primarily at local, nearby markets and based on natural and other local conditions in the country

Assuming a significant variation in conditions for food production and in consumer needs and values, a development at national or regional level based on these conditions will be possible, even advantageous. By and large, this is the development we have been seeing all along, to which must be added the growing presence of global competition and the pressure to market goods and services. This could mean the emergence of a diversity of systems in a diversity of environments where scale, intensity, technology, products and business approaches are all present in different combinations. Such a development would be in keeping with declared policy aims for the promotion of a sustainable society, greater concern for the environment and greater interest in rural and regional development policies.

These companies are subject to severe price competition from the international market and their production must continue to be efficient. Their competitiveness will therefore be predicated on their ability to exploit local conditions efficiently. Other important factors will be consumer preferences and the advantages of a local market for everything from resource needs to environmental services

Profitability does not therefore solely have to be dependent on the value of the product. Today, some of these services are paid for by the tax-payers over the environmental support programme. Environmental and other restrictions can also keep out or hamper external competitors. The need for animal material in the production systems that will be in operation can be met with advantage by national breeding organisations. Companies in this scenario will continue to attach great value to breeding activities carried out by Swedish organisations, possibly working in cooperation with their counterparts in neighbouring Nordic countries. Among the advantages are the ability to influence development including the opportunity to

define their own breeding goals, and the fact that selection takes place in the environment in which the animals will be used.

Industrialised countries still differ significantly in terms of approach and conditions of production. Swedish animal welfare provisions and regulations governing the use of drugs, including antibiotic preparations, puts a premium on the health traits of animal material. In this respect, breeding can serve as an effective preventive animal health measure. Efficiency in both economic and genetic terms is important in breeding work and problems can arise if the breeding population is too small. For trade and competition policy reasons, the state cannot extend financial support to breeding organisations.

We are therefore unlikely to see the emergence of many new breeding companies to meet relatively limited needs. While an increase in multiple-use farming may be expected, this is likely to depend on the favourable development of other activities and companies in rural areas. The demand for multiple-use services (as envisaged in scenarios 5, 6 and 7) will probably have to come mainly from people living in the vicinity. Offering specialised services in thinly populated rural areas is hardly a formula for success.

3. Organic production methods

One of the Government's policy aims in relation to sustainable development is to increase organic food production. While this need not entail a radical departure from the previous scenario, it lays greater stress on interplay with local conditions and environments. Neither does it wholly eliminate price competition, while laying at least as much emphasis on the importance of marketing, including information about and certification of the production system.

As regards animal material requirements, the picture is divided and does not differ clearly from Scenario 2. An organic production system that limits the purchase of necessities could well require special adaptations on the part of the animal material as in the case of systems based on free-range animals that spend a large proportion of their time outdoors.

How these new production systems are to be supplied with suitable animal material is by no means clear at present. Although breeding programmes can be established they must have enough backing – alternative support – in the initial stages to get under way.

4. Animals used for sport and leisure activities

Performance is vital in sporting and leisure activities that feature horses and dogs. The field is characterised by intensive breeding efforts, involving major contributions from international breeding organisations, to enhance animal performance. The same animal material also fulfils a major social need in the form of pets. The rearing of animals for leisure purposes is addressed in Scenario 5.

5. Domestic animals: a vital feature of future living habits

Some people like to surround themselves with pets of different kinds, from cats, dogs and riding horses to animals for small-scale food production. The social aspects of animal husbandry are important. Smallholdings in the countryside with scope for keeping domestic animals, mainly horses, and access to basic services are very much in demand.

This type of livestock husbandry already accounts for a large proportion of endangered breeds in Sweden, and with the right kinds of incentives could support an even larger share. The exact extent cannot be accurately predicted, but horses are already reared in large numbers outside conventional farming establishments and there are as many as 800,000 dogs. It is evident that there is widespread interest among Swedes in keeping and animals even where there is no expectation of financial profit.

6. Tourism and cultural services

Livestock husbandry and production systems open to public view and whose direct purpose is to conserve and revitalise a given cultural environment or landscape can constitute a basis for tourism in the area. Open-air museums take advantage of the same symbiotic relationship between animals and culture but also share the same problems. The tourist season takes up only a small part of the year and the animals need care and feed all year round. Costs are high and earnings small, which means that other, supplementary, activities must be found if the system is to be tenable. Native breeds should be the obvious choice here; any other option would not be in context.

7. Ecosystems and social services

Animals can serve a number of functions: as conservers of the countryside, the soil, the environment, etc. In this scenario, animal husbandry is identified as one of the prerequisites of protected eco-systems, enclosed pastureland with certain biotopes, coastal meadows, etc. The various kinds of existing livestock grants and financial support for environments where animals are kept as part of their conservation may be seen as one way of demanding and paying for these services.

If the goal is to develop livestock husbandry for purposes other than production, it will be necessary to identify areas in which animals can have a beneficial effect and to quantify these benefits. This will allow the best possible integration of breeding planning and the conservation of genetic resources and their sustainable use for different purposes. Failure to ensure effective integration will lead to a situation in which the demand for services will – once it has grown sufficiently strong – determine the development of livestock rearing, which will however be based on whatever animal material happens to be at hand. The end result could be Iceland ponies and Scottish Highland cattle on our lands, which might well be good for the soil but would also clearly show that the choice of Swedish native breeds was not a priority in those particular cases.

6. Strategies and national priorities for use, development and conservation

6.1 Conservation and development at different levels

Domestic animal genetic resources are not amenable to conservation in the same way as most other objects. The resources, live farm animals, are owned privately and their conservation entails a permanent commitment on the part of the owner. This is an entirely different type of undertaking than protecting a piece of land from exploitation or saving an old building from demolition. While the latter may entail a loss of future income they do not involve daily outlays.

There is no satisfactory, ready-made system for spreading the costs – the responsibility – for conserving domestic animal genetic resources among those who exploit these animals today, livestock owners and producers, and coming generations. In Sweden, the conservation of biodiversity is normally accounted the responsibility of the sector as a whole. This would presuppose the broad involvement – including responsibility for genetic resource-related matters – on the part of all those who benefit from livestock production at primary level and of all secondary beneficiaries, i.e. most of us. Involvement on such a scale will require some form of financial support or incentives in carefully chosen areas.

It follows from this that in the absence of a clearly defined application or benefit in the form of products, sporting activities, culture, etc., it will not be possible to sustain a flourishing livestock industry featuring a variety of breeds. A clear definition of the uses to which livestock can be put is also necessary if priority is to be given to the right objects and measures. It is expected that the exploitation of livestock following commercial and other values and the concomitant need for animal genetic resources will follow from the various scenarios described earlier.

The need for a variety of animal material in Sweden is not closely related to climate variation or adaptation to climatic conditions. It is instead its function, i.e. the actual characteristics of the animal material in relation to its purpose that is the most important consideration. The presence of adaptation to different feeding environments and production intensities is frequently discussed and studied in ongoing research projects at the University of Agricultural Sciences (*SLU*). Adaptation is also a highly relevant issue in ecological production systems and for the choice of animal material for outdoor pigs and free-range hens. It is well known that genotype x environment interaction can occur when livestock are tested and selected in one type of environment and used in another. The problem occurs both inside the country and in connection with livestock purchased from abroad.

Commercial livestock production cannot survive unless it is immediately profitable and has access to animal material effective enough to hold its own in a highly competitive market. Financial profitability in turn is not only dependent on genetic adaptability, but also on the ability of the business to adapt economically, i.e. ensure that its combined characteristics are appropriate to its earnings and production costs. The traits of the animal materials, such as production level and product quality, health and reproductive performance to mention some, are a vital factor in the development of the sustainable production systems we all want to see. Although the value of breeding activities that seek to safeguard local Swedish needs and are carried out in the same environment in which the animals will be used is difficult to estimate, it is likely to be substantial. Today's commercial breeders are forced to operate unaided in the open market and must therefore look to their short-term survival while retaining responsibility for the long-term development of the genetic resources they work with.

Though responsible for supervision of the sector as a whole, the state now has few or no powers to intervene in the development or operations of breeding companies. Development is essential in all areas of livestock and food production if these industries are to survive. Conditions for food producers have already been discussed. If production is not cost-effective in this country it is moved elsewhere. More locally adapted and diversified producers must also develop their own solutions, which must accord closely with the needs and wishes of local consumers. Livestock owners must also find new contexts for the active use of endangered breeds, which will not only induce livestock owners to rear them but will also represent a source of income.

Efforts are made to conserve genetic resources by keeping live animal populations and use them in some way. However, it is usually difficult to direct the uses to which livestock are put and thereby determine the effect on conservation. The state cannot dictate what breeds are kept in Sweden, nor is it forbidden to change breeds or to keep imported breeds. The only scope for regulation is through the provision of social services such as rural conservation and conservation of cultural heritage assets, where the keeping of specified animal material is a condition for funding. The same result would be achieved if it could be convincingly demonstrated that a native, local breed was the most suited to the task at hand. Some small-scale enterprises may be associated with trademarks, which in turn are linked to the mode of operation including the animal material.

6.2 Conservation and sustainable use of genetic resources

The Convention on Biological Diversity identifies areas in which action aimed at promoting sustainable use and biodiversity should be taken. This includes characterising of genetic resources, sustainable use, special measures for conservation where necessary, information and training. The documents drawn up by the FAO as support for a global strategy for the management of animal genetic resources for food and agriculture follow the text of the Convention. ‘Sustainable use’ carries the dual sense of sustainability in terms of use for different purposes and sustainable development of resources through breeding.

Targeted preservation based on a variety of measures applies to breeds of no economic interest and is applied under *ex-situ* conditions using frozen material and involving livestock rearing outside the animals’ normal living environments. The strategies being put in place to conserve and develop Swedish genetic resources for food and agriculture must be predicated on the development of livestock use, breeding, targeted conservation and information, in accordance with well-grounded priorities.

6.2.1 Sustainable development and conservation

Selection for different traits can be practised without exhausting genetic variation. In fact, the survival and active use of many breeds can often be attributed to successful breeding programmes. However, it should be added that more attention must be focused on the long-term development of kinships and inbreeding in the population.

Another important consideration is the need to ensure that breeding goals and selection procedures are designed to avoid adverse side effects. Although there are numerous examples of harmful side effects caused by deficient selection procedures, there are other cases where such deficiencies were corrected and the harmful side effects disappeared after a time.

Although variation is not exhausted by selection, the average level of traits obviously changes. This has raised the issue of whether older forms of a particular breed should be conserved. Populations from different time periods are interesting, not least for research purposes, but there are also alternative solutions in the form of sperm and embryo banks.

Differences of opinion on selection and its effects on genetic variation are often expressed. The lack of agreement may be due to the fact that the protagonists are referring to different aspects of genetic variation. Genetic variation within a breed is a quantitative measure of future development potential, while genetic variation in the sense of many breeds having certain phenotypical traits relates more to retained freedom of action in the choice of animal material. Although both must be conserved, many regard the conservation of diversity between breeds as the more important. The forthcoming national strategy for the conservation of livestock breeds must make provision for both interpretations of the concept of genetic variation.

6.2.2 Breeding goals and breeding plans

Whether a breed is numerically large or small, commercial, imported or native and endangered, there must be a breeding goal stating the breeder's aims and objectives in respect of the breed, and a breeding plan describing how these aims are to be achieved. These are essential procedures with all breeds, not least for reasons of animal welfare. Each animal's identity and pedigree must be registered. The principle is basically the same for all types of population. The development of relationship must be avoided in order to reduce inbreeding. In other words, the population must be sufficiently large.

Breeding goals for commercial breeds are of course very different from those chosen for endangered populations, and so they must be. The same applies to the means used. With commercial breeds, breeders can make provision for systematic immigration from other breeds, thereby reducing the risk of inbreeding. This cannot be done in the case of an endangered native breed as the primary concern here is to conserve its distinctive character as long as no similar breed exists in another country. The need for registration procedures, breed evaluation methods, progeny testing, etc. will also vary considerably from breed to breed.

6.3 Targeted measures in support of breed conservation

It is often argued that all breeds with local associations, particularly threatened breeds, should be conserved as this forms part of the conservation of genetic resources, which is a national responsibility. In the case of breeds where the financial returns for managing and breeding them are small, special incentives may be needed to maintain population size and to support the breeders' associations in their work. The only incentives currently provided in support of conservation efforts are compensation grants for endangered breeds. No priorities have been established other than the actual classification of certain breeds as threatened. Little evaluation or comparison of existing breeds to ascertain their distinctive characters or identify potentially interesting traits is carried out.

Kinships between breeds can be established by genetic analysis of neutral markers. Together, both methods of comparison can be applied to distinguish between different breeds and, where necessary, to set priorities. Breeds on the verge of extinction may be of considerable cultural value because they are closely associated with a certain area of the countryside or traditional livestock rearing practices. There may be adequate grounds for conserving a breed of this very type, even though no unique traits or genetic markers can be found for it. The

unbiased evaluation of different incentive packages and methods for monitoring development is essential if previously adopted measures or plans are to be changed should this prove necessary.

Commercial livestock breeds are not covered by subsidies or compensation schemes of any kind. Should these come to be regarded as less attractive by livestock owners, their populations will shrink and they could become endangered. In view of current developments, the status of commercial breeds should be closely examined to determine whether commercial livestock breeding activities can be sustained in Sweden.

6.3.1 Gene bank herds

Private livestock farming can be fairly unstable for a number of reasons, particularly where the population is small. Gene bank herds have been proposed as a way of maintaining long-term stability. Although the model is costly to maintain it should be further evaluated.

6.3.2 Cryoconservation of genetic material

Deep-freeze storage of genetic material should be used only as long as it is economically viable. The technique may also be regarded as insurance against unforeseen events, but only if storage facilities or procedures are themselves secure from accident. Frozen semen and embryos is both a support in day-to-day breeding activities and a way of keeping genetic material unchanged. Semen from most Swedish bulls used for artificial insemination since the 1960s has been cryoconserved through the agency of bull studs throughout the country. Some of this material – from Swedish Mountain Cattle bulls – has since been put into use and contributed substantially to broadening the breeding base of the population. The stored semen constitutes a unique gene bank for *SBR* and *SLB* breeds and must be securely preserved for the future.

6.3.3 Incentives in the Environment and Rural Development Programme

When the Environment and Rural Development Programme is next revised in 2006, there should be an evaluation of the effectiveness of environmental compensation schemes in helping to conserve endangered livestock breeds and whether they are fulfilling their intended purpose. Funding under the *KULM* scheme has made a decisive contribution to the information work of livestock breed conservation societies.

The Environment and Rural Development Programme for Sweden provides for projects aimed at restoring or conserving cultural or natural assets and promoting a transition to long-term sustainable agriculture. The funds are also intended for use in strengthening economic and social development in rural areas by supporting a changeover from conventional agriculture to the production and local sale of quality products and tourism.

6.3.4 Research, education and training, advisory services and information

Opportunities for collaborating on research into domestic animal genetic resources should be taken up by universities other than Swedish University of Agricultural Sciences. There is a longstanding need to characterise several important traits belonging to endangered breeds. Better mapping of these traits – e.g. through comparisons with other breed types – is urgently

needed. It is vital to obtain more and better facts on the benefits and advantages of the breeds which are being reared in this country.

There is a need for training, education and advisory services at various levels. Agricultural universities should examine the feasibility of using distance learning methods in connection with breeding work and the conservation and development of domestic animal genetic resources. There is an urgent need for updated teaching material for different education programmes and for different groups of players. The same applies to information material and methods for its dissemination. It should be possible to combine the old Swedish study circle model with distance learning to produce a modernised study circle format aimed primarily at livestock owners.

Farmers are kept well supplied with information through a large number of professional journals and news sheets for members. Activities aimed at disseminating information to the general public should be further developed. Animal parks and open-air museums have a major role to play here. People seeking information on animal genetic resources are likely to find what they are looking for on the internet websites of public authorities and organisations.

6.4 Responsibility and organisation

Government responsibility for a country's genetic resources is embodied in the Convention on Biological Diversity. The conservation of endangered native breeds has hitherto been largely based on the involvement and initiatives of private livestock owners and their organisations. The division of roles and responsibilities among the parties involved should be more clearly defined. It should be possible to achieve a clearer definition of goal- and responsibility-related issues through the development of the environmental quality objective "*a varied agricultural landscape*", or through the adoption of a new objective: the conservation of biodiversity. The Swedish Environmental Protection Agency has been commissioned by the Government to examine a 16th environmental quality objective addressing *inter alia* the issue of responsibility. Such a measure could be expected to bring activities involving the conservation and development of animal genetic resources for food and agriculture further into the foreground and ensure that they are accorded the status they deserve.

The Board of Agriculture, which bears ultimate responsibility in a number of areas related to domestic animal genetic resources, should retain this responsibility, which should, however, be defined more clearly, perhaps through a government instruction. A national network should be established with a view to maintaining contact with other organisations with responsibility for animal genetic resources. This forum/network could serve the Board in an advisory capacity and channel information about developments in other for a such as the Nordic Genetic Resources Council.

6.5 A new national programme

It is essential that a new programme for the conservation, development and future use of domestic animal genetic resources be drawn up. The Board of Agriculture has already been commissioned by the Government to submit proposals for a national strategy on animal genetic resources. These must be presented not later than 31 December 2002. The Board's terms of reference state that "it is essential that the new programme proposals include a detailed description of the Government's responsibility for genetic resources and of the division of this responsibility among the various public authorities and private organisations involved. The programme should also highlight the need for research and other training,

education and skills development work, networking and the harmonisation of national and international efforts and measures”.

The programme should include an account of resource and cost allocation in connection with efforts by government authorities, organisations and individual livestock owners to conserve endangered livestock breeds. Prominence should also be given to the total resource need and the importance of cooperation between government, the research sphere and industry.

For the most part, the new national programme should have the character of an action plan for the use of domestic animal genetic resources. The various roles played by livestock in society should be meticulously and comprehensively identified in accordance with the following parameters:

- The development of sustainable forms of exploitation of livestock in food production, sport and leisure activities.
- The identification and evaluation of services provided by domestic animals not involved in primary production, i.e. used in the conservation of rural landscapes, cultural activities, environmental services, sport and leisure activities.
- The identification of new roles for endangered native breeds – the definition of new use values to stimulate rearing of these livestock breeds.
- An examination of the need for breeding organisations and programmes for all livestock breeds/populations.
- An evaluation of grant, subsidy and compensation schemes with a view to ensuring that their purpose is not defeated.

Tables

Chapter 1. Introducing the Country

Justification and Use

The purpose of this chapter is to get basic information on the livestock sector in general (livestock population, livestock holders and their land resources, livestock contribution to major food products). We expect, from the information gathered in this chapter, to have a clear idea on major use of land, especially for livestock, availability of animal feed resources, and the contribution of the livestock sector in satisfying consumption demands of animal products.

Table 1.1 Importance of livestock to the gross domestic product in agriculture (millions of \$US)

Activity	\$US (millions)	Data from Year
Livestock production (official statistics)	\$842	1999
Other agricultural production (official statistics)	\$561	
Best estimate of additional value of livestock	NI	

NI = No information

Comments:

- Best estimate of additional value includes the value of all perceived contributions of livestock to agricultural services, other than food production, e.g. value of fertilizer from animal production, draught and transportation, forage production, etc., which usually are not costed in standard calculations.
- Livestock includes domestic ruminants, non-ruminants, and birds used for food and agriculture.

Table 1.2 Land use and current trends (1000 ha)

Category	Area (1000 ha)		Current trend
	1990	1999	
Arable land	2845	2747	-
Permanent crops	3	3	0
Permanent pastures	416	447	0
Agricultural area	3264	3197	-
Land area	41162	41162	0
Total Area	44996	44996	

Comments:

- Arable land: land under temporary crops (double-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for "Arable land" are not meant to indicate the amount of land that is potentially cultivable.
- Permanent crops: land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee and rubber; this category includes land under flowering shrubs, fruit trees, nut trees and vines, but excludes land under trees grown for wood or timber.
- Permanent pasture: land used permanently (five years or more) for herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land).
- Land area: total area excluding area under inland water. The definition of inland water generally includes major rivers and lakes.
- Total area: the total area of the country, including area under inland water.
- Indicate current trends in relation to the latest available year (-- = strongly decreasing, - = decreasing, 0 = stable, + = increasing, ++ = strongly increasing).

Table 1.3 Land use for livestock and current trends

	Area (1000 ha)	Area (1000 ha)	Current trend
Category	1990	1999	
Cropping for food ¹	349	253	0
Cropping for feed ¹	1955	1903	0
Cropping for food and feed ¹	350	275	0
Natural pasture ²	416	447	0
Improved pasture ²			0
Fallow	193	318	0
Forest ³	24400	27100	?
Non-agricultural	13499	10866	?
Total	41162	41162	

1) Rough estimates, not official statistics

2) The figures for natural pastures includes both natural and improved pastures

3) ECE/FAO definition of forest

Comments:

- Natural pastures are the ones grown without any external inputs, while improved pastures may be cultivated, semi-cultivated, fertilized, etc.
- Fallow is a non-cultivated cropping land put on rest.
- Indicate current trends in relation to the latest available year (-- = strongly decreasing, - = decreasing, 0 = stable, + = increasing, ++ = strongly increasing).

Table 1.4 Land tenure for livestock production¹

Category	Area (1000 ha)	%
Private	2735	100
Government and communal	12	0
Total	2747	100

1) The figures refers to cropping for both food and feed.

Comments:

- Private includes the private sector and the long term leasing.
- Include all land for which the primary purpose of its use is livestock production.

Table 1.5 Farm structure and distribution (1999)

Category	Number of farms / households ¹	%	Number of farms / house-holds ¹ with livestock	%
Landless	NA		NA	
> 0 to 2 ha 2)	315	0	315	1
> 2 to 10 ha	26573	33	12315	25
> 10 to 50 ha	37396	46	24933	50
> 50 to 100 ha	10969	14	8435	17
> 100 to 500 ha	5067	6	3672	7
> 500 ha	114	0	68	0
Unknown		0		0
Total	80434	100	49738	99

NA = Not applicable

1) The data refers to number of holdings

2) Rough estimates, not official statistics

Table 1.6 Livestock population, number of owners/house-holders and employment by species¹

Species	Livestock population (1000)	Number of owners / householders ²	Number of persons additionally employed	
			Fully	Partially
Cattle	1713	33978		
Sheep	437	8247		
Goats	NI	NI		
Horses ³	79710	14309		
Pigs	2115	6014		
Chicken	13709	6650		
- laying hens	5648	6441		
- chickens for laying	2202	829		
- broiler	5859	87		
Turkey	NI	NI		
Ducks	NI	NI		
Geese	NI	NI		
Rabbits	NI	NI		
Reindeer	220	943		

1) Data from 1999

2) The data refers to numbers of holdings

3) Figures from the official Swedish farm register which only contains information on livestock on holdings with more than 2 hectares of arable land. A rough estimate of the total number of horses would probably amount to about 280.

Table 1.7 Human population in the country

Year	Total (millions)	Rural or Farming (%)	Urban or Non Farming (%)	Total
1990	8,591			0
1999	8,861			0
Average annual growth rate	0,34			

Comments: Rural/Urban and Farming/Non Farming populations will be defined depending on the commonly used terminology for demography. For example in developed countries it is meaningful to consider farming and non-farming populations and in the developing world, rural and urban populations.

Table 1.8 Major livestock primary production (1000 tonnes/numbers)

Species	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (No.)	
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
Cattle	143,8	149,8	3432,0	3297,0						
Sheep	4,9	3,9	NI	NI						
Goats	NI	NI	NI	NI						
Horses	1,9	1,5	NA	NA						
Pigs	289,2	277,0								
Chicken	-	-								
- Hens	4,3	4,2			122,2	102,0				
- Broiler	42,4	90,0								
Turkey	2,1	4,0								
Ducks	0,1	0,2								
Geese	0,1	0,1								
Rabbits	NI	NI								
Reindeer	2,6	1,4								

Table 1.9 Major livestock primary product imports (1000 tonnes/numbers)¹

Species	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (No.)		Animals (No.)	
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
Cattle	13	55	0	1							0	0
Sheep	2	4	0	0							0	0
Goats	0	0	0	0							0	0
Horses	1	1	0	0							3	1
Pigs	16	57									0	0
Chicken ²	2	19			11	15					61	57
Turkey ²											-	49
Ducks ²											0	0
Geese ²											0	0
Rabbits	0	0									0	0

1) Meat imports: Including some processed products converted into carcass weight. Milk imports: CN 0401

2) Meat imports: Turkey, ducks and geese are included in the figures for chicken

Table 1.10 Major livestock primary product exports (1000 tonnes/numbers)¹

Species	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (No.)		Animals (No.)	
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
Cattle	12	7	9	16							0	8
Sheep	0	0	0	0							0	0
Goats	0	0	0	0							0	0
Horses	0	0	0	0							1	2
Pigs	39	20									0	6
Chicken ²	1	6			16	9					112	1127
Turkey ²											0	0
Ducks ²											0	0
Geese ²											0	0
Rabbits	0	0									0	0

1) Meat : Including some processed products converted into carcass weight. Milk: CN 0401

2) Meat imports: Turkey, ducks and geese are included in the figures for chicken

Chapter 2. The State of Production Systems

Justification and Use

The purpose of this chapter is to get a clear picture on the distribution of livestock species and their role by major production systems. Changes in major production systems over time for major species are monitored. Production systems are defined according to the level of inputs used.

Table 2.1 Distribution of livestock by production system (%)

Species	Production systems			Total
	Low input	Medium input	High input	
Cattle			100	100
Sheep			100	100
Goats			100	100
Horses			100	100
Pigs			100	100
Chicken			100	100
Turkey			100	100
Ducks			100	100
Geese			100	100
Rabbits			100	100

Comments:

- Assign a percentage based on thorough analyses of data available.
- **Production System:** 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 production of a particular livestock enterprise. Also termed **Production Environment**. Production systems 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 System:** a production system 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 System:** a production system 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 System:** a production system 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.

Table 2.2 Changes in the distribution of production systems during the last 20 years

Species	Production systems			Total
	Low input	Medium input	High input	
Cattle			++	0
Sheep			+	0
Goats			+	0
Horses			+	0
Pigs			++	0
Chicken			++	0
Turkey			++	0
Ducks			+	0
Geese			+	0
Rabbits			+	0

Comments:

- Assign a score based on thorough analyses of data available (-- = strongly decreasing, - = decreasing, 0 = stable, + = increasing, ++ = strongly increasing).
- Definitions of production systems are given at the bottom of Table 2.1.

Table 2.3 Type of livestock farm by production system for cattle (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial			75	75
Large-scale-commercial			25	25

Comments:

- **Subsistence:** less than 50% of production is marketed.
- **Smallholder:** small family farms with more than 50% of production marketed
- **Small-scale-commercial:** medium family farms with more than 50% of production marketed
- **Large-scale-commercial:** large farms or companies with all production marketed
- Definitions of production systems are given at the bottom of Table 2.1.

Table 2.5 Type of livestock farm by production system for sheep (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial			50	50
Large-scale-commercial			50	50

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.6 Type of livestock farm by production system for goats (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial			50	50
Large-scale-commercial			50	50

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.9 Type of livestock farm by production system for horses (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence			25	25
Smallholder			25	25
Small-scale-commercial			50	50
Large-scale-commercial				0

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.11 Type of livestock farm by production system for pigs (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial			25	25
Large-scale-commercial			75	75

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.12 Type of livestock farm by production system for chicken (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial			5	5
Large-scale-commercial			95	95

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.13 Type of livestock farm by production system for turkey (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial				0
Large-scale-commercial			100	100

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.14 Type of livestock farm by production system for ducks (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial				0
Large-scale-commercial			100	100

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.15 Type of livestock farm by production system for geese (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder				0
Small-scale-commercial				0
Large-scale-commercial			100	100

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Table 2.16 Type of livestock farm by production system for rabbits (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence				0
Smallholder			80	80
Small-scale-commercial			20	20
Large-scale-commercial				0

Comments:

- Definitions of production systems are given at the bottom of Table 2.1.
- Definition of farm type given at the bottom of Table 2.3

Chapter 3. The State of Genetic Diversity

Justification and Use

The purpose of this chapter is to identify the status of the diversity of breeds within species, in terms of total number of breeds, breeds at risk of being lost, and degrees of their characterization.

Table 3.1 Breed Diversity (Number of Breeds)

Species	Number of breeds									
	Current Total		At risk		Widely used		Others		Lost (last 50 yr)	
	L	E	L	E	L	E	L	E	L	E
Cattle	12	5	4		5		3	4		
Sheep	10	9	4		4		2	9		
Goats	3		2		1					
Horses	7	24	2		5	1		23		
Pigs	3	3	1		2			3		
Chicken	10	2	9		1	2				
Turkey										
Ducks	4		4							
Geese	2		2							
Rabbits	2		2							

Comments:

- L = Locally Adapted or Native; E = Exotic (Recently Introduced and Continually Imported).
- Breeds at risk are those with total number of breeding females and males are less than 1,000 and 20, respectively; or if the population size is less than 1,200 and is decreasing.

Table 3.2 Number of breeds for which characterization has been carried out (Number of breeds)

Species	At population level				At individual level		
	Baseline survey	Genetic distance	Breeds and crosses evaluation	Valuation	Performance recording	Genetic evaluation	Molecular evaluation
Cattle	17	7	4		14	15	17
Sheep	19	7	1		14	14	
Goats	3				1		
Horses	31				31	31	31
Pigs		1	4		4	4	4
Chicken							
Turkey							
Ducks							
Geese							
Rabbits							

Comments:

- Consider breed characterization during the last ten years.
- Baseline survey summary data describing the identification and observable characteristics, location, uses and general husbandry of the AnGR for each species used in the country for food and agricultural production.
- Genetic distances among breeds computed from molecular analyses.
- ‘Breeds and crosses evaluation’ refers to estimation of direct and maternal additive genetic, and heterosis effects.
- Valuation = description of the extent to which market values of AnGR predict their ‘real’ or ‘fair’ value, accounting for all goods and services they may provide to current and future generations of humankind. In the case of market failures, market prices will differ from the value that society attaches to AnGR
- Performance recording is based on individual animal data for milk yield, growth, reproduction, etc.
- Genetic evaluation refers to estimation of breeding values.
- Molecular evaluation includes information of markers, DNA, blood type, protein alleles, etc.

Chapter 4. The State of Utilization of AnGR (Use and Development)

Justification and Use

The purpose of this chapter is to identify the main use of animal genetic resources available in the country, especially the number of breeds that are really active in contributing to food and agricultural products. In addition, it focuses on the status of development of AnGR, their current breeding strategies, gaps and needs, and the involvement of different stakeholders in developing breeding systems.

Table 4.1 Relative importance of livestock products and services within species (%)

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertiliser	manure	Draught	Culture	Recreation	Fuel	Feather	Environmental management	Total
Cattle	74	26													100
Sheep		95			5										100
Goats	100														100
Horses		5									95				100
Pigs		100													100
Chicken		60	40												100
Turkey		100													100
Ducks		100													100
Geese		100													100
Rabbits		100													100
Reindeer		95			5										100

Comments: Think of the food and agricultural outputs as products that have a relative contribution to national production. Therefore, assign relative contributions for the important products listed below, based on a thorough analyses and valuation of data available in the country (sum of each species = 100).

Table 4.2 Relative importance of species within livestock products and services (%)

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertiliser manure	Draught	Culture	Recreation	Fuel	Feather	Environmental management
Cattle	100	39			NI								60
Sheep		1		100	NI								25
Goats		NI											
Horses		6						100		100			15
Pigs		39											
Chicken		10	100										
Turkey		NI											
Ducks		NI											
Geese		NI											
Rabbits		NI											
Reindeer		1											
Others		4											
Total	100	100	100	100	0	0	0	100	0	100	0	0	100

Comments: Assign relative contribution values for each product as a % of total output of that product, based on a thorough analyses of data available in the country (sum of each column = 100).

Table 4.3 Number of widely used breeds with breeding strategies (No. of breeds)

Species	Total number of breeds	Breeding strategies		
		Purebred selection	Cross-breeding	Both
Cattle	17	14	3	2
Sheep	19	14		5
Goats	3	3		
Horses	31	31		
Pigs	6	2		4
Chicken	12	10	2	
Turkey				
Ducks	2	2		
Geese	4	4		
Rabbits	2	2		

Table 4.4 Number of breeds with current breeding strategies and tools being used (No. of breeds)

Species	Breeding goals	Breeding strategies		Tools				
		Designed	Designed and implemented	Individual identification	Recording	AI	ET	Genetic evaluation
Cattle	17		17	17	17	17	2	13
Sheep	19		19	19	16	7		16
Goats	3		3	3	1	3		
Horses	31		31	31	31	2	1	31
Pigs	5		5	5	4	4		4
Chicken	12		12					
Turkey								
Ducks	2		2					
Geese	4		4					
Rabbits	2		2					

Comments: AI = Artificial Insemination; ET = Embryo Transfer.

Table 4.5 State of the art of technologies / methodologies used in breeding strategies

Technology or Methodology	Used for:	
	Research	Breeders
Multi-trait selection index construction	100	100
Optimization tools for breeding plans	75	25
Electronic database related to recording schemes	100	100
Genetic evaluation Software for: phenotypic selection breeding values	100	100
Reproductive technologies (AI, ET, etc)	100	100
Microsatellite linkage maps for QTL identification for Marker Assisted	50	
Other technology (specify)		

Comments: Assign a percentage to indicate the extent that the technology or methodology is being used at research institutions or by breeder's associations in the country.

Table 4.6 Role of stakeholders in the implementation of tools for the development of AnGR

Stakeholders	Breeding goals	Individual identification	Recording	Artificial insemination	Genetic evaluation
State Government	3	3			3
Local Government	1	2	2	2	1
Breeder's	5	5	5	5	5
Private companies					
Research	5	1	1	1	5
NGO's					

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) based on thorough analyses of data available, to indicate the role of involvement of each stakeholder on the implementation of tools that support the development of AnGR.

Table 4.7 Involvement of stakeholders in activities related to the development of AnGR

Stakeholders	Legislation	Breeding	Infrastructure	Human	Farmer's
State Government	4	4	4		
Local Government	4				
Breeder's associations	1	5			5
Private companies					
Research		5			
NGO's					

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) based on thorough analyses of data available, to indicate the degree of involvement of each stakeholder on activities that support the development of AnGR.

Table 4.8 Stakeholders preference for animal genetic resources

Stakeholders	Locally adapted breeds	Imported within region	Imported exotic breeds
State Government	3		3
Local Government	3		3
Breeder's associations	5		4
Private companies	3		5
Research	3		3
NGO's	3		3

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) based on a thorough analyses of data available, to indicate the degree of preference of the various types of AnGR by stakeholders.

Table 4.9 Priority of needs for utilization of technologies for the development of AnGR

Technology	Needs			
	Knowledge	Training	Financial resources	Breeder's organization
Recording	3	1	1	1
Genetic evaluation	3	1	1	1
AI / ET	2	1	1	1
Molecular techniques	4	3	3	1
Breed organisation techniques				

Comments:

- AI= Artificial Insemination; ET= Embryo Transfer
- Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the priority of solving specific needs in order to use technologies to support the development of AnGR.

Chapter 5. The State of Conservation of AnGR

Justification and Use

The purpose of this chapter is to identify activities in in-situ and ex-situ conservation programmes, the degree of involvement of stakeholders and future needs for such programmes.

Table 5.1 Current number of breeds in managed conservation programmes

Species	Number of locally adapted breeds at risk			
	Total	Managed <i>in situ</i>	Managed <i>ex situ</i>	Both (in and ex situ)
Cattle	17		12	5
Sheep	7	1		6
Goats	3			3
Horses				
Pigs	1	1		
Chicken	10	10		
Turkey				
Ducks	4	4		
Geese	2	2		
Rabbits	2	2		

Comments:

- *In situ* conservation: includes all measures to maintain live animal breeding populations, including those involved in active breeding strategies 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: genetic material within living animals but out of the environment in which it developed (*Ex situ in vivo*), or external to the living animal in an artificial environment, usually under cryogenic conditions including, *inter alia*, the cryoconservation of semen, oocytes, embryos, cells or tissues (*Ex situ in vitro*). Note that *ex situ* conservation and *ex situ* preservation are considered here to be synonymous.

Table 5.2 Current number of breeds receiving incentives and for which various tools for management of *ex situ* conservation programmes are used

Species	Incentives			Tools				
	Gov.	NGO	Market	Semen storage	Embryos storage	DNA/Tissue storage	<i>In vivo</i>	Monitoring system
Cattle	5	12		17				
Sheep	6			6				
Goats	3			3				
Horses								
Pigs	1							
Chicken	10							
Turkey								
Ducks	4							
Geese	2							
Rabbits	2							

Comments:

- *In vivo*, such as zoological garden, farm park, etc.
- Incentives means any kind of support (human and financial resources, tax waving, higher prices, etc.) that stimulates conservation programmes of AnGR
- Monitoring system refers to the number of schemes in which more than 10% of population size is conserved.

Table 5.3 Current number of breeds receiving incentives and for which tools for *in situ* conservation programmes are used

Species	Incentives				Technical tools			
	Gov.	NGO	Market	Private	Recording	AI	ET	Others
Cattle	5				2	5		
Sheep	6				2	7		
Goats	3				1	3		
Horses								
Pigs								
Chicken								
Turkey								
Ducks								
Geese								
Rabbits								

Comments:

- AI = Artificial Insemination; ET = Embryo Transfer.
- Incentives means any kind of support (human and financial resources, tax waving, higher prices, etc.) that stimulates conservation programmes of AnGR.

Table 5.4 Stakeholders involvement in the management of conservation programmes

Stakeholders	<i>In situ</i> Conservation	<i>Ex situ</i> Conservation
Government	4	4
Breeder's associations	5	4
Private companies	1	2
Research institutions/universities	2	1
NGO's	2	1

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) based on thorough analyses of data available, to indicate the degree of involvement of each stakeholder on conservation programmes.

Table 5.5 Priority of needs for utilization of technologies for *in situ* conservation programmes

Technology	Needs			
	Knowledge	Training	Financial resources	Technology
Recording	3	3	4	2
Genetic evaluation	3	1	1	1
AI / ET	2	2	4	2
Molecular techniques	4	2	4	2
Breeder improvement techniques				

Comments:

- AI= Artificial Insemination; ET= Embryo Transfer
- Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the priority of solving specific needs in order to use technologies to support conservation programmes.

Chapter 6. The State of Policy Development and Institutional Arrangements for AnGR

Justification and Use

The purpose of this chapter is to identify policies related to the use, development and conservation of animal genetic resources. It summarises needs and identifies the main priorities to be considered in policy development for animal genetic resources management.

Table 6.1. Effects of existing policies and legal instruments on the utilization (use and development) of AnGR

Species	Urban/peri-urban systems		Rural production	
	Industrial systems	Small-holder systems	Industrial systems	Small-holder systems
Cattle	NA	NA	1	3
Sheep	NA	NA	1	3
Goats	NA	NA	NA	3
Horses	NA	NA	NA	1
Pigs	NA	NA	1	1
Chicken	NA	NA	1	2
Turkey	NA	NA	NA	1
Ducks	NA	NA	NA	1
Geese	NA	NA	NA	1
Rabbits	NA	NA	NA	1

Comments: Assign a score (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the extent that existing policies and legal instruments support the use and development of AnGR.

Table 6.2 The focus of current policies on activities related to the utilization (use and development) of AnGR

Species	Activities			
	Use of exotic breeds	Use of locally adapted breeds	Training, research and extension	Organization of breeders/farmers
Cattle	2	3	4	5
Sheep	1	3	3	4
Goats	1	3	1	3
Horses	1	1	3	4
Pigs	1	2	3	4
Chicken	3	1	2	2
Turkey	1	NA	1	1
Ducks	1	1	1	2
Geese	1	1	1	2
Rabbits	1	1	1	2

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the extent that current policies support activities related to the utilization of AnGR.

Table 6.3 Prioritising the needs to enable the development of AnGR policies

Needs	Required		
	Immediately	Medium term	Long term
Financial resources		X	
Human resources (knowledge)			X
Organizational structures		X	

Comments: identify the main needs for policy development and specify if it is critical (immediately required) or important in the medium or long term.

Table 6.4 The priority of future needs in policy development for AnGR conservation programmes

Species	Policy development related to:				
	Technology	Infrastructure	Human resources	Financial resources	Organizational structures
Cattle	2	2	5	5	5
Sheep	2	2	5	5	5
Goats	2	2	5	5	5
Horses	2	2	5	5	5
Pigs	2	2	5	5	5
Chicken	1	1	5	5	5
Turkey	NA	NA	NA	NA	NA
Ducks	1	1	5	5	5
Geese	1	1	5	5	5
Rabbits	1	1	5	5	5

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the priority for the development of policies to support AnGR conservation programmes.

Table 6.5 The priority of future needs in policy development for the utilization (use and development) of AnGR

Species	Policy development related to:				
	Technology	Infrastructure	Human resources	Financial resources	Organizational structures
Cattle	2	2	5	5	5
Sheep	2	2	5	5	5
Goats	2	2	5	5	5
Horses	2	2	5	5	5
Pigs	2	2	5	5	5
Chicken	1	1	5	5	5
Turkey	NA	NA	NA	NA	NA
Ducks	1	1	5	5	5
Geese	1	1	5	5	5
Rabbits	1	1	5	5	5

Comments: Assign scores (1 = none, 2 = little, 3 = regular, 4 = more, 5 = high) to indicate the priority for the development of policies to support the utilization of AnGR.