Norway Country Report on Farm Animal Genetic Resources, 2002

Committee on Farm Animal Genetic Resources

Editor: Nina H. Sæther

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PREFACE

The planned publication in 2005 of the first ***Report on the State of the World's Animal Genetic Resources*** was initiated by the FAO. All member states were invited to prepare country reports as a basis for this work. The Norwegian Ministry of Agriculture appointed the Committee on Farm Animal Genetic Resources to prepare Norway's country report. The ministry allocated funds for this work in September 2001.

The Committee on Farm Animal Genetic Resources organized this assignment as a project, which began on 01 October 2001, and was completed on 31 December 2002. The committee acted as the project board, responsible for delivering the report to the ministry. The board appointed a working committee to prepare the report, with representatives from breeding organizations, public authorities and the Committee on Farm Animal Genetic Resources itself. PhD Student Nina Hovden Sæther from the Department of Animal Science, Agricultural University of Norway, was employed as project coordinator and author of the report. The chairwoman of the working committee was Elisabeth Koren from the Committee on Farm Animal Genetic Resources.

In October 2001, the project coordinator and Signe Dahl (member of the working committee) participated at FAO's regional introductory seminar in Denmark, regarding the use of FAO's reporting tools. As a step in the preparation of the Norwegian report, an open seminar was held at the Norwegian Museum of Agriculture on 14 June 2002. The seminar, which was titled *Diversity, markets and possibilities in Norwegian livestock farming – a seminar on farm animal genetic resources and new uses for genetic know-how,* gathered 46 participants from breeding organizations, interest groups and other stakeholders. The coordinator has also presented experiences from the preparation of the report along the way; e.g., at international conferences in Lithuania (8th Baltic Breeding and Genetic Conference at the Lithuanian Veterinary Academy, Kaunas, in May 2002), in Rome (FAO`s Commission on Genetic Resources for Food and Agriculture, Ninth Regular Session, in October 2002) and in a chronicle in a Norwegian agricultural magazine on 11 July 2002.

The report was presented to the Committee on Farm Animal Genetic Resources for approval on 01 November 2002.

The Committee on Farm Animal Genetic Resources would like to sincerely acknowledge the work of project coordinator Nina Hovden Sæther, who is very dedicated to the field of farm animal genetic resources, and would also like to thank the working committee for its dedication and hard work in connection with the preparation of the country report. The report gives a thorough summary of Norway's farm animal genetic resources and the breeding efforts conducted within each of the species. The report also raises important issues regarding the international process initiated by the FAO. This survey also functions as a solid basis for the further development of the committee's long-term activities regarding the surveillance and management of Norway's farm animal genetic resources. The committee would finally like to thank Grethe Tuven for the illustrations, Arne Ellingsberg for helping with manuscript preparation and Vera Gjersjøe for the use of the photograph on the frontispiece.

The report was translated to English from the original Norwegian version by Karl Kerner.

Ås, 11 December 2002

Trygve Skjevdal (sign)

Chairman - Committee on Farm Animal Genetic Resources

SUMMARY

This report presents all livestock production systems in Norway that significantly contribute to the country's food and agricultural production. It describes the regulatory framework for Norwegian agriculture and aquaculture, as well as characteristics of the country's production conditions and breeding work. The report discusses national expertise in the field of farm animal genetic resources and future developments regarding the country's use of these resources. Furthermore, the report presents the conservation of Norway's historical breeds with small populations. It concludes by making recommendations on which areas both Norway and the Nordic countries should emphasize regarding R&D activities and capacity building.

Breeding activities and traditional production systems for the various domestic animal species are presented. Production conditions are discussed by highlighting limiting factors and risks within the various production systems. Animal breeding activities are presented by describing their organization and discussing issues of sustainability. Furthermore, the report mentions the routines for collecting and preserving genetic material in long-term storage, and discusses the conservation of historical breeds with small populations within the different animal species.

The production systems included in the report are: combined meat and milk production (cattle), beef cattle production (suckler herds), dual-purpose sheep production (meat and wool), goat milk production, a variety of horse-related industries (equestrian sports, recreational and health-related services), pork production, egg production (hens), meat production (chickens, turkeys), aquaculture (farmed salmon and trout), honey production, domestic reindeer production and hunting and herding dogs.

In addition to presenting all livestock production systems of importance for the country's food and agricultural production, the report shall also analyze the conservation of Norway's historical and national breeds with small populations. The work of the Committee on Farm Animal Genetic Resources from its establishment in 1986 through today is therefore presented.

Via several international agreements, Norway has committed itself to promoting the sustainable management of its farm animal genetic resources. The report discusses the necessary conditions enabling the sustainable use and development of these resources. Above all, it is important to develop general policy guidelines that promote sustainability, also in connection with other political processes, such as trade and patent agreements.

The report discusses several areas in which farm animal genetic resources can be applied. These include the establishment of biobanks, which can be used to generate new knowledge about gene functions, the use of historical breeds with small populations in landscape management and the development of niche products.

Norway has sufficient basic expertise needed for the sustainable management of its farm animal genetic resources. However, new situations and challenges show that there is a need for capacity building within certain areas, in order to secure the appropriate management of farm animal genetic resources in the future. These areas are mainly related to the clarification of technical terminology and the division of responsibilities for the future sustainable management of Norway's farm animal genetic resources.

The report concludes that sustainable management of farm animal genetic resources can best be achieved by encouraging continued diversification of livestock farming throughout the country.

THE SCOPE OF THE REPORT

This report is part of the preparations for the FAO's "Report on the State of the World's Animal Genetic Resources". The FAO has decided that the State-of-the-World report is only to include avian and mammalian species. Nevertheless, each country is encouraged to include all domestic animals of interest to food and agriculture. Norway has thus chosen to include the following production systems in its Country Report (in the same order as they appear in the FAO's predefined tables):

Cattle	- combined meat and milk production
	- beef cattle production (suckler herds)
Small livestock	- dual-purpose sheep production (meat and wool)
	- goat milk production
Horses	- equestrian sports
	- recreational and health-related services
Pigs	- pork production
Poultry	- egg production (hens)
	- meat production (chickens, turkeys)
Aquaculture	- meat production (salmon, trout)
Fur-bearing animals	- fur production (mink, fox)
Bees	- honey production, pollination
Reindeer	- meat and hide production
Dogs	- hunting
	- herding

The report is structured according to the FAO's "Guidelines for the Development of Country Reports".

The presentations of the different production systems in Chapter 1 follow the same template. The aim was to give a brief, but nonetheless thorough overview of all production systems, with regard to production conditions and breeding efforts within each species. Relevant breeding organizations and professional associations were asked to contribute to these presentations. The contributions bear evidence of the fact that the different parties emphasized different aspects when responding to our inquiry.

All production data (total output, scope of production, etc.) are presented in tabular form in a separate appendix. These tables are pre-defined FAO models, and the data are supplied as completely and accurately as possible. Mr. Ole Rognstad of Statistics Norway supplied the data for Tables 1.1 to 1.10

For further information about the various production systems or domestic animal breeds, please contact the Committee on Farm Animal Genetic Resources, c/o Norsk Landbruksmuseum, the respective breeding organizations, or any of the institutes/agencies listed on page 39 of this report.

1 NORWEGIAN LIVESTOCK FARMING AND AQUACULTURE

1.1 Natural Conditions and Regulatory Framework for Agriculture and the Fish Farming Industry

1.1.1 NATURAL CONDITIONS

Norway is Europe's northernmost country, covering a distance of 1750 km between 58 °N and 71 °N. This is more than the distance between Oslo and Rome. The country's total land area is 323,000 km^2 (excluding the islands Svalbard and Jan Mayen), its population is 4.5 million, with a population density of 14 persons per km^2.

Norwegian agriculture consists of farming, horticulture, forestry, reindeer farming and other related businesses, such as farm tourism. Agricultural activities are carried out further north than in any other country in the world. The total agricultural area is 1.03 million hectares, or 0.21 ha per capita. Farmland accounts for less than 3 % of the total land area, compared to 57 % for the European Union as a whole. Productive forestland covers 22 % of the land area, whereas mountains, extensive grazing and other outlying land, lakes and built-up areas account for the remaining 75 %.

Norway's natural conditions are very favourable for fish farming. There are numerous, unpolluted fjords, which are protected from the extreme conditions of the open sea. Water temperatures are ideal for the production of species such as salmon, trout, cod and halibut.

Norway has substantial north-south and east-west climate gradients. The highest and lowest temperatures measured were 35.6 °C in Nesbyen (southeastern Norway, on 20 June 1970) and – 51.4 °C in Karasjok (Finnmark, northern Norway, on 01 January 1886). Inland areas in northern and eastern Norway have a typical continental climate, with warm summers and cold winters. The entire coast is characterized by a maritime climate, with relatively cool summers and mild winters.

Annual precipitation also varies. The zone with the highest annual rainfall lies about 30-40 km inland from the coast. The highest annual precipitation is 3575 mm, measured in Brekke in the county of Sogn and Fjordane (western Norway). The driest areas are the inland regions of Finnmark (north), as well as parts of the Østerdal and Gudbrandsdal valleys (eastern Norway). The driest meteorological station is Skjåk II in Oppland county, with an annual precipitation of 278 mm. The length of the growing season varies between 200 days (most favourable areas in southwestern Norway) and 100 days along the coast of eastern Finnmark. In the alpine regions, the growing season is even shorter. The growing season is defined as the number of days with a mean temperature of more than 5 °C.

Norway's extreme climate and topography limit the extent of livestock production, but on the other hand, they also enable certain unique productions, e.g., reindeer farming. Norway is part of the Scandinavian peninsula, with its extensive reindeer grazing areas. The best winter pastures for reindeer are those areas with little snow and nutrient-poor bedrock, representing good growing conditions for lichens (on which the reindeer feed). Lush summer pastures, however, require an ample supply of rain and rich soils.

1.1.2 REGULATORY FRAMEWORK FOR AGRICULTURE AND THE FISH FARMING INDUSTRY

Norwegian agriculture and livestock farming are greatly affected by the prevailing climatic and geographical conditions. The major livestock enterprises are combined milk and meat production (cattle), combined weaner pig and pork production, and combined meat and wool production (sheep). Compared to most industrialized countries, Norwegian agriculture is very small-scaled. Small and medium-sized family farms account for most of the country's livestock production. Most cattle and pig farmers work their farms full-time, whereas sheep farming mainly is a part-time activity.

In 1999, livestock production accounted for 72 % of the total agricultural output, which in turn accounted for 0.85 % of Norway's gross domestic product. Dairy farming is the most important agricultural enterprise. The fish farming industry accounted for 0.3 % of the gross domestic product in 1999, with salmon and trout as the two main products. While the production and consumption of dairy products is decreasing, there is an upward trend for meat production, especially of pork and poultry.

Traditionally, Norwegian agriculture and livestock production were assigned several public responsibilities in addition to just producing food. Such a multifunctional agriculture includes such issues as self-sufficiency and food security, rural policy (rural settlement and development), environmental pollution, cultural landscape and socio-economic aspects related to income developments and distribution within the sector.

The combination of high production costs and the broad range of goals for agriculture present a tremendous challenge to the design of national agricultural policies. In general, agricultural policy in Norway has been based on import regulations and a national farm support system combining budget allocations with extensive regulations.

Stringent border protection

Norway is more or less self-sufficient regarding all major

animal products. Import protection mainly aims at securing the sale of Norwegian products on the domestic market. Another goal is to avoid unprofitable exports. Stringent import restrictions have also been considered necessary in order to secure the highly favourable animal health status in the country. After the EU's veterinary regulations were introduced in Norway in 1994 (due to the establishment of the EEA), import restrictions have become weakened, and partially replaced by the farm animal sector's self-imposed regulations.

National subsidy system

The major national farm support schemes include regional support, cultural landscape support, structural support for small farm units, investment support and various welfare measures. On one hand, small farms receive relatively more support, while on the other hand, there are concession limits for concentrate-based production systems, limitations on farm size when receiving investment support and a milk quota system. These factors have slowed down the development towards increasingly larger farm units, thus helping to maintain the small-scale structure of Norwegian animal production.

Due to the country's natural conditions and its agricultural policies, the level of support in Norwegian agriculture and livestock production is among the highest in the world (OECD, 1999). Trade liberalization and support reduction commitments have led to increasing pressure on Norwegian agricultural policy and to significant changes within the sector. At the same time, the general public is less willing to support Norwegian agriculture. As a result of economic restrictions and market deregulation, farm income is decreasing, the rate of structural changes is increasing and recruitment to the farm (and livestock) sector is becoming increasingly difficult. Norway's tight labour market also makes it hard to find sufficient labour. In sum, these developments may cause Norwegian animal production systems to follow the pattern in other industrialized countries, with a gradual disappearance of its small-scale structure.

A general understanding is that Norway's small-scale farm structure has contributed considerably to the use of old, native breeds in mainstream farming systems. This has been of major importance for the survival of these breeds, and has contributed to the continued existence of viable populations of several historical breeds. Changing the small-scaled structure of Norwegian agriculture can be expected to have a significant effect on the sustainability of the historical breeds in mainstream agriculture.

Quotas and concessions

Two important regulatory mechanisms in Norwegian agricultural policy are quotas and concessions. Cow and goat milk production are regulated by quota systems, which aim at balancing milk production and market demand. Each dairy farm is annually assigned a quota for how much milk it can produce. The minimum quota for cow milk is 30,000 litres per farm. For dairy goats, the minimum quota was raised from 5000 litres to 15,000 litres in 2002. The milk quota system was introduced in 1983, and is based on a milk quota regulation laid down by the Ministry of Agriculture in agreement with the Norwegian Farmers' Union and the Norwegian Farmer and Smallholders' Union. The framework of the quota is annually evaluated and determined in the Agricultural Agreement.

Since the quota system was introduced in 1983, the number of dairy farmers has been reduced by about 44 %. The total national milk quota was reduced by about 18 % in the same period.

Between 1996 and 2002, the total national milk quota was reduced by about 12.3 %. This is probably due to the introduction of a scheme offering financial compensation to dairy farmers who stop producing milk.

In 2002, it was decided to increase cow milk quotas by 1 %, to a total of about 1,583 million litres. This was based on milk production and consumption predictions for 2002, in addition to an uncertainty regarding the extent of quota sales in the fall. The 2002 Agricultural Agreement also decided upon a 4 % increase of the goat milk quota, to a total of 23.4 million litres.

The production of pork and poultry is legally regulated by a concession act. This act aims to regulate the structure within these two sectors and to avoid the development of industrial-type animal production in the most concentrate-intensive production systems (see page 20-21). Due to political as well as environmental considerations, such an agro-industrial development with large production units is not desirable. As of 1 January 2002, there were about 8650 registered pig or poultry producers in Norway. About 94 % (ca. 8150 farmers) of these had a total output below the concession limit. These figures indicate that the act, in accordance with its intention, has actually managed to limit the development of large, industrialized farm units.

All aquaculture activities are subject to licensing. Aquaculture concessions are assigned in accordance with the Fish Farming Act. The law aims to secure a balanced and sustainable development of the aquaculture sector, enabling it to become a profitable and viable rural industry. In 2000, there were 1000 licensed salmon and trout farmers, divided among 10 of Norway's 19 counties.

The role of agricultural cooperatives in Norwegian agriculture

The strong position of agricultural cooperatives is a characteristic of Norwegian agriculture and animal production. This has been promoted by public rules and regulations.

Table 1.1-1 Sales of animal products to retailers and bulk consumers; market share of agricultural cooperatives in 2001

Animal product	Percentage of sales via cooperative enterprises
Milk	95 %
Cheese	70 %
Beef, pork, mutton/lamb	47 %
Eggs	70 %
Poultry	85 %

The cooperative enterprises' high market share for all important animal products (see Table 1.1-1.), helps to secure sales and producer prices.

In addition, most breeding activities in the farm animal sector have been carried out by cooperative organizations. Due to the farmers' control of animal breeding programmes, they have shown considerable commitment to ongoing breeding efforts and the extensive data registration schemes, see Table 1.1-2 page 12.

Predators

After about 100 years with little or no predators, populations of wolverines, bears, wolves and lynxes have become established in parts of the Norwegian wilderness. In certain rough grazing areas, this has created problems for livestock farmers. Norwegian farmers have become accustomed to being able to graze their stock on rough grazing land without any fear of losses due to predators. Now, the predators must be fenced out or the livestock must be herded in certain areas. This new situation has caused some farmers to move their grazing stock from rough grazing land to fenced-in, cultivated pastures, while others have completely phased out such production systems that are dependent on rough grazing. The latter applies especially to sheep farming.

Animal welfare

In Norway, just like in most industrialized countries, consumer awareness of farm animal welfare has been steadily increasing. This has resulted in many new regulations, with specific requirements to animal housing and care for all major farm animal species. For most production systems, this has led to significant changes and improvements of animal welfare.

1.1.3 DISTINCTIVE FEATURES OF NORWEGIAN FARM ANIMAL PRODUCTION AND AQUACULTURE

Farm animal production systems

Norway's topography, climate and northern location greatly affect the country's animal production. There are vast areas of semi-natural pastures, which are utilized in cattle, sheep and goat farming. At the same time, livestock has to be kept indoors for many months due to the long and harsh winters. A high technological standard, expensive farm buildings, small-scaled farm structure and a strong focus on animal welfare further characterize Norwegian farm animal production. Until 1994, there were stringent restrictions on the import of livestock. In addition to the cold climate, the import restrictions helped to maintain an extremely high animal health status; this will be described in Chapter 1.2, Farm Animal Production Systems in Norway.

The trend during the past decade has been a decreasing number of livestock-farming enterprises, but a stable and perhaps even increasing livestock population. Average herd size is thus increasing for all farm animal species. Milk production is decreasing, whereas meat production is increasing, especially for monogastric animals such as poultry and pigs. However, farms are generally still very small in Norway, with average herd sizes of, e.g., 14 dairy cows and 850 laying hens (1999).

In 1999, there were approximately 71,000 farms in Norway with more than 0.5 ha farmland. Total labour input was about 79,000 man-years in farming, 8000 in forestry, 1200 in reindeer farming and 2700 in the fish farming industry. Agriculture employs about 6 % of the country's workforce, and related activities (food processing, etc.) about the same.

Aquaculture

In the course of the past 30 years, Norwegian aquaculture industry has developed from being a sideline-occupation to a major industry. Today, Norway is the world's largest exporter of salmon and trout, and accounts for 54 % of the global production of salmon. Only about 5 % of Norwegian salmon is sold on the domestic market, and salmon is exported to more than 100 countries. The biggest buyer of Norwegian salmon is Denmark (EU member), whereas Japan is the main market for Norwegian trout. It is expected that Norway's marine aquaculture industry will continue to grow significantly. Even though salmon and trout will surely remain the main products for many years to come, the industry is continuously developing the production of other marine species.

The breakthrough for the fish farming industry came around 1970, with the introduction of floating netpens. Nowadays, the entire Norwegian aquaculture industry utilizes intensive fish farming systems, with salmon (*Salmo salar*) and rainbow trout (*Oncorhynchus mykiss*) as the dominating species. It made sense to start salmon farming in Norway, since the country has favourable natural conditions and many large salmon populations as a source of genetic material. The present Norwegian salmon breeding stock originates from wild salmon populations in 40 Norwegian rivers.

1.1.4 DISTINCTIVE FEATURES OF NORWEGIAN ANIMAL BREEDING

Norwegian animal breeding programmes

Norwegian animal breeding is organized within farmer-owned enterprises, and is characterized by broad breeding goals, use of dual-purpose breeds and a large percentage of farmer participation in active breeding. The scientific and technical standards are high, and breeding programmes are based on the calculation of breeding values using the BLUP system (Best Linear Unbiased Prediction). The system optimizes the use of available performance data of the animals and their relatives. Uncritical use of the method enhances selection of relatives, thus increasing inbreeding in the population. Most Norwegian animal breeding systems have introduced restrictions on use of sires in order to limit the increase of inbreeding.

Animal breeding in Norway

Animal breeding has had and still has a strong position in Norway. Important reasons for this include:

- Farmer-owned and controlled breeding schemes.
- Breeding goals determined by farmers.
- Use of broad breeding goals, both with regard to performance and functional traits.
- Extensive participation in the farmer-based recording schemes.
- Documented results of the breeding work.
- Research and practical breeding work are closely integrated.
- New methods and ideas are quickly put to use.
- One or only very few active breeding populations within each species.
- Limited sales of live animals and little focus on animal phenotype. Farmers have thus rather similar views regarding the goals and benefits of breeding programmes.

Fish breeding

In contrast to organized breeding programmes for all other farm animals in Norway (excluding poultry), breeding work for salmonoids is carried out by private companies, and not by cooperative enterprises. These companies conduct traditional breeding activities such as phenotype testing, sibling testing and breeding-value appraisal, but also production and sales of spawn, fry, smolt and mature, farmed fish. Three companies are mainly responsible for conduct-

Table 1.1-3 Participation in farmer based recording schemes in Norway in 2001 (in % of herds)

Production system	Participation in farmer based recording schemes (% of all herds)
Cattle, dairy	95 %
Cattle, suckler cows	47 %
Small livestock, sheepmeat/wool	24 %
Small livestock, goat milk	71 %
Pigs, weaner pig production	52 %
Fur-bearing animals	21 %

Table 1.1-2 Breeding systems and traits applied in the breeding of Norwegian domestic animals and salmonoids

Breeding system	Cattle		Sheep	Goats	Horses	Pigs	Bees	Fur-bearing animals	Salmonoids	Dogs
	Dairy	*Suckler cow*								
Progeny testing	X	X	X	X			X	X		
Sibling (family) testing						X			X	
National recording system	X	X	X	X	X	X	X	X	X	X
Phenotype testing	X	X	X	X	X	X	X	X	X	X
Performance test					X					X
Breeding traits										
Milk yield	X			X						
Milk solids	X			X						
Weight gain	X	X	X			X			X	
Carcass quality	X	X	X			X			X	
Meat quality						X			X	
Temperament	X	X			X		X	X		X
Health	X				X	X		X	X	X
Fertility	X	X	X			X		X		
Conformation	X	X	X	X	X	X				X
Udder conformation	X			X		X				
Polledness	X	X	X							
Wool yield and quality			X							
Maternal traits		X	X			X				
Honey yield							X			
Swarming tendency							X			
Skin length and fur quality								X		
Early maturity									X	
Breed type					X					X

ing advanced, family-testing based breeding programmes in Norway. All fish farmers have equal access to the genetic improvements, and the breeding system is now able to supply enough spawn to cover the entire industry's demand.

However, since the breeding of salmonoids is conducted in Norway, using Norwegian genetic material, it is regarded as a national breeding programme. Norway is therewith the only country in the world with a national breeding programme for Salmonoids used in domestic production.

1.1.5 EXPORT OF NORWEGIAN FARM ANIMAL GENES, CATTLE AND PIGS

Cattle

GENO Breeding and A.I. Association, the breeding organisation for Norwegian Red Cattle (*norsk rødt fe*, NRF), has been actively exporting NRF semen for more than 10 years, to countries such as Australia, Ireland, New Zealand and the USA. The most important markets are presently Ireland and the USA. In California a group of cattle farmers is cooperating on the use of NRF semen in their Holstein herds, in order to improve declining vitality in calves and declining fertility and longevity of their cows. In Ireland and Northern Ireland, a total of about 350 NRF cows are presently being tested. The trials are motivated by disappointment with the Holstein breed, especially in the transition to seasonal calving and increased grazing, e.g., as was introduced in New Zealand. In 2004 introducing 400 new calves from Norway will extend the trials.

The preliminary results of the NRF exports are promising. This could lead to the access to extensive international markets for NRF semen, for crossing with Holsteins. It must be stated that the international interest in NRF semen did not develop as a result of any adaptation of the Norwegian breeding goals to external markets. The interest in the NRF material is rather based upon the foreign breeders' perception of the Norwegian breeding goal and breeding scheme as being a viable alternative to the breeding done by the large, international breeding companies.

Net profits from GENO's exports would help to secure the Norwegian breeding work in the coming years. The exports will be carried out as semen exports. The supply of live animals, as was the case in Ireland, must be seen as a one-time event in connection with the initiation of trials.

Table 1.1-4 shows the number of exported NRF semen doses between 1994 and 2001. The increase is significant, but a large share of the increase is due to somewhat unreliable and not very stable markets based on humanitarian aid measures, e.g., in the Balkans.

Pigs

In the mid-1990s the Norwegian Pigbreeders Association (Norsvin) established a subsidiary company with exclusive international marketing rights for all genetic material and technology developed by Norsvin, Norsvin International AS, and is jointly owned by Norsvin (66 %) and the Norwegian Meat Cooperative (34 %).

Internationally, Norway's animal health status is exceptional. In combination with the excellent quality of Norsvin's breeding stock, this forms an extremely favourable basis for exporting pig genes. Previous exports have shown that very few other breeds, if any, outperform the Norwegian pig's health traits. Furthermore, the feed efficiency and daily weight gain of Norwegian fattening pigs are among the best in the world. Meat quality is considered to be relatively good, and Norway is investing considerable resources in order to further improve this area.

The export of live animals from Norway without simultaneously assuring future royalty payments is not a very viable solution, since one has no control of how these genes are utilised. Furthermore, the high level of costs in Norway does not favour the bulk export of hybrid animals. Norsvin International's business concept is thus to establish subsidiary populations in selected markets and to locally propagate the genetic material by selling live animals and semen. This can occur in companies in which Norsvin International either has ownership interests or with which they cooperate via partnership agreements. Royalties and/or profit shares secure the financial returns to Norsvin International. The main goal of this activity is to secure the long-term funding of Norsvin's R&D activities.

At present, Norsvin International is in operations in Australia, Finland, Iceland, Lithuania, New Zealand, Sweden, Thailand and the USA. The company's strategic plan focuses on the Nordic and Baltic countries, northern-central Europe and North America as the major markets in the future. The export activities vary considerably. Norsvin International's market share in Sweden is about 40 %, and Sweden is thus by far the company's most important market. Exports to the other countries are so far much less extensive.

Table 1.1-4 Export of NRF semen, number of doses, 1994-2001.

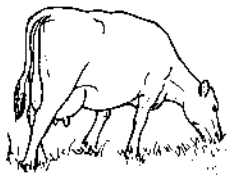
Year	1994	1995	1996	1997	1998	1999	2000	2001
Number of NRF semen doses exported	9 330	14 965	11 530	46 197	22 650	18 000	51 170	80 000

Table 1.1-5 Export of live animals by Norsvin International AS 1998-2001.

Year	1998	1999	2000	2001	2002
Exported live animals	333	131	184	173	915

1.2 Farm Animal Production Systems in Norway

1.2.1 CATTLE – DAIRY COWS



Dairy production systems in Norway

In 1999, a total of 22,400 farmers submitted production subsidy applications for 318,000 dairy cows. This gives an average of 14 dairy cows per farm.

Traditional production systems for cattle in Norway

Dairy cows account for about 85 % of the Norwegian cattle population. Typical dairy farms are family enterprises with small herds. Usually, milk and meat production are combined. All roughage is produced on the farms, whereas most concentrates are purchased. Milk yields could be higher (see Table 1.2-1.), the present level is due to milk quotas, high per-cow production subsidies and the need for producing numerous calves for meat production.

Feeding can be characterized as a roughage-based, indoor feeding system, with substantial amounts of grass silage. Summer grazing is common, encompassing mountain pastures to merely open-air runs. Tie-stall barns are by far the most common housing type, whereas most newly built barns now use loose-housing systems. At present, there is a trend towards larger herds using loose-housing barns and more advanced technology, in some cases even milking robots. The establishment of joint operations between two or more dairy farmers enables the introduction of larger herds.

Limiting factors

There are limiting factors for both the individual animal's performance and total output. As long as the main goal is to produce for the domestic market, the total output must be strictly limited by market regulations (see page 10). Otherwise, production in Norway is limited by climatic conditions and limited access to farmland. Due to the climate, only certain fodder crops can be grown. Feed can be imported, but the minimum requirements for spreadable acres (for manure) must be met. Milk yields per cow are mainly limited by the amount and type of imported feedstuffs. In general, domestically produced feedstuffs place certain restrictions on how much milk can be produced per cow. It is nevertheless a goal that most of the feed for dairy cattle is produced in Norway.

Risk factors

There are two types of risk factors in Norwegian dairy production:

1. Factors related to climate and infectious diseases.
2. Economic factors.

Presently, the most significant risk factor is the access to the investment capital necessary for modern dairy production. The capital requirements have become so high that the production system is extremely vulnerable to economic fluctuations.

Dairy cattle breeding

Organization of Norwegian cattle breeding

In Norway, 99 % of the dairy cattle population belong to the breed "Norwegian Red Cattle" (in Norwegian: *Norsk rødt fe* – NRF). The breed was established in the 1950s, and is based on Ayrshire, Swedish Red-and-White (SRB) and national cattle breeds existing in Norway at that time. Eventually, all local breed associations joined NRF. Today, NRF's breeding work is being conducted by the GENO Breeding and A.I. Association (previously NRF).

Today's cattle breeding is characterized by extensive use of herd recording data and centralized use of AI bulls. The Dairy Herd Recording Scheme is the foundation of Norwegian cattle breeding. The scheme is operated by TINE, the Norwegian dairy cooperative. GENO is responsible for bull management, semen production, insemination services,

Table 0-1 Performance data for dairy production in Norway

Milk yields							Feed composition				% of cows in the herd recording scheme
Year	No. of dairy cows	No. of herds	Cows per herd	Kg milk per cow	% fat	% protein	% concentrates	% pasture *	% silage	% hay	
1990	285,874	21,954	13.0	6363	3.98	3.25	39.1	15.1	37.2	1.9	86.0
2000	270,028	18,723	14.4	6094	4.15	3.20	36.4	17.2	41.6	1.2	94.5

Source: Annual Report 2000, TINE Norwegian Dairies
** In 1998, a new law was introduced, according to which all cows must be outside at least eight weeks every summer. This explains the increase in grazing percentage from 1990 to 2000.*

breeding-value appraisals and the selection of breeding animals. Unless otherwise requested, all cattle farmers using NRF semen are also members of GENO. In the NRF breeding strategy, there are no specific breeding herds; all herds participating in the herd recording scheme are in principle considered equal. More than 95 % of all dairy cows take part in the recording scheme.

Sustainability of breeding work

The breeding goals in Norwegian dairy cattle breeding are based on the notion that a dairy cow is not meant to merely produce a lot of milk in a short period of time. Other important traits are fertility, calving and disease resistance. This approach is reflected by the selection and weighting of traits included in the Norwegian breeding strategy.

Table 0-2 Weighting of traits in GENO's breeding strategy for Norwegian Red Cattle (NRF)

Trait	Weighting (%)
Protein yield	23
Meat yield	9
Body and leg conformation	6
Udder	14
Disposition	4
Fertility	15
Stillbirths	2
Calving ease	2
Mastitis	22
Other diseases	3

Within this breeding objective, health, fertility and calving traits combined account for 44 %, whereas milk (protein) yields only account for 23 %. Sufficient allowance has thus been made for functional traits. When such a diversity of traits with rather high weighting are included in the breeding objective, many different combinations can result in a high total breeding value. Thus, different types of animals can receive high rankings. Annually, about 120 young bulls are tested with progeny groups of 250-300 daughters, thus also ensuring a high degree of reliability for traits with a low heritability.

Three important factors are thus positive with regard to sustainability:

1. Both production and function are expressed by many traits, and are strongly weighted in the breeding strategy.
2. Many different combinations can result in a high total breeding value. This means that animals from different breeding lines can be selected, thus automatically reducing the risk of inbreeding.
3. The breeding work is based on data from ordinary dairy herds. In connection with the diversity of traits applied, this guarantees that the breeding programme produces animals that are well adapted to normal operating conditions.

Routines for long-term storage of genetic material

GENO is the only agency operating AI centres for cattle in Norway. One hundred semen doses are taken from every bull at a Norwegian AI centre for long-term storage, independent of its breed or owner.

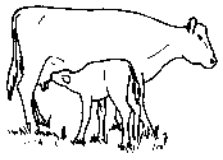
For NRF cattle specifically, GENO has introduced routines to secure the long-term storage of genetic material of all bulls and bull mothers.

1. Since 1979, GENO has routinely taken blood samples of all purchased bull calves and their mothers. The blood samples are frozen and stored.
2. Since 1985, one hundred semen doses have been taken from all progeny-tested bulls for long-term storage. The semen is stored in liquid nitrogen.

Historical and national dairy cattle breeds with small populations

Besides NRF Cattle, Norway has six national, historical dairy cattle breeds with very small populations. These breeds are: Sided Trønder and Nordland Cattle, Telemark Cattle, Western Fjord Cattle, Western Red Polled, Eastern Red Polled and Døla Cattle. The populations vary between ca. 1000 and less than 100 breeding females. Sided Trønder and Nordland Cattle and Telemark Cattle still have their own separate breeding organizations, which are responsible for breeding and conservation within the two breeds. Since the mid 1980s, semen samples have regularly been collected from bulls of the other four breeds. This work is being managed by the Committee on Farm Animal Genetic Resources (see page 28), in cooperation with the various breed associations and GENO. Two or three AI bulls are purchased each year. For more information on these breeds and their conservation, please contact the Committee on Farm Animal Genetic Resources, c/o Norwegian Museum of Agriculture (address on page 39).

1.2.2 CATTLE - SUCKLER COWS



Traditional production systems for suckler cows in Norway

There are about 46,000 suckler cows in Norway. Of these, about 30,000 are in pure suckler herds, and 16,000 in dairy herds. In 1999, a total of 5116 farmers submitted production subsidy applications for 33,705 suckler cows. This gives an average of 6.5 suckler cows per farm. There are no reliable data on the number of purebred beef cattle in Norway, but in 2001, 7131 purebred beef cattle cows were registered in the herd recording scheme. The most common production system for suckler cows is loose-housing with spring calving, outdoor grazing during summer and indoor finishing of weaned calves. Artificial insemination accounts for about 10 % of all service, the remainder is natural service.

Limiting factors

There are three limiting factors in suckler cow produc-

Top: Norwegian Red Cattle is the dominant breed, accounting for 85 % of all the cattle in Norway and 99% of the dairy cows. (Photo: Jan Erik Kjær, BUSKAP).
Bottom: A Norwegian Red bull at GENOs AI-centre. (Photo: Brox).

Animal welfare regulations require that all cattle must be outdoors at least eight weeks every summer. Top: Sidet Trønderfe- and Nordlandsfe and NRF cattle grazing mountain pastures in Valdres, 2002. (Photo:Aalerud/Skoe). Bottom (left): The Telemark cow – one of Norway's six national dairy cattle breeds. (Photo: NLM) Bottom (right): NRF cattle. (Photo: Jan Erik Kjær, BUSKAP).

Table 0-3 Performance data for suckler cows in Norway 2001

No. of suckler cows	No. of herds	Average herd size	No. of suckler cows slaughtered	Age at slaughter (months)	Weight gain (g/day)
46,353	5655	8.2	2777	18.8	491

Source: Annual Report 2001, Norwegian Beefbreeders Association.
Annual Report 2001, Beef inspection, Norwegian Meat Research Centre.

tion: available farmland/climate, market and meat yields per animal. The Nordic grazing season is short, and more or less all suckler cows in Norway need winter housing. Housing and fodder acreage requirements thus set certain limits to production. Beef production in Norway is based on the domestic market, which again limits the amount of beef that can be produced. Meat yields per animal are limited by the genetic potential, fodder supply and the chosen production system (extensive or intensive).

Risk factors

As in dairy production systems, the risk factors in Norwegian suckler cow production are related to climatic conditions, infectious diseases and economy. Presently, the biggest threat is that profitability in suckler cow production is very poor.

Suckler cow breeding

Organization of Norwegian suckler cow breeding

Eleven different beef cattle breeds are registered in Norway. Most of the suckler cows in Norway are crosses, either between beef cattle breeds or between these and Norwegian Red Cattle (NRF).

Beef cattle breeding is organized by the Norwegian Beefbreeders Association. Major breeding activities include phenotype testing, progeny testing, breeding value estimation and distribution of AI. Organized breeding is carried out for five of the beef breeds, and progeny tests are conducted for 8-16 bulls in each of these breeds annually. Each bull has a progeny group of 200 sons. There is extensive cooperation in the field of beef cattle breeding between the Norwegian Beefbreeders Association and GENO.

Sustainability of breeding work

The common, general breeding goal for beef cattle in Norway is maximizing net value. This can result in different breeding strategies for the different breeds.

The Norwegian breeding index system for beef cattle includes the following traits: fertility, calving ease, maternal traits, weight gain and carcass traits. Feed efficiency is an additional trait that is considered when selecting AI bulls. The objective of the Norwegian breeding work is to breed functional animals that enable cost-efficient production. This is achieved through a cooperative breeding structure, in which suckler cow farmers are active participants and set the agenda. The breeding populations of Norwegian beef cattle are small. Inbreeding is avoided by supplementary imports of genes as semen and embryos.

Routines for long-term storage of genetic material

One hundred semen doses are taken for long-term storage from each bull in Norwegian AI centres (see page 15), disregarding the bull's breed or ownership. This applies to beef cattle breeds as well.

Historical beef cattle breeds with small populations

Norway has no traditional beef cattle breeds. All historical Norwegian breeds were bred as dual-purpose cattle (milk and meat production). However, milk production was always considered to be the more important of the two. These breeds are briefly described on page 15.

1.2.3 SHEEP

In 1999, a total of 21,692 farmers submitted production subsidy applications for 1,084,271 winter-fed sheep (including Feral Sheep). This gives an average of 50 sheep per farm.

Dual-purpose sheep

Sheep farming in Norway is typically a part-time enterprise, and very few sheep farmers live exclusively from this production. The main breeds are Norwegian White Sheep and Spæl (short-tailed) Sheep. At present, these breeds are not at risk, even though their populations seem to be slightly decreasing.

Sheep production systems

Traditional sheep production systems in Norway

The indoor feeding period usually lasts from November to May. The lambing season is in April/May, immediately followed by turnout. At first, ewes and their newborn lambs graze on cultivated pastures, but are turned out to rough/mountain pastures as soon as possible. In September/October, the sheep in the mountains or rough grazing land are gathered, sorted and slaughtered. Mating season is November/December, and it is common to mate lambs born in spring of the same year. Most sheep are sheared in the fall (before going indoors) and one month before lambing begins in the spring. Main products are meat (80 % of income), wool (20 % of income) and hides. Increasingly, the importance of sheep in the maintenance of the rural landscape is being mentioned as another important aspect of sheep farming.

Top: Norwegian white sheep in a modern, winter-insulated barn. The inn-door period normally lasts from November to May. (Photo: Arne Maurtvedt, SAU OG GEIT).
Bottom: Sheep collected from island-pastures in the autumn. Sheep-production is based on the extensive grazing of distant out-lying pastures and mountain grazing lands during the summer months. (Photo: Arne Maurtvedt, SAU OG GEIT).

Top: Dairy goats on rough pasture. Goat-farming is based on utilizing marginal grazing resources. (Photo: Nina Hovden Sæther, NLM's archive).
Bottom (left): Coastal goats in Selje 2001, once kept for meat production, now only a small population remains. (Photo: Bine Melby, NLMs archive).
Bottom (right): A flock of modern dairy-goats on a mountain summer farm in Balsfjord, Northern Norway waiting to be milked. (Photo: Archive NORDEN).

Limiting factors

The main limiting factors in Norwegian sheep farming include limited access to cultivated pastures in the spring, the long indoor feeding season, predators and conflicts due to users' rights to grazing areas, which can impede the traditional use of rough grazing lands.

Risk factors

Important risk factors for the sheep-farming industry are the poor economic framework (due to the prevailing agricultural policies) and poor recruitment. Other risks include predators, diseases (scrapie) and market destabilization due to surplus production.

Sheep breeding

Organization of Norwegian sheep breeding

Norwegian Sheep and Goat Breeders' Association (*Norsk sau- and geitalslag*, Nsg) organize sheep breeding activities in Norway. A subsidiary, NSG Semin A/S (jointly owned by Nsg and GENO) is responsible for AI services. Special county breeding committees organize the breeding work at the local level, including the lamb shows held every fall to select the best ram lambs.

The breeding system is based on so-called "ram circles", i.e., breeding co-operative groups of 10-30 farmers that select and progeny-test young rams. The ram circles also have a system for the use of AI and elite rams. Breeding values are only calculated for rams used in the ram circles. There are stringent regulations for breeding work carried out via the ram circles and the payment of subsidies per progeny-tested ram. The ram circles have the first rights to semen of the country's best AI rams. Flocks that do not participate in the ram circles are called non-breeding flocks, and are supplied with licensed lambs, tested rams or semen from the ram circles and NSG Semin A/S.

Sustainability of breeding work

Due to a decentralized breeding strategy, a large sheep population and the farmers' commitment, inbreeding has so far not been a serious problem. In recent years, the supply of AI services and their use have increased significantly, and there are signs of intensive use of a limited number of elite rams, which can quickly increase the degree of inbreeding. However, if the right measures are implemented, there is no immediate threat of inbreeding problems.

Sheep breeding has a broad breeding goal and can thus be considered sustainable. Five traits are included in the breeding index: weight gain, meatiness, fat, mothering abilities and fertility. Diseases are not recorded thoroughly enough to be included in the selection of breeding animals. In the selection of females, their dam's and sire's breeding values are included, as well as traits such as grazing behaviour, temperament and ease of lambing. At lamb shows, young rams are assessed on the basis of their dam's and sire's breeding values, weight gain, body and leg conformation, wool quality and wool yield.

Trends and threats in Norwegian sheep farming

The general trend in agriculture, with increasingly fewer, but larger farms, also implies that many farmers are phasing out sheep production. At the same time, average flock size is increasing and the total sheep population has remained fairly stable in recent years. This development weakens the producer environment, making it harder to establish and maintain traditional forms of cooperation such as the ram circles, joint grazing and outfield fence maintenance.

Because of diseases and growing predator populations, an increasing number of farms now graze their sheep on fenced in, cultivated pastures throughout the entire summer. The demand for higher meat percentage, and the price strategies used to achieve this, have led to the use of heavier breeds. Niche products, such as feral sheep meat, may also affect the choice of breeds, although hardly to any significant extent.

There are claims that certain breeds are better adapted to grazing in areas with predators, but this is presumably only a temporary solution to the problem. If the trends towards increased use of cultivated pastures for sheep grazing continues, we may experience a transition to a more intensive system with heavier sheep breeds.

Routines for long-term storage of genetic material

AI services for sheep were introduced in the early 1970s, but at a very modest scale to begin with. For many years, semen was collected from 10-15 rams of different breeds each year.

The oldest rams in the long-term storage bank were born in 1976/77. Semen was collected from these rams in the early 1980s. Already at this time, about 100 doses from most rams were stored, but from some rams only a smaller quantity was collected.

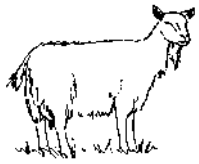
Since 1997, the use of AI has increased rapidly, and the routine collection of 100 semen doses from each ram has continued. Thus, more than 35,000 doses are now on long-term storage. Since 1999, there has been talk of dividing the semen bank between two physical locations, but this has not been done so far.

The use of semen from the long-term storage bank has to be approved by the National Sheep Breeding Council. Long-term storage doses have been used only twice since 1998.

Historical sheep breeds with small populations

There are 10 national sheep breeds in Norway: Norwegian White Sheep, Old Spæl Sheep, Feral Sheep, Spælsau (Old Norwegian Short Tail Landrace), Dala Sheep, Steigar Sheep, Rygja Sheep, Norwegian Cheviot Sheep, Grey Trønder Sheep and Norwegian Pelt Sheep. In addition, there are two "breeds" approved by the Norwegian Sheep and Goat Breeders' Association, but not by the Committee on Farm Animal Genetic Resources (see page 28). The Norwegian Sheep and Goat Breeders' Association collects semen from the national breeds, of which three are considered at risk because of their small breeding populations. In 1998, the Sheep and Goat Breeders' Association and the Committee on Farm Animal Genetic Resources initiated a joint project on the collection and freezing of Old Spæl and Grey Trønder Sheep semen.

1.2.4 DAIRY GOATS



In 1999, a total of 727 farmers submitted production subsidy applications for 53,091 dairy goats. This gives an average of 73 dairy goats per farm. Goat farming in Norway is based on the production of milk and milk products, not meat. Most goat farms are found in more rural areas, often where farming is marginal (e.g., along the fjords and in northern Norway). The production system is based on utilizing local grazing resources.

Goat production systems

Traditional goat production systems in Norway

Traditionally, milk was the only product from goats in Norway. Kids that weren't kept as replacements were usually killed and discarded right after birth. The goats kid between December and February, and spend the winter in insulated barns. The summer months are spent grazing, often on mountain or hillside pastures.

Limiting factors

The most important limiting factors in goat production are diseases, milk quotas and feeding intensity. There is a relatively high frequency of certain diseases (mainly Caprine arthritis encephalitis (CAE), Caseous lymphadenitis and abortion), which often leads to early culling. Due to the combination of limited milk quotas and a relatively high per-goat subsidy, only few farmers fully utilize the goats' maximum production capacity.

Risk factors

Goat farming is troubled by poor recruitment because of poor profitability, limited leisure time, a high frequency of diseases and difficulties in combining goat farming with other, off-farm employment. At present, the dairies are required to receive all goat milk. However, the discontinuation of this scheme would have a substantial effect on the goat farming industry.

Goat breeding in Norway

Organization of Norwegian goat breeding

The Norwegian goats were earlier divided into geographical groups, since mating mainly occurred between animals within a region. As a result of modern breeding work and extensive use of AI services, most goats are now regarded as one breed, the Norwegian Dairy Goat, more or less comprising the entire active goat population in the country. Norway is the last country in Western Europe with such a large population of this type of dairy goat.

The Norwegian Sheep and Goat Breeders' Association is responsible for organizing goat breeding programmes in Norway, e.g., by calculating breeding values and distributing frozen semen. Practically, the work is carried out in so-called "buck circles", equivalent to the "ram circles" described in the chapter on sheep breeding, see page 17. The advantage of this system is that one can work with larger breeding units than are available as individual goat flocks, and thus also larger progeny groups, with daughters in different environments. The system's weakness is that it involves transporting animals and thus helps to spread diseases. Transport from one flock to another places quite a strain on the bucks. Many promising bucks have therefore died at a young age, which in turn reduces the efficiency of the breeding efforts. The success of the "buck circles" demands sound management and much loyalty by all participating members.

Sustainability of breeding work

Inbreeding may quickly become a substantial problem if restrictions on the transport of animals are introduced in order to limit the spread of diseases. Such restrictions cannot be offset by AI, since its use in goats is complicated, costly and unreliable. AI in goats is thus poorly developed. The general breeding goals for dairy goats are the production of milk (and milk products) with a good, distinctive goat taste, optimal utilization of local fodder resources and grazing land, as well as securing goat health and fertility. The breeding index includes milk yield, protein, lactose and fat contents, udder conformation and milkability. Dry matter is weighted 1.4 times more than milk yield in the index. Diseases are not recorded well enough in order to be included in the selection of goats. All breeding is self-contained, and not dependent on imported breeding stock.

Trends and threats in Norwegian dairy goat farming

Many Norwegian dairy farmers are phasing out their production and selling their milk quotas. The buck circles are becoming smaller, and the general negative trend leads to a smaller breeding population. If this trend continues, the present breeding programme must be evaluated with regard to the expected breed improvement and the development of inbreeding.

The dairy goat industry is threatened. At the same time, there are positive developments with regard to developing alternative farming systems, marketing, capacity building and disease control. This may help to reverse the trend during the next decade and to secure the existence of the Norwegian dairy goat. For example, various production models have been tested that focus more on the role of goats in landscape management. These include production systems with combined milk, meat and wool production, as well as only meat and wool production. The latter includes kidding later in spring (April/May), and use of suckler goats – so that milk is not one of the products.

Routines for long-term storage of genetic material

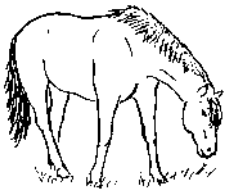
Each year, four to seven of the country's best progeny-tested bucks are used for the collection of semen. Since 1977, semen doses from these bucks have been put into long-term storage banks. The oldest frozen semen doses are from bucks born in 1970.

Historical goat breeds with small populations

There is a small population of coastal goats in the County of Sogn and Fjordane (Selje municipality). The goats were used for meat production, in a special farming system adapted to local climate and topography. Nowadays, the system is

only being used by a few farmers. However, some dedicated locals, the Norwegian Sheep and Goat Breeders' Association and the Committee on Farm Animal Genetic Resources have initiated various measures to stimulate the old farming system, and have frozen semen for present use as well as long-term storage.

1.2.5 HORSES



In 2000, there were about 42,000 horses in Norway, and the total employment in horse-related activities was about 4000 – 4500 man-years. In addition, there are extensive activities related to recreational horsemanship. In 1999, a total of 6843 persons submitted production subsidy applications for 24,573 horses. This gives an average of 3.6 horses per farm.

Earlier, horses were mainly used as a means of transport and draught power in agriculture. Even though there is still some traditional use of horses in farming and forestry, most of the modern horse industry is based on horse breeding and raising, horse-racing and other equestrian sports, as well as various recreational and health-related services.

Production systems in the horse industry

Horse breeding and raising is done on a significant number of Norwegian and international breeds. These activities are mainly conducted in connection with normal farm operations, partially as a hobby, and partially as professional breeding of top-quality horses for various purposes. Both cultivated pastures and rough grazing are important sources of fodder for these horses.

Equestrian sports include harness racing, thoroughbred racing and horse riding. Nearly half of the Norwegian horse population are trotters. Training and racing of harness horses is mainly carried out professionally in connection with betting activities (totalisator). The same pattern applies to thoroughbred racing. Horse riding is mostly carried out at riding centres and schools. Many active riders are children and teenagers (often girls).

Horse-related services are becoming increasingly important, and are often carried out as an additional farm enterprise. The most important of these are fodder production and livery services, which represent substantial values. Others include recreational activities such as mountain riding, horse-drawn wagon and sled trips, etc. Horses are also suited for physical, social and psychological rehabilitation. The demands on safety, quality and professional attitude are predominant in all of these activities.

Limiting factors

The horse industry now mainly caters to the vacation, recreation and health markets. These are major areas of economic growth in modern society, representing a tremendous potential for the industry. Horses are also used in youth welfare services and to satisfy people's needs for animal and nature contact. In agriculture, horses contribute to significant value creation and employment, in addition to utilizing grazing land and thus helping to manage the cultural landscape. Important limitations are that many horses are not adapted well enough to modern uses, and that many horse owners lack sufficient know-how and quality assurance routines. The horse industry has also struggled to become accepted as a full-fledged industry, both politically and by the general public. However, the Government is now finally in the process of formulating an action plan for the development of the Norwegian horse industry. The entire industry is suffering from poor profitability, and losses are rather common. However, those that do succeed, often achieve satisfactory financial results.

Horse breeding in Norway

Horse breeding is carried out in accordance with the regulations on approved (purebred) equine animals and the breeding strategies of the various breed associations. The Norwegian Agricultural Inspection Service approves the various breed associations. Presently, there are 11 breeding plans for a total of 19 horse breeds. Four of these are national breeds for which Norway is specifically responsible. The Ministry of Agriculture has delegated the authority for approving breeding plans to the Norwegian Equine Centre, which also is responsible for all centrally-organized breeding measures. If a stallion is to be used in Norwegian horse breeding, he must have been licensed at a public Norwegian exhibition held by the Equine Centre.

The breeding plans are the main breeding tool, containing the general breeding goals. For each breed, general objectives are presented, in addition to specific objectives for such breeding traits as conformation, temperament, performance traits and disqualifying defects. Performance traits vary from clearly defined, quantifiable requirements in trotting breeds to much more qualitative assessments in other breeds, such as their suitability for riding and driving. The breeding plans also contain selection criteria for stallions, which are mainly based on the stallion licensing rules. The plans shall also include ranking criteria for mares and possible measures aimed at limiting inbreeding.

Artificial insemination is not much used in horse breeding, although it has become more common in thoroughbred and harness horse breeding in the past few decades. This is mainly done by using fresh semen at stallion stations, as well as temporarily stored, chilled semen that can be sent from a stallion station to a waiting mare. Frozen semen is also used in order to introduce popular, foreign stallions. However, this is costly and results in relatively low conception rates.

Sustainability of breeding work

Sustainability is especially important for the national horse breeds. In general, health and performance recording of leisure horses is quite poor compared to most other livestock species in Norway. For those horse breeds that have introduced the BLUP system (see explanation on page 11), the restrictions on close breeding have been insufficiently established. This is a serious threat to the sustainability of the breeding work. Such restrictions can include quotas on the number of breeding stallions and on the number of

The Fjord Horse, Norway's largest national horse breed and the only one with a significant international distribution. (Photo: Bine Melby, NLM's archive).

male offspring from each stallion. For the other livestock species using the BLUP system, one has succeeded in introducing stringent restrictions on close breeding, in order to avoid inbreeding. The reason for their success is that the breeding associations themselves own the sires, and thus have full control of their use. However, in horse breeding, most stallions are privately owned, and the restrictions can only be included as rules in the breeding plans.

Routines for long-term storage of genetic material

No storage facilities for horse semen exist in Norway.

National horse breeds

There are four national horse breeds in Norway: Fjord Horse, Døle Horse, Nordland Pony and the Coldblooded Trotter (managed in cooperation with Sweden). The *Fjord Horse* has a significant international distribution, and its population is large enough to allow the sustainable management of the breed. The population of the *Coldblooded Trotter* is also large, however, with an increasing degree of inbreeding as a result of using BLUP indexes without placing restrictions on close breeding. The *Døle Horse* has some problems due to its small breeding population (approximately 300 breeding females and 30 breeding males). There also seem to be problems related to inbreeding in the Døle Horse as a result of extensive line breeding during the first half of the 1900s and the small present population. The *Nordland Pony* almost became extinct following the Second World War. The active breeding population is still very small (about 150 foals born per year) and a high degree of inbreeding has been documented.

1.2.6 PIGS

Pig production systems

Traditional pig production systems in Norway

In Norway, there are about 90,000 breeding sows, with an annual production of about 1.5 million fattening pigs. There are approximately 3000 herds, and each farm thus averages 26 breeding sows or gilts. Compared to other industrialized countries, pig production in Norway is small-scaled. There are three main pig production systems: weaner pig production, combined production, and specialized finishing units. Piglet producers sell weaners (ca. 22 kg) to slaughter pig producers for finishing. Combined operations include the breeding, rearing and finishing of the pigs, whereas a finishing unit purchases weaner pigs and feeds them until they are ready for slaughter.

Limiting factors

Pig production in Norway is restricted by concession limits (see page 10 for a detailed description of the concession policies in pig production). The number of breeding sows is limited to 70 per year, and the number of pigs in a herd fed to finish to 1400 per year. As in many other livestock industries, there is also a lack of qualified labour.

Pig breeding in Norway

Organization of Norwegian pig breeding

Norsvin organizes all pig breeding in Norway. Norsvin is responsible for everything from testing and determining breeding indexes to the sales and distribution of semen. Three breeds are used in Norsvin's breeding work: Norwegian Landrace (L), Norwegian Duroc (D) and Finnish Yorkshire (Y). These are used in various combinations [sow x boar, respectively]; [L x L], [LY x L] and [LY x LD]. The Landrace is the most important breed, accounting for about 80 % of the breeding sow population, while Duroc and Yorkshire account for about 17 % and 4 %, respectively. Pig breeding is organized as a traditional breeding pyramid, in which the breeding herds are at the top. These herds produce and deliver potential breeding males for testing and cross-bred or pure bred females for the multiplyer level. The multiplyer level sells females to commercial producers. Contract breeding is used for Durocs, and Duroc-crosses are only available for the members of the meat cooperative. Norwegian Yorkshire breeding is purely propagation for the production of LY hybrid sows, see next paragraph.

Sustainability of breeding work

Norsvin has estimated the increase of inbreeding in the Norwegian pig population to be 0.2 % per year, which implies that inbreeding cannot be regarded as a threat to the sustainability of the system. Norsvin's breeding system is based on cooperation with the Finnish Breeding Organization (FABA), and all Yorkshire semen is imported from Finland. Considering the entire Norwegian pig programme, these imports are rather limited and do not have much effect when assessing sustainability. When considering sustainability, the versatility of the breeding objective is an asset.

Risk factors

Norway is very privileged with regard to pig diseases. Many of the diseases common in neighbouring countries are not a problem in Norway. These include such diseases as salmonella, scab, swine dysentery and progressive atrophic rhinitis. A change in this situation would be a serious threat to Norwegian pork production, and especially to Norwegian pig breeding. For that reason, large-scale production with a larger disease risk due to extensive and long transports is considered a threat to the industry. The risk of infections is also promoted by the general increase of international mobility.

Routines for long-term storage of genetic material

Norsvin carries out all freezing of boar semen. Since about 1990, some semen doses of the best elite AI boars have been frozen for long-term storage. Since 1998, 20 semen doses from each elite boar have been routinely frozen for long-term storage. This implies that all family lines are represented in the long-term storage facilities. Each year there are about 50 elite AI boars per breed, which are young boars selected according to breeding value, conformation and relationship. In the long-term gene bank, semen doses from 15 Landrace boars and 12 Duroc boars are stored every year. In addition, semen from five Yorkshire boars is stored each year, even though the semen is imported from Finland. Of

Top: Piggery with maternity pens. (Foto: Tore Mælumsæter). Bottom (left): Hybrid sow with piglets. (Foto: Atelier Klingwall/ Norsvin). Bottom (right): Landrace boar. (Photo: Atelier Klingwall/ Norsvin).

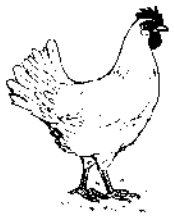
each boar, 15 semen doses are stored. The intention of the gene bank is purely long-term storage, and not any kind of use (in active breeding). No guidelines have been made as to how long the semen shall be stored, but Norsvin expects that the Committee on Farm Animal Genetic Resources has some ideas in this respect.

In addition, the Norwegian Museum of Agriculture has commissioned the long-term storage of "historical-type pig" semen. This semen is completely at the disposal of the museum. There are no historical populations of Norwegian pig breeds in Norway outside of the commercial pig breeding activities.

Biobank

Norsvin is now collecting and systematizing all biological material in a biobank, which also will include Norsvin's breeding and AI database. The establishment of the biobank is a joint project with Aqua Gen AS. When the upgraded biobank is operational in 2003, it will meet the demands regarding the storage of genetic resources, including both the storage of biological material and relatedness and performance data for each individual animal. Blood from boars, mainly used for paternity and halothane tests, has been stored since 1986, and will also be included in the biobank.

1.2.7 POULTRY



In 1999, a total of 3769 egg producers submitted production subsidy applications for 3,216,750 laying hens. This gives an average of 853 laying hens per operation. A total of 484 farmers produced 27,523,776 broiler chickens, resulting in an average production of nearly 57,000 chickens per operation.

Production systems in the poultry industry

Laying hens

At present, 93 % of all egg production is carried out in various types of 3-hen cages. These cages are being phased out, and new cage facilities cannot be installed and put to use after 01 January 2003. A new EU directive totally bans the use of traditional cage systems after 01 January 2012. For the new cages that are to replace present systems, Norway has introduced more stringent space requirements than the EU. Seven per cent of present production occurs in various types of freerange facilities, with an increasing trend. The concession limit for egg production is 5000 laying hens. Units with more than 5000 layers account for 8 % of the country's egg producers. (See page 10 for details on Norway's livestock concession laws.)

Broiler chickens and turkeys

The production of chicken and turkey meat has always been based on floor production systems with different types of bedding. The increasing demand on production efficiency has led to increasing animal densities. Except for general provisions in the animal welfare act, there have so far been no official regulations limiting animal density. The poultry industry itself recommended a maximum limit of 35 kg live weight per m^2, applying to both broilers and turkeys. The Ministry of Agriculture introduced new rules on 01 January 2002, limiting densities to 34 kg live weight per m^2 for broilers and to 38 kg live weight for turkeys. If the average live weight for turkeys exceeds 7 kg, the maximum density is set to 46 kg per m^2.

Poultry breeding

Organization of Norwegian poultry breeding

In 1994, the Norwegian authorities principally enabled the free import of livestock to Norway. Norwegian poultry breeding (ducks, geese, turkeys, laying hens and broiler chickens) was not able to compete with the foreign breeding companies, and was therefore phased out. At that time, Norway was the last European country with public, national poultry breeding programmes. From 1994 to 2002, one Norwegian breeding station for laying hens was still in operation, accounting for 1 % of the nation's production stock. Since 2002, all parent and grandparent stock are imported from 5-6 international breeding companies; two of which supply egg laying chickens, two supply broilers and one supplies turkeys.

Trends and threats to the Norwegian poultry industry

Egg consumption is expected to remain constant at about 10-11 kg/person/year. The consumption of chicken, turkey and duck meat has doubled in the past decade, and is expected to continue to increase. Due to the poor microbiological quality of foreign eggs and poultry, it is expected that only Norwegian products will be available on the domestic market in the foreseeable future. Especially salmonella is a problem in many other countries (except for Finland and Sweden). In spite of the favourable salmonella status of Norwegian products, the high level of costs in Norway will presumably exclude any export of poultry products.

Routines for long-term storage of genetic material

No collection or storage of genetic material from poultry being used in the industry is presently being carried out in Norway. This is the responsibility of the breeding companies selling parental stock.

Historical poultry breeds with small populations

In 1973, the Norwegian Poultry Gene Bank was established in order to conserve the active breeding lines. It also aimed to conserve the Jær Hen, which is the closest Norway comes to a national landrace breed. The Poultry Gene Bank now manages 15 populations, including the remains of the stock, which was in active production up to 1994. The Norwegian Poultry Association is administratively and scientifically responsible for the gene bank for laying hens in Norway.

1.2.8 AQUACULTURE (FISH FARMING)

Fish farming production systems

Traditional aquaculture production systems in Norway

In 1999, a total of 800 licensed operations produced nearly 470,000 tons of farmed fish (see page 10 for a description of the allocation of licenses in the fish farming industry). All of the licensed producers have aquaculture as their main source of income. Salmon and rainbow trout account for more than 95 % of the output.

The value chain in the production of farmed salmon and trout is broodstock/spawn production, fry/smolt production, grow-out, slaughtering/processing and marketing. The process starts by stripping eggs and milt (sperm) from broodstock. The fertilized eggs are then transferred to hatcheries and are usually sold to fry and smolt producers as eyed eggs about 30 days after fertilization. The eyed eggs hatch after another 30 days, and for a while, the fry still live off the nutrients in the egg-sac. After another 40 days, when 2/3 of the egg-sac has been used, the fry are transferred to feeding containers and given dry feed. Here, the fry are kept until they are smoltified after 8-15 months, depending on the water temperature. The fish are now called fingerlings or smolt, weigh 80-150 grams and are fully adapted to living in salt water. In the sea, the fish are kept in floating netpens (between 1000 and 10,000 m^3), where they are fed for 10-18 months until they have reached an average weight of 3-5 kg. At slaughter, the fish are 2-3 years old, whereas broodstock remains in the sea for another year or two. Slaughtering is done by transferring the fish to CO_2-saturated water and bleeding them. The generation interval for salmon is four years, for trout three years. Broodstock is transferred from sea water to fresh or brackish water 3-4 months before stripping.

Limiting factors

The production of eggs and broodstock is mainly regulated by concessions (see page 10). A large production volume is necessary for efficient and profitable breeding operations, and only a few facilities have been licensed.

Smolt production is also regulated by concessions. The maximum annual output is limited to 2.5 million smolt per enterprise. The industry claims that this limit possibly restrains investments in new and improved technology. New technology is necessary for increasing production capacity and reducing environmental impact. However, such investments are financially meaningless if the increased capacity cannot be utilized.

Several laws and regulations, which limit such factors as the size of the operations, stocking density, regulate grow-out facilities and total feed consumption. In addition, the site's carrying capacity, the need for temporary safety zones and future protection zones are evaluated. As in smolt production, the capital requirements of grow-out facilities will continue to increase, as the demands on know-how and technology grow in order to secure efficiency and profitability.

Risk factors in salmon and trout production

The viability of the aquaculture industry depends on favourable market conditions. The export of Norwegian farmed fish is extremely vulnerable, since 71 % of the farmed salmon is sold to the EU, and 80 % of the farmed trout is exported to Japan. All factors affecting these markets thus have a great effect on the aquaculture industry. Well-known risk factors include import restrictions and the market's conception of how "safe" it is to eat Norwegian fish, with regard to animal health, use of antibiotics and animal welfare. The access to qualified labour can also be a problem for the industry, especially finding and keeping aquaculture experts in the remote areas in which the facilities often are located. Finally, governmental regulations can have substantial effects on the aquaculture industry, and it is thus important that the regulatory framework is conceived as favourable and reliable by the industry.

Fish breeding in Norway

Organization of Norwegian fish breeding

Breeding stock is selected at breeding stations that cover the entire life cycle from fish eggs and milt to mature broodstock. The breeding stations conduct family testing with full-sibs in groups that are tested for those traits included in the breeding objective. Some of the testing is done at field stations under ordinary production conditions. Based on the performance data from the breeding and field stations, a breeding index is calculated for each individual fish. The breeding stations when selecting broodstock then use these indexes. The stations then sell eggs and smolt to fingerling production facilities, who use this stock to produce eggs for smolt producers, who in turn sell smolt to grow-out operations.

Sustainability

Since private breeding companies carry out fish breeding, detailed breeding plans are not public documents. However, the companies claim that their breeding programmes are sound, taking inbreeding and multiple traits sufficiently into consideration. For example, salmon breeding focussed to begin with mainly on performance, i.e., weight gain. Eventually, other traits such as fat contents, fat distribution and meat colour were included. Recently, the focus on resistance against specific diseases is being emphasized in breeding. This is important for the fish themselves, producers and consumers alike. The Norwegian fish farming industry feels it should pioneer in this field, since Norway already has extensive experience from breeding for disease resistance in other livestock species, e.g., cattle. Breeding for disease resistance in Norwegian salmon and trout would increase the sustainability of the industry, and the know-how could be transferred to other species.

Trends and threats to the Norwegian aquaculture industry

During the past decade, the trend in the aquaculture industry has clearly been a concentration to fewer, but larger fish farming enterprises. New technology is continuously being developed, and new species, such as cod and halibut, are being introduced as farmed species.

Top: Farmed salmon (Photo: Akvaforsk). Bottom (left): Since 1980 the breeding company Aqua Gen has collected and frozen milt from its stock for longtime storage. (Photo: Mari Bjørke, Geno). Bottom (right): Fur-farming production: Silver fox (above) and crossmink young (under). (Photo: Norges Pelsdyralslag).

The greatest present threats to the industry are international competition and the access to sufficient feed supplies, especially of marine fat and protein. Public opinion is another important factor. As a result, the aquaculture industry has become very aware of and has drastically reduced its use of antibiotics.

Routines for long-term storage of genetic material

Since 1980, the breeding company Aqua Gen has collected and frozen milt from its trout and salmon stock for long-term storage. The gene bank now consists of milt from 334 rainbow trout and 508 salmon, and includes data on relatedness, milt quantity and age group. Aqua Gen owns the material, and funds and administrates the milt collection and storage. Most of the milt is stored in a single storage tank, but a small share of the material is stored elsewhere. There are no routines for keeping track of the withdrawal of milt from the storage tank, and there is thus no complete index of the stored material. However, this is being improved.

Biobank

Aqua Gen AS is in the process of establishing a biobank in cooperation with Norsvin, see page 21.

1.2.9 FUR-BEARING ANIMALS

In 1999, there were about 1000 fur farmers and 131,278 fur-bearing animals in Norway. Compared to other livestock production systems, Norwegian fur farmers receive little public support, and are thus totally dependent on world market prices. This market dependency has a significant effect on the number of animals in production, and as a result, the population of fur-bearing animals varies considerably from year to year. There are no import restrictions other than certain veterinary requirements. The combination of the relatively small breeding population, world market dependency, varying population size and free import of breeding stock places great demands on the breeding of fur-bearing animals.

Fur farming production systems

Traditional production systems for fur-bearing animals

Fur farming is usually carried out in combination with other farm operations. The farm units are thus small compared to fur farms in other fur-producing countries. They are mainly located in Norway's mountain and fjord regions. Presently, silver fox, blue fox and mink are being kept. The mating season is February – April. All minks and 70 % of the foxes are mated naturally. Fox cubs and mink kits are born in May, and are weaned at the age of eight weeks. The young animals are at first kept together, but are eventually moved to separate cages, usually in pairs. When the cubs or kits are about six months old, their winter pelt is fully grown. At this stage, those animals to be slaughtered are separated from the breeding stock.

Limiting factors

Norwegian fur production is based on the world market and its fluctuations. Prices depend on the general economic situation, economic trends and fashions. Nationally, the fur industry is affected by the authorities' technical requirements and the general economic conditions. There are practically no fur-processing facilities in Norway today and no furriers that produce entire garments. At a modest scale, there is some alteration and production of special ornaments and trimmings. Such small-scale enterprises have usually been established in remote areas, and only process small quantities of locally produced furs.

Risk factors

In addition to market fluctuations and changing technical requirements, another major risk is the introduction of diseases with imported breeding stock. The excellent health status of Norwegian fur-bearing animals is an important asset for the industry.

Animal welfare and political interest groups have regularly put a lot of pressure on the fur farming industry, including a proposed ban on fur farming, for the sake of animal welfare. This pressure has affected the authorities' demands regarding the fur farming industry. There is thus some anxiety related to the presentation of the Report to the *Storting* (the Norwegian Parliament) on animal welfare in December 2002. One possible scenario is that the fur market is very favourable, but that the regulatory framework either prohibits fur farming, or places such extensive demands that production *de facto* becomes impossible. An example of such a situation is fox fur production in Sweden.

Fur-bearing animal breeding in Norway

Organization of Norwegian fur-bearing animal breeding

Breeding work is mainly limited to on-farm breeding, except for a few cases of cooperation between farms. This work is organized as "fox-breeding circles", in which several farmers share breeding males, thus enabling a sufficient number of progeny for progeny testing.

Sustainability

Due to the large number of small farms, extensive on-farm breeding and varying population size, it may seem probable that increasing inbreeding could become a problem. However, an extensive live animal trade balances the situation, and the national fur-bearing animal population should thus not be threatened by increasing inbreeding. The situation is expected to be the same ten years from now, with certain reservations with regard to silver fox breeding. Specific measures may have to be implemented in order to avoid inbreeding problems if the number of silver fox farms and breeding animals is further reduced. However, based on the market situation in 2002, there seems to be no immediate threat thereof.

One of the objectives of the Norwegian Fur Breeders' Association is to breed for several important traits simultaneously. The most important economic traits are fertility, skin length and fur quality. Since each farmer determines the breeding goals on her farm herself, these

traits are clearly favoured on most farms. Nevertheless, the Fur Breeders' Association's breeding plan also promotes the inclusion of less heritable and profitable traits, such as fur brightness and purity, maternal traits and temperament. Those that have taken these recommendations into consideration have achieved good results. Compared to the development of the Finnish blue fox, one has achieved a considerably more well-balanced animal type in Norway. The price for this development is that the improvement of skin length has been less and slower in Norway than in Finland. As a result, Norwegian fur farmers have imported a substantial number of Finnish breeding animals. This will affect a relatively large share of production in the years ahead. However, some regions in Norway have stuck to the national breeding strategies, but have altered the weighting of certain traits in selection. This has led to a significant improvement of skin length, while keeping many of the special quality features of the Norwegian fox.

There is no organized import of breeding stock, but since there are no import restrictions for live animals, a certain extent of imported blue fox from Finland and mink from Denmark must be expected. This does not present any problems for the fur breeding efforts, but is not directly desirable, either. Animal imports are always connected with a certain risk of introducing unwanted traits and contagious diseases.

Routines for long-term storage of genetic material

Preserving genetic material

Fox semen can be frozen, whereas mink semen does not tolerate freezing. A living gene bank is thus necessary in order to preserve mink genetic material for the future. In Norway, there are storage routines for fox semen, but no living gene bank for mink.

The Norwegian Fur Breeders' Association has a gene and a semen bank for foxes. The gene bank contains semen from males with specific colour mutations, which are becoming less common, whereas the semen bank contains semen from the 10-15 best breeding males from the period 1987-99. The aim was to collect 100-200 doses from each animal, but this was not always achievable. The total semen stock in the two storage banks is: 8778 doses of 0.5 ml each, collected from a total of 99 males between 1987 and 1999.

Furthermore, a few male foxes and minks have been exported to living gene banks in Denmark. The fate of these animals is beyond the reach of the Norwegian Fur Breeders' Association.

In December 2001, the Nordic fur-breeding associations finalized an evaluation of the necessity and potential for the joint Nordic conservation of genetic resources of fur-bearing animals. The project concluded that a company should be established (*Nordiske pelsdyrgener* A/S, i.e., 'Nordic Fur-bearing Animal Genes Ltd.'), to be jointly owned by the Nordic fur-breeding associations. The company should be responsible for the long-term freezing storage of semen of different fox types, and for the establishment of populations of various blue fox and mink mutants. The project's final report is available via the Norwegian Fur Breeders' Association, see page 39 for their address.

National populations of fur-bearing animals

In the field of fur-bearing animals, one prefers using the term 'mutants' rather than 'breeds'. Presently, there are 28 mutants of fur-bearing animals in Norway, which are considered national populations. Of these, 12 are in danger of disappearing due to the lack of demand. However, semen of these fox mutants is stored in the Norwegian Fur Breeders' Association's gene bank.

1.2.10 BEES

Beekeeping production systems

Traditional honeybee production systems in Norway

Norway has a stable number of between four and five thousand beekeepers and about 80-100,000 honeybee colonies. Many beekeepers migrate with their colonies in order to utilize nectar flows at different localities. Some let their bees forage in areas with flowering raspberries in summer, others in heather in autumn. Even other beekeepers remain stationary, with only one major nectar flow. Migratory beekeeping seems to become increasingly common, partially due to increasing demands on profitability, but also due the extensive overgrowing of heathlands.

Limiting factors

When varroa mites were found in Norway, migration restrictions were introduced. This greatly limited the affected beekeepers' possibilities for moving their colonies and therewith efficient honey production. The restrictions have gradually been loosened, but vast expanses of heather areas along the western coast of Norway are still poorly utilized. One reason is that the mobility of the beekeepers with numerous colonies in southeastern Norway is still limited, while there only is little local beekeeping in the heather areas themselves. The risk of easing up on the mobility restrictions is the increasing spread of the varroa mite.

Economically, heather honey is the main type of honey. The increasing overgrowth of heathlands is thus a threat to this part of the beekeeping industry. Heather gradually disappears as forests replace the former heathlands. The heather plants that still grow in the forest produce little or no nectar.

Beekeeping is mainly a part-time occupation in Norway. The very few full-time beekeepers might find it difficult to find qualified labour to assist them. In situations where abundant honey flow would allow the movement of a large number of colonies, beekeepers depend on hiring skilled labour, which, however, can be difficult to find.

Risk factors

Due to the biology of the honeybee, diseases can have serious effects. However, the general health status of the Norwegian bee population is good, due to limited import of bees and efficient strategies for combating the disease outbreaks that do occur. In addition, most beekeepers maintain high hygienic standards, e.g., by renewing wax and cleaning all materials. The varroa mite is under control, and has so

far not been spread throughout the entire country. In 2002, tracheal mites were found for the first time in Norway. This will presumably again result in further restrictions regarding the movement of colonies. One expects to eventually control the tracheal mite, but in a transition phase, the loss of colonies is probable. Outbreaks of American foulbrood occur occasionally, but is not a significant problem compared with other countries. For beekeepers, outbreaks of foulbrood have serious effects, since the bee colonies and all materials need to be burned. A temporary ban on migration is also imposed on the beekeepers in the vicinity of the infected apiary.

Bee breeding in Norway

Organization of Norwegian bee breeding

The Norwegian Beekeepers Association is conducting breeding programmes with two geographical bee races: the Carniolan bee (*Apis mellifera carnica*) and the dark European honeybee (*A. m. mellifera*). Each year, about 360 tested queens of each breed are produced, the breeds alternating every other year. Of the 360 tested queens, about 30 are selected for breeding when the tests are completed. These are used to supply eggs for breeding tested queens and as drone layers at the test queen mating station. Due to bees' rather unique reproductive biology and sex differentiation, this is necessary in order to avoid inbreeding problems. Queens for sale are produced from the best brood queens. The broodstock is also improved with good genetic material from beekeepers or by importing eggs. From this stock, queens are produced that are mated with the same drones and compared with the other test queens.

There are some Buckfast bees in Norway. The Buckfast Club organizes the breeding of this bee breed, with assistance from the Norwegian Beekeepers Association.

Sustainability

The Norwegian bee-breeding plan aims to limit the increase of inbreeding to a minimum, even without importing breeding stock. The breeding index includes the traits honey yield, temperament and swarming tendency, but not health. The breeding of Buckfast bees is dependent on imported breeding stock in order to avoid inbreeding.

Routines for long-term storage of genetic material

Norway does not have gene banks for bees. No satisfactory method for the freezing of bee semen has been developed, thus, living gene banks are needed. The closest Norway has come are several pure breed areas of Carniolan and dark European bees. However, ordinary bee breeding is carried out in these areas, which thus cannot be defined as living gene bank areas. The Beekeepers Association is aware of this dilemma, but does not consider it possible to establish pure breed areas without controlled selection of bees.

The pure breed areas for dark European bees were established in the early 1970s by local beekeepers. Elected inspection committees of local beekeepers now manage the areas. The traditional practice of regularly dividing colonies secures the constant use of many maternal lines and therewith a large degree of biodiversity. International expertise has been extensively used in this work, and the first international conference on the conservation of the dark European bee was held in Norway in 1995.

The native honeybee in northern and western Europe

The dark European bee (*Apis mellifera mellifera*) is considered to be the native honeybee of northern and western Europe. Norway may have the largest population of this bee race in Europe, and is thus especially responsible for securing its survival.

Norway has one large pure breeding area for the dark European bee, including about 2000 colonies in several municipalities in southwestern Norway (Vest-Agder and Rogaland counties). The dark European bee is large, with a dark, and sometimes shiny colour. Their temperament varies more than that of the Carniolan bees. They can be gentle, but also quite aggressive. They build up slower in spring (e.g., than Carniolan bees), but are excellent honey producers and overwinter well. Most dark European bees are found in southern and eastern Norway, but can be used in professional honey production throughout the entire country.

1.2.11 DOMESTIC REINDEER FARMING

At a national scale, domestic reindeer farming is a minor industry, but both locally and for the Sami population it has a significant economic and cultural importance. Reindeer herding is closely associated with the Sami, an indigenous people of the Nordic region. The Sami are divided between the four countries Norway (ca. 43,000), Sweden (ca. 17,000), Finland (ca. 6000) and Russia (ca. 2000). The Sami have the exclusive rights to reindeer farming in the defined Sami areas in both Norway and Sweden. However, Norway also has areas in which non-Sami keep reindeer, and in Finland, the Sami represent a minority among the reindeer herders.

Reindeer herding is an extremely extensive production, requiring vast areas of land. Grazing reindeer use 35-40 % of the land area of the Scandinavian peninsula, but only account for 0.6 % of Norway's total meat production.

Production systems in the reindeer industry

Traditional reindeer farming systems

Different forms of reindeer herding systems have developed, depending on the use of grazing lands and seasonal migration patterns. The basic principle of seasonal migration, however, is the same, only the scale varies. The largest group of reindeer-herding Sami are the semi-nomadic Sami in the Norwegian county of Finnmark, who move their herds between the summer pastures along the coast and the winter pastures on the inland mountain plateau. Other Sami as well as non-Sami herders usually have permanent homes, and only move their herds across relatively short distances throughout the year.

Top: Domestic reindeer farming in Norway is the exclusive right of the Sami, and based on a combination of traditional practice and adaptation to modern technology. (Photo: Magnar Evertsen). Bottom (left): The reindeer is physiologically and behaviourally adapted to a short intensive growth period during summer. (Photo: Roger Pedersen). Bottom (right): Reindeer farming - a way of life. (Foto: Roger Pedersen).

Risk factors

Reindeer farming is a marginal production system and is vulnerable to disturbances. Reindeer are physiologically and behaviourally adapted to a short and intensive summer period (rapid weight gain) and a dormant winter period, in which they reduce their activity in order to minimize energy and nutrient losses. It is important that the reindeer are allowed to graze undisturbed on the best pastures. If humans or predators disturb them, they flee and use precious time on finding new grazing areas.

In recent years, losses due to predators have increased sharply, and have created serious problems for the industry. The Norwegian national assembly has thus decided neither to establish core conservation areas for wolverines, nor introduce a permanent wolf population within the Sami reindeer grazing areas.

In the past decades, many encroachments have been made on reindeer grazing lands which have led to direct and permanent loss of reindeer pastures. These include technical facilities in connection with hydro-energy development, road construction, military training grounds, artillery ranges, mines, tourist facilities and recreational housing development.

Reindeer breeding in Norway

Organization of Norwegian reindeer breeding

The Scandinavian domestic reindeer is more or less regarded as one common population. The Norwegian wild reindeer are mainly domestic animals that have gone wild, with the exception of the wild reindeer population in the Dovre Mountains, which presumably has little domestic reindeer blood.

For reindeer, no organized breeding programmes exist, comparable to those for other Norwegian livestock In most herds, only uncontrolled, natural mating occurs. Thus the animals' paternal lineage is often unknown. The herd owners manage the herds, and select animals for breeding and for slaughter according to various criteria, which, however, are usually not recorded in writing. The Sami use knowledge and traditions to select future breeding animals, based on an overall evaluation of the main traits size, conformation, colour, antler development, behaviour, lineage and appearance. However, in the southern areas one has started to systematize the recording of calf and female reindeer weights as a basis for selecting breeding animals. Experience has shown that a lower weight limit of 60 kg for 1 ½ year old heifers is considered optimal.

Sustainability

In most production systems, 1 ½ to 3-year old bucks are used for mating. Usually, a buck percentage of 10 % is regarded as sufficient. Following the mating season, the breeding bucks can be slaughtered, leaving a winter herd consisting primarily of reproductive females (80 %) and replacement calves. This mating system seems to ensure the constant replacement of breeding bucks, and thereby minimizes the risk of inbreeding.

Routines for long-term storage of genetic material

There are no routines for this in the Norwegian reindeer industry.

Trends and threats to the Norwegian reindeer industry

In Finnmark county, it is becoming increasingly common to feed reindeer roundbale silage and hay. This method has mainly been introduced as a result of the deterioration of winter pastures. In many Swedish Sami settlements, winter-feeding has become quite widespread, and in Finland it has been common practice for several decades.

Government support to the reindeer industry (via the Norwegian Reindeer Husbandry Administration) and the general trends in society have to a large degree contributed to a one-sided focus on meat yields in reindeer farming. This has led to an increase in herd size and generally more reindeer instead of breeding larger animals. Especially in Finnmark, the meat production subsidies have resulted in improved profitability in reindeer herding. The Sami often choose to invest their profits by increasing their herds, since the herd represents their production capital.

Technical improvements such as new fencing systems, snowmobiles, four-wheel drive, roads, telecommunications and other infrastructure have enabled new ways of herd management and greater flexibility. At the same time, technology also limits the freedom of the individual owners and the reindeer owner cooperatives (*siida*). The work requires less labour than before, and the need for labour is limited to certain periods of the year. This enables household members to find employment outside of the reindeer industry. Alternative employment possibilities have led to certain drain of labour from reindeer herding, but have also enabled others to continue in the business with the help of external income.

For the Sami, reindeer farming is much more a way of life than 'just another business', and this is often the main motivation for Sami reindeer herders to continue. Traditionally, the Sami mostly had a barter economy, in which the diversity of products was adapted to the local natural conditions, even though the barter market also affected the production goals. The present focus on meat as the major reindeer product and the general technological development have had a dramatic effect on the management of the reindeer population and their habitat. Many herds have become too large, and much of the traditional grazing lands have been used for other purposes. In certain areas, this has led to overgrazing and starvation. The Sami reindeer owners' loyalty to their traditional way of life leads to competition between the reindeer owners, with extremely low yields and poor profitability as a result.

Coordinating the management of grazing land resources is thus extremely important, but is hindered by ambiguous regulations, internal conflicts, changing national subsidy policies and the lack of control mechanisms. Especially in Finnmark county, this has resulted in the degeneration of lichen grazing lands.

1.2.12 DOGS

Hunting and herding dogs

Dogs are important domestic animals in Norwegian agricultural production, even if they are not regarded as a separate production system. They are used for hunting and herding, and thus play an important role in the utilization of natural resources, i.e., game and grazing land. In addition, they also contribute to the recreational value of such activities as hunting and livestock herding. In 2000, more than 90,000 elks, red and roe deer were felled in Norway. The total carcass weight of elk and red deer alone is estimated at 6000 tons.

Hunting dogs

Law confirms the value of dogs as hunting assistants. The Act on Game and Deer of 1994 requires the access to a certified tracking dog for all moose, red deer and roe deer hunting. Hunting dogs are used for hunting a wide variety of game:

- Big game hunting is the most common, and also yields most meat. Big game hunting requires the use of certified tracking dogs in order to ensure humane hunting conditions (with the exception of wild reindeer hunting).
- Trail and fell dogs (bassets and hounds), including hare hounds, den dogs and deerhounds, are used to hunt hares, foxes, etc., as well as for deer hunting.
- Pointing dogs (setters and pointers) are used to hunt ptarmigans and grouses, whereas flushing and retrieving dogs (spaniels and wachtelhund) are used to hunt grouses, waterfowl, hares and roe deer.
- Pure retrievers are mainly used in Norway to hunt wading birds, ducks and geese.

Herding and livestock guarding dogs

Herding (sheep) dogs are used to herd or gather sheep. They are especially useful when collecting sheep on rough and mountain grazing land, but are also used for other livestock herding tasks on farms. Herding and livestock guarding dogs differ in the way they watch and herd livestock. Herding dogs are typically intelligent dogs that are eager to learn, and have kept much of their hunting instinct. This can be seen in the way they move when in use. This hunting, or in the case of herding dogs, "herding" instinct is the basis for their training. The most common herding dog breeds in Norway are border collies and working kelpies. Approximately 2000-3000 border collies and 200-300 working kelpies are presently in active use as herding dogs in Norway.

Livestock guarding dogs have well-developed social instincts, and are very loyal to their herd. These dogs are used to protect the herd from external threats, e.g., predators. In order to perform well, guarding dogs should be set to watching a clearly defined or fenced-in area or distinct livestock herds. The use of livestock guarding dogs has been recently receiving more attention in Norway due to the increasing predator populations in rough grazing areas during the past few years. In this connection, a number of dog breeds that previously were unknown in Norway, have been imported and tested.

Factors limiting the use of dogs in agriculture

The major limiting factor is the time, knowledge and experience required to successfully train dogs. The use of dogs is teamwork between humans and dogs, and thus, the labour costs associated with dog training are a significant restraint.

Risk factors

The biggest genetic risk is that there exist many different breeds performing the same set of tasks, especially hunting. This leads to a large number of breeds, often with a relatively small population within each breed.

Trends and threats regarding the use of hunting and herding dogs in Norway

The use of hunting dogs is becoming more and more important as part of the efforts to ensure humane hunting practices. For example, the mandatory use of retrieving dogs for bird hunting (as already is the case for big game) is being discussed. Also, the use of herding dogs has increased slowly, but gradually in recent years. Sheep dogs are "cheap labour" on sheep farms, even when considering the costs involved in training. Even in times of poor profitability in sheep farming, the use of herding dogs would presumably be maintained. The use of large livestock guarding dogs in predator-prone areas has been successfully introduced. However, the costs involved in training and follow-up may present a problem.

Dog breeding in Norway

Dog breeding is the responsibility of the individual breeder. However, breed associations provide assistance and advice for most of the breeds. The Norwegian Kennel Club serves all breed organizations, and keeps studbooks and records the results of tests, shows and official health diagnoses.

Collecting and preserving genetic material

Some breeders organize the collection and freezing of semen from their dogs, but there are no fixed routines for long-term semen storage. A few breed associations also collect semen and may have long-term storage policies. In the mid-1990s, the Committee on Farm Animal Genetic Resources, the Norwegian Kennel Club and the respective breed associations initiated a joint programme for the collection, freezing and storage of semen from the few native Norwegian dog breeds. They aim to freeze semen from ten unrelated males from each of the native breeds, but so far, this goal has not been achieved.

National dog breeds

Norway has seven national dog breeds. These include three hare hound breeds (Hygenhund, Dunker and Haldenstøver), two elkhound breeds (Grey and Norwegian Elkhound and Black Norwegian Elkhound), a combined herding and watchdog (Norwegian Buhund) and a companion dog (former hunting dog) breed (Norwegian Lundehund). Except for the Grey Elkhound, they all have so small populations that they must be regarded as breeds at risk. All of the native breed associations are associated with the Norwegian Kennel Club.

1.3 Conserving Norway's Historical Farm Animal Breeds

1.3.1 COMMITTEE ON FARM ANIMAL GENETIC RESOURCES

The present Committee on Farm Animal Genetic Resources was appointed by the Ministry of Agriculture in 2001 to be nationally responsible for councelling and coordinating work on preservation of genetic resources of farm animals. The Committee replaces and continues the functions of the former Farm Animal Genetic Resources Committee established by the Norwegian Museum of Agriculture in 1986. The Norwegian Museum of Agriculture functions as the committee's secretariat, and is responsible for implementing its decisions. The necessary funding is allocated via the Agricultural Development Fund, and annual grants have increased from NOK 30,000 in 1987 to NOK 1,600,000 in 2002.

The Committee on Farm Animal Genetic Resources is responsible for evaluating, advising on and implementing measures aimed at conserving farm animal genetic resources in Norway. This includes the conservation of breeds at risk, small populations of old livestock breeds and active breeding populations. For the old farm animal breeds at risk, the Committee on Farm Animal Genetic Resources is responsible for conservation and management; and for the active populations, the committee has a monitoring role and acts as a consultant to the respective breeders` association.

The committee shall:

- Survey and increase public awareness for the importance of conserving farm animal genetic diversity, thus enabling agriculture to meet present and future economic, biological and scientific needs.
- Increase the understanding for the role of old farm animal breeds as part of our cultural heritage.
- Register critical breeds, and propose specific measures for their conservation.
- Function as a national and international information and contact agency, and act as a consultative body for issues related to the conservation of farm animal genetic diversity.

The committee's strategic plan for 2000-2005 can be found at http://www.nlm.nlh.no/strategi.html. Other information about the committee can be found at http://www.genressurser.no/husdyr/genressursutvalget.htm.

1.3.2 THE COMMITTEE ON FARM ANIMAL GENETIC RESOURCES – CURRENT TASKS

The Committee on Farm Animal Genetic Resources works according to the goals and guidelines recommended by the FAO. To begin with, the committee was engaged in the conservation of historical and rare breeds in Norway, but has in recent years also focussed on the conservation of farm animal genetic resources within the active breeding populations.

Traditionally, the conservation of historical and rare breeds aimed to promote the use of these breeds by farmers in regular production environments. The most important measures included the dissemination of breed information and developing networks between dedicated individuals. The establishment of gene banks and conservation herds has been considered a necessary supplement to this work, but *in situ* conservation of actively used animals is still the main thrust of the committee's efforts.

The criteria qualifying a breed as a national breed or population have so far not been formalized in any way, but practically, the following aspects have been considered:

- The breed must have been recognized as a breed within the past 100 years. Such a recognition can be an official approval in the form of an approved breeding organization, proven Norwegian breeding work or other documentation showing that the breed has been considered as a separate breed for a certain period of time.
- There must be a sufficient number of animals and lines in the breed, in order to enable the measures necessary for its conservation.
- In general, no strict proof of pedigree has been required. Preferably, the animals should have been registered in a breeding organization, but for many breeds and herds, this has not been the case. In these cases, the animals are generally evaluated, with a specific emphasis on their breed characteristics and breed history. If they then are included in a breed conservation programme, parentage and progeny are recorded annually.

The work of the Committee on Farm Animal Genetic Resources so far can be summarized in the following main points:

1) Surveying animals and farm animal breeds in need of conservation measures

The Committee on Farm Animal Genetic Resources has a good overview of most of the rare Norwegian farm animal breeds worth conserving. For cattle, a database of more or less all individual animals of the relevant breeds has been established. The database ("cow database") was started after two cattle surveys in 1989 and 1991. The database, which is continually updated, is a vital tool for monitoring the populations of the rare cattle breeds (except for Sided Trønder and Nordland Cattle). Breeds of other species have also been surveyed and registered, e.g., the Trønder Rabbit, the White Norwegian Goose, the Smålens Goose,

the Coastal Goat, the Grey Trønder Sheep and the Old Spæl Sheep. For most of these populations, individual records are kept, but have not been entered in an electronic database.

2) Contribute to the establishment of gene banks (ex-situ)
The Committee on Farm Animal Genetic Resources promotes the development of semen and embryo storage facilities for relevant species, in cooperation with the breeding organizations. Ever since 1986, GENO has been an important partner regarding the conservation of cattle breeds, but the committee has also cooperated with other organizations on the freezing of semen from certain breeds and populations. The Committee on Farm Animal Genetic Resources has also helped to establish living gene banks for species whose semen cannot be frozen (e.g., White Norwegian Goose).

3) Enabling access to breeding stock
The main objective of the Committee on Farm Animal Genetic Resources is to maintain viable populations of all national farm animals breeds in need of protection. This is achieved by establishing contacts between interested individuals, arranging live animal sales, establishing conservation herds, promoting the introduction of headage support for old breeds and by enabling the access to semen of relevant livestock species. The Committee on Farm Animal Genetic Resources has initiated or participated in the freezing of semen of cattle, sheep, goats and dogs. Except for dog semen, this frozen semen is available to any farmer without extra charge. A certain number of the frozen semen doses and all of the dog semen are retained for long-term storage.

4) Establishment of conservation herds for especially vulnerable populations
For breeds of special interest, the Committee on Farm Animal Genetic Resources has made agreements with various institutions (often agricultural schools) and farmers, in which these parties receive financial support for committing themselves to keeping the respective animals. The agreements include such points as breeding activities within the herd and recording those persons who purchase live animals from the herd. Conservation herds exist for cattle, rabbits and geese.

5) Research
The committee is participating in the Nordic project *Genetic Diversity and Origin of the North European Cattle Breeds*, which was initiated by the Nordic Gene Bank Farm Animals (NGH, see page 36). The Norwegian part of the project is carried out in cooperation with the Agricultural University of Norway (Department of Animal Science) and the Norwegian School of Veterinary Science (Department of Morphology, Genetics and Aquatic Biology). The project is studying genetic distances between various cattle, sheep and goat breeds.

6) Knowledge dissemination and networking
The committee has given priority to the dissemination of knowledge and information to specific user groups and the general public. Other important tasks are the development of networks among users and the facilitation of interest groups for the various breeds. Information measures include:

- Brochures for many of the relevant breeds.
- The newsletter *Bjellekua* ("The Lead Cow") is regularly sent to owners of old breeds.
- Videos and slide shows.
- Lectures by national livestock experts.
- National and Nordic seminars.
- Continuous contact between the secretariat and the many interest groups working for the conservation of old national farm animal breeds.

7) Coordinate the conservation of large and small farm animal populations
The Committee on Farm Animal Genetic Resources is a coordinative body, working with the various aspects of gene conservation within the entire scope of Norwegian farm animals. The committee is responsible for the conservation and management of the small populations of breeds at risk. For the larger, active populations, the committee shall monitor and give advice to the respective breeders' organizations. In recent years, the committee has increased its focus on issues of sustainable breeding and conservation of farm animal genetic resources in the active populations. It needs to develop routines in order to follow up its role as a surveillance body. The committee should, in cooperation with the active breed associations, define relevant goals and fix criteria for sustainable breeding.

2 FUTURE USE OF FARM ANIMAL GENETIC RESOURCES

2.1 National Policies

Political commitments

Regarding genetic resource issues, several important political commitments have been made during the past decade, including:

- Convention on Biodiversity and Agenda 21 (1992/93)
- FAO's global strategy for farm animal genetic resources (1993)
- The Nordic Prime Ministers' "Declaration on Sustainable Development" (1998)
- Strategies by the Nordic Council: "Sustainable Development, a New Direction for the Nordic Countries"
- The Nordic Council of Ministers' "Strategy for the Conservation of Genetic Resources in the Nordic Countries 2001 – 2004 (2000)"

Based on these national and international statements and agreements, Norway has committed itself to developing the sustainable management of genetic resources. This requires the initiation of measures at a national level. It is thus a general commitment that livestock-based value creation and business development must be based upon the protection and sustainable use of farm animal genetic resources.

Sustainable use and development of genetic resources

The most important considerations for developing the sustainable use and development of genetic resources are:

1. General policy guidelines that also promote sustainability in connection with other political processes, such as the establishment of trade and patent agreements.
2. Emphasizing the development of knowledge about sustainability, and about the direct and indirect effects of a sustainable development.
3. Develop well-informed and rational regulations for the utilization of farm animal genetic resources.
4. Promote appropriate division of labour between public agencies and the private breeding organizations, ensuring the sustainable management of the country's farm animal genetic resources.
5. Develop a notification system to ensure that measures are conducted in accordance with the Convention on Biodiversity and national commitments.

Assessing the value of farm animal genetic resources

When considering genetic diversity as a resource in the future, value assessments will play a major role. When genetic resources become an integrated part of business activities, the chances for their conservation in the long run increase. The value of genetic diversity is either a real value or a potential value in connection with the following:

- Added value through genetic improvement – leading to better products and/or improved livestock production methods.
- Cultural and historical value of experiencing the old breeds in a viable cultural landscape.
- Innovation based on bioprospecting.
- Intrinsic value of genetic diversity.

2.2 New Uses for Farm Animal Genetic Resources

2.2.1 DEVELOPMENT OF BIOBANKS

In addition to further developing the genetic resources through breeding activities, the data in the national animal recording schemes and the biological material (e.g., semen and blood samples) collected as part of the breeding programmes also represent an exploitable resource. Such extensive collections of recorded data (for individual animals) and biological material are often called biobanks. All of the available information in a biobank can be combined in order to develop new biological insights. Usually, a biobank is defined as a tissue collection from different individuals, but it may also include a collection of e.g., recorded data in addition.

In Norway, TINE Norwegian Dairies and GENO Breeding and A.I. Association have established a cattle biobank enterprise. This was done in order to:

1. make sure that the rights to these resources remain with their owners, i.e., the farmers,
2. utilize the material's potential as a source of knowledge about gene functions, and
3. use the material as a basis for creating values which can benefit the farmers.

The potential of biobanks depends on their contents. The Norwegian cattle biobank is unique, since it contains health and fertility data dating back to the 1970s, in addition to performance data and information about lineage. The biobank can thus serve as a basis for research in many different areas, such as cattle breeding, general livestock breeding, livestock and human medicine, general immunology and general fertility. Presumably, the biobank will eventually enable the study of even other fields.

Similar biobanks are also being established for pigs and salmon in Norway (see page 21 and 23).

2.2.2 BRANDS BASED ON SPECIFIC GENOTYPES AND PRODUCTION ENVIRONMENTS

There are no strong traditions in Norway for establishing brand names that are based on breeds, production environments or production methods. The bulk production of "run-of-the-mill" products has been typical for the past decades. Recently, however, consumers have begun to appreciate origin labelling specifying products associated with genotypes, production methods or regional origin. Due to Norwegian climate and topography, labelled niche products based on extensive farming methods could help farmers to achieve higher prices. All in all, origin labelling can thus contribute to securing the economic foundation of alternative breeds.

Examples of such brands, developed by both large and small, cooperative and private enterprises, include *Edelgris* ("Prime Pork"), *Tjukkmjølk* (a local dairy's cultured milk), *Rørossmør* (locally produced butter) and *Villsau* (feral lamb).

2.2.3 UTILIZATION OF BIOLOGICAL EFFICIENCY IN EXTENSIVE FARMING SYSTEMS

Biological efficiency is defined as performance in relation to inputs used, such as feed, labour and housing. Owners of old livestock breeds often claim that these breeds have a high biological efficiency (require less inputs than modern breeds), even though there is so far not much scientific evidence hereof. In farming systems with other objectives than only increasing productivity, the old, less improved breeds can thus be profitable in a "net efficiency income" context.

2.2.4 USE OF LIVESTOCK FOR LANDSCAPE MANAGEMENT

During the past decades, Norwegian agriculture has been increasingly expected to supply other public services than merely producing food. This development is also reflected in regulatory and economic farm policy measures. During the past 12-13 years, traditional price subsidies have been reduced, whereas the level of non-product-specific (acreage and headage based) subsidies has increased. Such subsidies can to a large degree be regarded as public support for agriculture's production of collective goods, e.g., cultural landscapes. The Report to the *Storting* no. 19 (1999-2000) states that this policy should on the whole be continued.

It should thus be possible to develop livestock production systems in which the animals primarily are used for landscape management instead of milk or meat production. For such a use, it should be in the general public's interest to prefer national breeds to exotic, imported breeds. In this way, it would be possible to combine the country's commitment to preserving its farm animal genetic resources with the declared policy goal of maintaining viable cultural and pastoral landscapes.

3 NORWEGIAN EXPERTISE IN THE FIELD OF FARM ANIMAL GENETIC RESOURCES

3.1 Present Status

Education and research

Educational system

All inhabitants of Norway have the same rights to primary and secondary education. All public education, including secondary education, is free. Norway spends 6.8 % of its gross domestic product on education; the OECD average is 4.9 % (OECD, 1997). Of the total population (4.3 million), nearly 900,000 are following some kind of education. In addition, nearly 1 million persons participate in adult education courses each year. The educational level has risen significantly in recent years. Approximately 83 % of the population (ages 25-64) have more than just primary education, 54 % (over age 16) have completed secondary school, and 26 % have college or university degrees. Two per cent of the pupils in secondary schools are taking agriculture-related programmes. About 570 students (about 0.3 % of all students) are studying animal science, aquaculture or veterinary medicine. In the past years, about 15-20 PhD degrees were issued per year in the same fields.

Education in the field of farm animal genetic resources

Sustainable breeding and genetic diversity are integrated within several livestock breeding courses taught at the Agricultural University of Norway (NLH). A separate course on farm animal genetic resources has been offered for nearly ten years, and NLH has also arranged PhD-level courses in the same field.

Livestock-related organizations

Norwegian farmers have longstanding traditions when it come to joining forces in cooperative enterprises. As a result, there are many organizations in agriculture with highly qualified staff. These organizations focus primarily on advising and training their members. Nearly all training and further education of livestock farmers are managed by the various livestock breeding and trade associations. In addition, the breeding organizations also ensure their members' access to suitable breeding stock.

Public extension services

Municipal offices of agriculture

The municipal (or inter-municipal) offices of agriculture have highly qualified staff providing a wide range of agricultural services. The level of farm animal related expertise in the offices depends on the extent of livestock farming within the municipality.

County departments of agriculture

The county administration in each of Norway's 19 counties is responsible for implementing laws, policies and guidelines made by the *Storting* and the government. The county departments of agriculture shall contribute to the implementation of national farm policies by spreading information, and administrating national policy and locally adapted measures. Another vital task is promoting rural development, based on farming, forestry and related industries.

Until recently, each county employed a livestock expert to supply extension and information services, arrange seminars, etc. to the regional livestock farming community.

Public administrative agencies

Norwegian Agricultural Inspection Service

The Norwegian Agricultural Inspection Service is a directorate under the Ministry of Agriculture, responsible for administrating regulations on agricultural inputs. The Inspection Service shall control that the quality of inputs meets public requirements with regard to their beneficial effects and health, environmental and safety issues. They also inspect plant material, monitor harmful organisms and approve breeding organizations in accordance with the Act on Livestock Breeding of 4 December 1992 (no. 130).

Norwegian Animal Health Authority

The Norwegian Animal Health Authority monitors and documents animal health in Norway, and works to prevent the spreading of animal diseases as a result of national and international animal trade. To achieve this, the Animal Health Authority ensures that public animal health and welfare regulations are followed, and maintain nationwide veterinary services. The regional veterinarians are responsible for public information, supervision and advice on correct use of medicines.

Norwegian Council on Genetic Resources and the Committee on Farm Animal Genetic Resources

In 2001, the Norwegian Ministry of Agriculture established the Norwegian Council on Genetic Resources, with three subordinate committees on farm animal, crop and forest tree genetic resources, respectively. The Norwegian Council on Genetic Resources shall counsel and coordinate the work on genetic resources in agriculture. The three genetic resource committees shall design and implement measures based on national action plans for the conservation and use of genetic resources for agriculture and food production. The Committee on Farm Animal Genetic Resources is described in detail on page 28. More information on the Norwegian Council on Genetic Resources can be found at: http://www.genressurser.no.

Nordic Gene Bank – Farm Animals (NGH)

Since the early 1990s, NGH's secretariat has been located on the campus of the Agricultural University of Norway. For more information on NGH, see page 36.

3.2 Expertise Required for Managing Farm Animal Genetic Resources

3.2.1 Trends in the Existing Research Environments

Basic professional training in agriculture

There is a great need for professional expertise among those who carry out the day-to-day management of the country's farm animal genetic resources – the farmers. The three most recent agricultural censuses (1979, 1989 and 1999) show that the share of farmers and/or their partners with an agricultural education steadily increased, up to 40 % in 1999. However, in the past five years there has been a 20 % decline in students applying to agricultural schools. This trend may have a negative effect on the level of theoretical competence among the country's farmers, since it may lead to the closure of schools or limited services. This in turn, will hamper the access to such training in the future.

Professional breeding expertise and research

The Rio Convention on Biodiversity states that all countries have a national responsibility for the management of their farm animal genetic resources, and that farmers should become more involved in this work. Norway should be able to fulfil these commitments, as Norwegian breeding work is known for its high level of professional expertise, broad breeding goals and user participation. In order to maintain this situation, it is important that traditional breeding expertise is further developed. Such expertise is also necessary in order to integrate new knowledge from other fields, e.g., biotechnology, and thus utilize the large potential of scientific cooperation.

The largest scientific breeding environment is located at the Department of Animal Science at the Agricultural University of Norway (NLH), and includes cooperation between NLH staff and employees of various breeding organizations. A recent trend has been the transfer of NLH's permanent breeding positions to other fields, such as bioinformatics and product quality. As a result, the breeding organizations have gradually become the leading environment for applied breeding research.

The Norwegian School of Veterinary Science is the country's leading institute in the fields of livestock disease genetics, molecular biology and reproduction technology.

3.2.2 TRENDS IN THE LIVESTOCK BREEDING INDUSTRY

As described in Chapter 3.1, Norway has sound basic know-how regarding the management of farm animal genetic resources. However, new situations and challenges show that there is a need for capacity building, in order to secure the appropriate management of farm animal genetic resources in the future.

Defining and dividing responsibilities

International commitments and general social changes require a more detailed definition of the breeding organizations' commitments with regard to sustainable breeding and proper conservation of farm animal genetic resources. Norway has two laws that cover livestock breeding, viz., the Livestock Breeding Act and the Welfare of Animals Act.

Livestock Breeding Act

All breeding organizations are approved by the Norwegian Agricultural Inspection Service (see page 32), pursuant to the Livestock Breeding Act of 4 December 1992, no. 130. The main objective of the act as stated in its provisions is to *"secure responsible breeding"*. Furthermore, the breeding organizations must be able to document that they have *"a sufficient number of animals in order to conduct a proper breeding programme, or to enable the conservation of animal stock (the breed) when considered necessary"*. However, the terms "responsible breeding" and "conservation of the breed" are not further specified. Such a specification also lacks with regard to setting clearly defined minimum requirements for effective population size and for the more general objectives of sustainable resource management.

Welfare of Animals Act

In the Welfare of Animals Act, the following reference is made to breeding:

"§ 5. Breeding
It is not permitted to alter the genes of animals by applying genetic engineering or traditional breeding methods, if
1. this prevents the animals from behaving normally or negatively affects their physiological functions,
2. this inflicts unnecessary suffering on the animals, or
3. the changes give rise to general ethical reactions.

It is not permitted to breed animals that have become as described in sub-section 1."

Again, there are no precise definitions of many of the phrases, such as *"negatively affects their physiological functions"*. It has been scientifically documented that the natural physiology of many modern livestock breeds, which have been bred for cost-efficient and effective performance, may have been negatively affected. These changes could represent a threat to the future sustainable utilization of these breeds.

Clarifying legal issues

The desire to combine all recorded farm animal data with the knowledge that has been developed in the field presents us with new legal challenges, i.e., regarding the rights to these resources. Such knowledge is collected and developed in biobanks (see page 31). It is thus important that the farmers, who are the actual resource (i.e., livestock) owners are secured the rights to the resources represented by the biobank data.

3.2.3 AREAS OF RESEARCH

Sustainable breeding

Sustainable breeding is a much used term when discussing the sustainable management of farm animal genetic resources. Even though the term is given a lot of attention, and is considered very important; it has so far not been clearly defined. There is thus a need for clarifying the contents of the term, and developing research strategies in accordance with such a definition.

Characterizing livestock populations in their production environments

As part of the second phase of the development of the Domestic Animal Diversity Information System (DAD-IS), the FAO recommends that all member states compile thorough characteristics of the old native breeds' traditional production environments. This recommendation also requires the detailed definition of terms and the development of appropriate research strategies. This is a demanding, but very important task. Farm animal genetic resources are most successfully maintained in the animals' traditional environments, and it is thus important to have clear guidelines for the description of production environments.

Biological efficiency

The biological efficiency of old farm animal breeds, i.e., their performance in relation to inputs used, such as feed, labour and housing, should be studied to clarify their potential in farming systems that emphasize other goals than maximizing productivity. Being less productive does not necessarily imply that old farm animal breeds have a lower biological efficiency. Some research on this issue has been initiated, but more studies are necessary in order to gain a better understanding of the old breeds' biological efficiency.

Utilization of biobanks

In recent years, biobanks (see page 31) have been established for several livestock species in Norway. Biobanks have a significant potential as a basis for gaining a better understanding of gene functions, and there is a great need for developing the know-how needed to utilize this potential.

Cryopreservation

The freezing of eggs, embryos and semen for long-term storage is one of the most important methods for securing farm animal genetic resources. R&D activities are necessary for those species for which cryopreservation is still poorly developed. This applies especially to poultry, horses, bees and minks.

Genetic distances

In Norway and the Nordic countries, several research projects on studying genetic distances of livestock breeds have been carried out. These projects have generated new insights into the interrelatedness and development of Norwegian and Nordic livestock breeds. The research should be extended to including additional breeds and markers.

Breeding within small populations

Expertise on breeding within small populations is the actual basis of sustainable management of farm animal genetic resources. Knowledge in this field is necessary for the historical breeds with small populations as well as for the mainstream breeds. In the latter, the modern, efficient breeding strategies *de facto* lead to breeding within very small effective populations.

4 CONSERVING FARM ANIMAL GENETIC RESOURCES – FUTURE PRIORITIES

Increased national focus on the sustainable management of farm animal genetic resources can best be achieved by encouraging the diversification of livestock farming throughout the entire country. In this connection, it is important to:

1. Establish a farm animal population that is large and diverse enough to secure the sound management of the national farm animal genetic resources. This can be achieved by:
a. Strengthening the economic conditions of livestock farming.
b. Stimulating and developing niche products.
c. Securing highly vulnerable production systems that are based on the use of valuable, national farm animal genetic resources.
2. Strengthen research and education leading to a better understanding of methods for sustainable management of farm animal genetic resources.
3. Develop appropriate regulations for the utlization of farm animal genetic resources.
4. Establish guidelines and routines for the conservation, storage and use of genetic material in long-term storage.

5 RECOMMENDATIONS FOR INTERNATIONAL COOPERATION

5.1 Nordic Gene Bank Farm Animals and the Nordic Council of Ministers

Official Nordic cooperation is channelled via the Nordic Council and the Nordic Council of Ministers. In 1984, the Nordic Gene Bank for Farm Animals (NGH) was established as a body under the Nordic Council of Ministers. NGH shall promote and coordinate national measures in the field of genetic resource management, in accordance with the provisions of the Rio Convention. The organization focuses on issues with a Nordic perspective, and aims to contribute to value creation by conserving and utilizing the genetic resources of Nordic livestock. For more information, see http://www.nordgen.org. NGH is funded by the agricultural ministers' programme for cooperation in the field of genetic resources.

5.2 Suggestions for Areas in which NGH Should Upgrade its Activities

Several issues outlined in Chapter 3.2 (page 33) have international dimensions. Nordic Gene Bank Farm Animals should initiate the discussion of these issues among the Nordic countries and their breeding organizations in order to encourage a joint effort of securing a sustainable management of our Nordic farm animal genetic resources. Important issues which NGH should raise are:

- The situation for several Nordic commercial breeds and their breed associations is starting to become critical. These associations have established relatively sustainable breeding strategies, i.e., they have broad breeding goals and equal access to breeding stock, including tested elite animals as well as animals that are to be tested for breeding value appraisal. However, several international breeding companies with a one-sided focus on breeding for improved performance have begun to establish themselves on the Nordic market. Some of the Nordic breeding associations could be outcompeted by these companies, since their product is easy to sell and the farmers are promised quick profits. NGH should call attention to the Nordic breeding associations' responsibility for ensuring sustainability and promote professional breeding cooperation in the Nordic region. Such cooperation should aim at utilizing the traditionally sound breeding expertise in the region as well as the Nordic farmers' experience in participating in cooperative breeding schemes. Such cooperative breeding often results in a vigorous stock, sound net earnings in the long run, but not always immediate profits.

- Many Nordic livestock populations have the same origin. This is confirmed by historical evidence as well as results from studies of genetic distances of Nordic cattle and sheep breeds. With this in mind, it should be possible to establish common guidelines for the conservation of Nordic landraces, independent of which Nordic country the different animals inhabit. Such guidelines could also help to underline the various commercial breeding associations' joint responsibility for cooperating in order to meet the challenge represented by increasing internationalization of breeding work.

- NGH should be responsible for facilitating the exchange of knowledge between various interest groups for Nordic landraces.

- In recent years, NGH has funded several research projects on the conservation of farm animal genetic resources. It is very important that this funding is continued in order to secure the future development of expertise within the field.

6 CONTRIBUTORS TO THE REPORT

6.1 Working Committee Members

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Elisabeth Koren	Chair-woman	Norwegian Museum of Agriculture
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Signe Dahl	Member	Norwegian Sheep and Goat Breeders' Association
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6.2 External Contributors

The following persons responded to enquiries made by the secretary of the working group, either by sending their own contributions or by supplying documents such as annual reports, breeding plans, etc. All such documents are registered and archived by the Norwegian Museum of Agriculture.

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6.3 List of Addresses

AKVAFORSK, PO Box 5010, NO-1432 Ås, akvaforsk@akvaforsk.nlh.no, http://www.akvaforsk.no/

Aqua Gen AS, Industriveien 13, NO-7200 Kyrksæterøra, firmapost @aquagen.no, http://www.aquagen.no/

Avlslaget for sidet trønderfe and nordlandsfe, NO-2364 Fåvang, atle@stn-breeding.no, http://www.stn-breeding.no/

Det kongelige norske landbruksdepartement, PO Box 8007 Dep, NO-0030 Oslo, postmottak@ld.dep.no, http://odin.dep.no/ld/

Eksportutvalget for fisk, NO-9291 Tromsø, mail@seafood.no, http://www.seafood.no/

Eksportutvalget for fisk, Strandveien 106, NO-9291 Tromsø, postmottak@seafood.no, http://www.seafood.no/eff

GENO, NO-2326 Hamar, geno@geno.no, http://www.geno.no/

Institutt for husdyrfag, PO Box 5025, Norges landbrukshøgskole, NO-1432 Ås, webmaster@nlh.no, http://www.nlh.no/ihf/

Marine Harvest Norway AS, Postboks 4102 Dreggen, NO-5835 Bergen, rita.brokstad@marineharvest.com, http://www.marineharvest.com

Meteorologisk institutt, PO Box 43 Blindern, NO-313 OSLO, met.inst@met.no, http://met.no/index.shtml

Nordisk Genbank - Husdyr, Postboks 5025, NO-1432 Ås. Ngh@nordgen.org , http://www.nordgen.org/

Norges Birøkterlag, Bergerveien 15, NO-1396 Billingstad, sekretariat@norbi.no http://www.norges-birokterlag.no/

Norges Bondelag, PO Box. 9354 Grønland, NO-0135 Oslo , bondelaget@bondelaget.no, http://www.bondelaget.no/

Norges Pelsdyralslag, PO Box 175 Økern, NO-0509 Oslo, post@norpels.no, http://www.norpels.no/

Norsk Fjørfelag, Moerveien 10, NO-1430 Ås, nfl@nfl.no, http://www.nfl.no/

Norsk Genressursråd, http://www.genressurser.no/genressursraad/hoved.htm

Norsk Hestesenter, Starum, NO-2850 Lena, nhest@nhest.no, http://www.nhest.no/

Norsk institutt for landbruksøkonomisk forskning, PO Box 8024 Dep, NO-0030 Oslo, postmottak@nilf.no, http://www.nilf.no

Norsk Kennel Klub, PO Box 163 Bryn, NO-0611 Oslo, info@nkk.no, http://www.nkk.no/

Norsk Kjøttfeavlslag, PO Box 349 Økern, NO-0513 Oslo, kjottfe@kjottfe.no, http://www.kjottfe.no/

Norsk Landbruksmuseum, PO Box 5104, NO-1432 Ås, norsk.landbruksmuseum@nlm.nlh.no, http://www.nlm.nlh.no/

Norsk Rasefjærfeforbund, Nordheim, NO-4737 Hornnes, lunden@sensewave.com, http://www.geocities.com/rasefnor/

Norsk Sau- and Geitalslag, PO Box 2323 Solli, NO-0201 Oslo, nsg@nsg.no, http://www.nsg.no/

Norsvin, PO Box 504, NO-2304 Hamar, norsvin@norsvin.no, http://www.norsvin.no/

Opplysningskontoret for egg and hvitt kjøtt, PO Box. 4233 Nydalen, NO-0401 OSLO, post@egg.no, http://www.egg.no/

Opplysningskontoret for kjøtt, PO Box 395 Økern, NO-0513 OSLO. post@ofk.no, http://www.matprat.no/

Reindriftsforvaltningen, Markveien 14, NO-9510 ALTA, alta@reindrift.no, http://www.reindrift.no/

SalmoBreed as, PO Box 11,NO-6601 Sunndalsøra, post@salmobreed.no, http://www.salmobreed.no/

Statistisk sentralbyrå, PO Box 8131 Dep, NO-0033 Oslo, ssb@ssb.no, http://www.ssb.no/

TINE BA, PO Box. 9051 Grønland, NO-0133 Oslo, tfs@tine.no , http://www.tine.no/

State of the World's Animal Genetic Recources

Predefined Tables

Contents

Key to the Symbols

¨ in a cell means ”No information”.
- in a cell means 0, no value.
0 in a cell means less than 0.5.

Contents of Tables

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)	$822	1999
Other agricultural production (official statistics)	$348	1999
* Best estimate of additional value of livestock	$43	2000

* Estimation over the value of fertilizer from animal production, see attachement for calculation.

Comments:

- Best estimate of additional l 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) 1989	Area (1000 ha) 1999	Current trend
Arable land	877	883	0
Permanent crops	4	3	-
Permanent pastures	109	151	+
Agricultural area	991	1 038	0
Land area	30 681	30 625	
Total Area	32 388	32 376	

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

Category	Area (1000 ha) 1989	Area (1000 ha) 1999	Current trend
Cropping for food	69	79	+
Cropping for feed	793	794	0
Cropping for food and feed	6	2	0
Natural pasture	..	..	
Improved pasture	114	162	+
Fallow	9	2	-
Forest	7 036	7 036	0
Non-agricultural	22 654	22 551	
Total	30 681	30 626	

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 production. 1999

Category	Area (1000 ha)	%
Private	1 038	100
Government and communal	-	-
Total	1038	100

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	%	Number of farms / house-holds with livestock	%
Landless	398	1	398	1
> 0 to 2 ha	3 206	5	1 459	3
> 2 to 10 ha	27 633	39	18 393	36
> 10 to 50 ha	37 926	54	29 821	58
> 50 to 100 ha	1 451	2	902	2
> 100 to 500 ha	126	0	85	0
> 500 ha	-	-	-	-
Unknown	-	-	-	-
Total	70 740	100	51 058	100

Table 1-6 Livestock population, number of owners/house-holders and employment by species 1999

	Livestock population (1000)	Number of owners / householders	Number of persons additionally employed	
Species			**Fully**	**Partially**
Cattle	1 033	30 130	..	..
Sheep	2 325	24 750	..	..
Goats	79	1 477	..	..
Horses	27	7 310	..	..
Pigs	738	5 876	..	..
Hens	3 181	4 064	..	..
Chicken (broilers)	4 834	424	..	..
Reindeer	188	559	2 834	..
Fish	173 314	1 041	2 671	918
Fur-bearing animals	810	1 000	..	..

Reindeer: tame reindeer
Fish: Fish farming; total no of licences for salmon and tout production, incl. hatcheries. Stock of live fish for food as per 31. December 1999

Table 1-7 Human population in the country

Year	Total (millions)	Rural or Farming (%)	Urban or Non Farming (%)	Total
1990	4 233 116	7,7	92,3	100
1999	4 445 329	5,8	94,2	100
Average annual growth rate 1990-1999	23 579			

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)

	Meat (t)		Milk (t) 1)		Eggs (t)		Fiber (t)		Skin (No.) 2)	
Species	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**
Cattle	81,8	95,6	1 914,0	1 708,0					352,2	388,2
Sheep	23,4	22,9	-	-			5,0	5,1	1 140,9	1 149,6
Goats	0,3	0,3	28,2	22,4			..	..	26,3	21,0
Horses	0,8	0,6	-	-					3,2	2,4
Pigs	83,4	109,3							-	-
Chicken 3)	19,8	36,5			49,8	47,7	-	-	-	-
Reindeer	2,3	1,6							78,1	46,9
Fish 4)	149,8	473,8								
Fur-bearing animals 5)									849,0	724,8

1) Converted from litres by multiplying the volume in litres by 1,0325

2) No. of skins for respectively cattle, sheep, goats, horses and reindeer are equal to no. of carcasses.

3) Comprise meat from all poultry species.

4) Comprise salmon and trout.

5) Comprise sales of skins from farmraised fur-bearing animals.

Table 1-9 Major livestock primary product imports (1000 tonnes/numbers)

	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (No.)		Animals (No.)	
Species	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**
Cattle	1,0	2,9	-	-					0,0	0,0	0,0	0,0
Sheep	0,3	0,5	-	-			0,9	1,3	..	..	-	-
Goats	-	-	-	-			-	-	..	..	-	-
Horses	-	-	-	-					..	..	0,5	1,3
Pigs	2,0	2,0							..	..	-	-
Chicken 1)	0,3	0,3			0,8	0,4	0,0	0,1	..	..	5,5	145,1
Reindeer	0,0	0,6							..	..	0,3	5,5
Fish 2)	0,4	0,9									..	..
Fur 3)									186,1	28,1	0,2	0,7

1) Comprise all poultry species

2) Comprise salmon and trout

3) Comprise farmraised fur-bearing animals

Table 1-10 Major livestock primary product exports (1000 tonnes/numbers)

	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (No.)		Animals (No.)	
Species	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**	**1990**	**1999**
Cattle	7,5	9,2	-	-					-	0,0	-	0,0
Sheep	1,8	0,5	-	-			3,4	3,6	..	..	-	-
Goats	-	-	-	-					..	..	-	-
Horses	-	-	-	-					..	..	0,2	0,2
Pigs	1,6	11,5							..	..	-	0,1
Chicken 1)	0,1	-			0,3	0,2	-	0,0	..	..	0,0	114,3
Reindeer	..	..							..	..	-	0,1
Fish 2)	134,2	371,9									0,0	0,3
Fur 3)									1 072,5	750,4	0,0	0,3

1) Comprise all poultry species.

2) Comprise salmon and trout.

3) Comprised farmraised fur-bearing animals

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 (%)

	Production systems			
Species	**Low input**	**Medium input**	**High input**	**Total**
Cattle			100	100
Sheep			100	100
Goats			100	100
Horses			100	100
Pigs			100	100
Chicken			100	100
Reindeer		100		100
Honeybees			100	100
Fur			100	100
Fish			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

	Production systems			
Species	Low input	Medium input	High input	Total
Cattle			0	0
Sheep			0	0
Goats			0	0
Horses			0	0
Pigs			0	0
Chicken			0	0
Reindeer		0		0
Honeybees			0	0
Fur			0	0
Fish			0	0

Comment:

- 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 (%)

	Production systems			
Type of operation	Low input	Medium input	High input	Total
Subsistence			9	9
Smallholder			91	91
Small-scale-commercial				0
Large-scale-commercial				0

Comments:

- **Subsistence:** less than 50% of production is marketed. In Norway this is defined to be farms with less than 1 999 working hours per year spent on the farm.
- **Smallholder:** small family farms with more than 50% of production marketed. In Norway this is defined to be farms with more than 1 999 working hours per year spent on the farm.
- **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 2-4 Type of livestock farm by production system for sheep (%)

	Production systems			
Type of operation	Low input	Medium input	High input	Total
Subsistence			47	47
Smallholder			53	53
Small-scale-commercial				0
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 2-5 Type of livestock farm by production system for goats (%)

	Production systems			
Type of operation	Low input	Medium input	High input	Total
Subsistence			7	7
Smallholder			93	93
Small-scale-commercial				0
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 2-6 Type of livestock farm by production system for horses (%)

	Production systems			
Type of operation	Low input	Medium input	High input	Total
Subsistence			57	57
Smallholder			43	43
Small-scale-commercial				0
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 2-7 Type of livestock farm by production system for pigs (%)

	Production systems			
Type of operation	Low input	Medium input	High input	Total
Subsistence			12	12
Smallholder			88	88
Small-scale-commercial				0
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 2-8 Type of livestock farm by production system for egg laying hens (%)

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

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.

Tabell 3-1 Breed Diversity (Number of Breeds)

	Number of breeds									
	Current Total		At risk		Widely used		Others		Lost (last 50 yr)	
Species	**L**	**E**	**L**	**E**	**L**	**E**	**L**	**E**	**L**	**E**
Cattle	7	16	6	14	1	0	0	2	2	-
Sheep	10	2	3	2	4	0	3	2	-	-
Goats	2	4	1	4	1	0	0	0	-	-
Horses	4	28	2	24	2	4	2	24	-	-
Pigs	2	1	-	1	2	1	-	-	1	-
Chicken	15*	5	15*	¨	0	5	-	-	**	¨
Reindeer	1	-	-	-	1	-	-	-	-	-
Honey bees	2	1	1	-	2	1	-	-	-	2
Dogs	7	***	6	¨	1	¨	¨	¨	-	¨
Fur 1)	28	1	12	1	16	1	-	-	2	23
Fish 2)	12	-	-	-	7	-	5	-	-	-

* Includes the breeds and lines on the Norwegian Gene Bank for Poultry.
** There isn`t lost any breeds during the last fifty years, but some lines in the Norwegian Gene Bank for Poultry have been cleared out.
*** There are approximately 40-50 dog breeds in Norway that could be used for hunting or herding, but far the less are used in active duty.
1) Includes fox and mink. Breed is synonymous with mutant.
2) Breed is synonymous whith breeding population.

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)

	At population level				At individual level		
Species	**Baseline survey**	**Genetic distance**	**Breeds and crosses evaluation**	**Valuation**	**Performance recording**	**Genetic evaluation**	**Molecular evaluation**
Cattle	23	7	2	0	23	6	6
Sheep	12	11	4	0	12	4	12
Goats	1	3*	0	0	1	1	1
Horses	19	4	0	0	19	0	0
Pigs	3	1	3	0	3	3	3
Chicken	0	0	4	0	0	0	0
Reindeer	1	3*	0	0	0	0	0
Honey bees	3	0	0	0	3	3	0
Dogs	7	0	0	0	0	0	0
Fur 1)	28	0	0	0	28	28	0
Fish 2)	12	0	0	0	12	12	0

1) Includes fox and mink. Breed is synonymous with mutant.
2) Breed is synonymous whith breeding population.

* The spieces have been grouped differently than traditionally breed grouping.

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.

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.

Tabell 4-1 Relative importance of livestock products and services within species (%)

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertiliser manure	Honney and pollinating	Culture	Recreation	Fuel	Feather	Environmental management	Total
Cattle	67	33			..	..	..		..	..			*	100
Sheep		81		19		..	..		..	..			*	100
Goats	99	1				..	..		..	..			*	100
Horses						..	..		..	**	..		*	
Pigs		100				..	..		..	..			..	100
Chicken		58	42			..	..			..		0	..	100
Reindeer		100			..	..	..		***				..	100
Honey bees						..		50+50	..	..			..	
Dogs						..			..	**			..	
Fur					100	..	..	..	..	..			..	100
Fish		100				..			..	..			..	100
														0 *

Beitedyras betydning for å holde et åpent kulturlandskap har økende aksept.
** Hest og hund har en akseptert verdi som rekreasjonsmiddel, men verdien er ikke tallfestet.
*** Reindrift er sterkt knyttet til den samiske kulturen, men dette er ikke tallfestet.

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).

Tabell 4-2 Relative importance of species within livestock products and services (%)
Beregnet på grunnlag av tall fra Totalkalkyler for jordbruket, 2002, Budsjettnemnda for jordbruket.

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertiliser manure	Draught	Culture	Recreation	Fuel	Feather	Environmental management
Cattle	99	41			..	..	*	..	..	..	..		..
Sheep		12		100		..	*	..	..	..	..		..
Goats	1	0				..	*	..	..	..	..		..
Horses		0				..	*	..	..	..	..		..
Pigs		36				..	*	..	..	..	..		..
Chicken		10	100			..	*	..	..	..	..	100	..
Reindeer		1			..	..	..	..	..	..	..		..
Honey bees						..	..	..	..	..	..		..
Dogs						..	..	..	..	..	..		..
Fur						..	*	..	..	..	..		..
Fish						..	..	..	..	..	..		..

* Det gjøres beregninger for verdien av husdyrgjødsel (see attachement), men regnes ikke som en inntekt i produksjonen.

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)
Number of breeds is the same as in table 3-1, column "Current total, locally adapted breeds".

		Breeding strategies		
Species	Total number of breeds	Purebred selection	Cross-breeding	Both
Cattle	7	7		
Sheep	4	3	1	
Goats	1	1		
Horses	6	6		
Pigs	2	1	1	
Chicken	0			
Reindeer	1	1		
Honey bees	2	2		
Dogs	..			
Fur	13	13		
Fish	7	7		

Table 4-4 Number of breeds with current breeding strategies and tools being used (No. of breeds) Number of breeds is the same as in table 3-1, column "Current total, locally adapted breeds".

		Breeding strategies		Tools				
Species	Breeding goals	Designed	Designed and implemented	Individual identification	Recording	AI	ET	Genetic evaluation
Cattle	7	7	7	7	7	7		7
Sheep	7	7	7	7	7	4		4
Goats	1	1	1	1	1	1		1
Horses	19	19	19	19				
Pigs	2	2	2	2	2	2		2
Chicken	0							
Reindeer	0							
Honey bees	3	3	3			2		
Dogs	7	7	7	7				
Fur 2)	3	3	3	3	3	2		3
Fish 3)	3	3	3					

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

2) Breed is synonymous with specieses as all mutant within the same spieces have the same breeding goal and breeding strategy.

3) Breed is synonymous with breeding company as breeding populastions within the same breeding company have the same breeding goal and breeding strategy.

Table 4-5 State of the art of technologies / methodologies used in breeding strategies

	Used for:	
Technology or Methodology	Research	Breeders
Multi-trait selection index construction	100	100
Optimization tools for breeding plans	60	50
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	20	10
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
Federal Government					
State Government	1	5	1	1	1
Local Government	1	1	1	1	1
Breeder's	5	5	5	5	5
Private companies	2	2	1	2	2
Research	2	1	1	1	2
NGO's	2	1	1	1	1

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
Federal Government					
State Government	4	2	2	2	5
Local Government	1	1	1	1	1
Breeder's associations	1	5	5	5	2
Private companies	1	1	1	1	1
Research	1	4	1	3	1
NGO's	1	1	1	1	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 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
Federal Government			
State Government	3	2	1
Local Government	1	1	1
Breeder's associations	5	3	1
Private companies	3	3	3
Research	5	5	2
NGO's	5	1	1

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	2	1	1
Genetic evaluation	3	2	1	1
AI / ET	2	1	1	1
Molecular techniques	3	2	3	1

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.

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

	Number of locally adapted breeds at risk			
Species	**Total**	**Managed *in situ***	**Managed *ex situ***	**Both (*in* and *ex situ*)**
Cattle	6			6
Sheep	3	1		2
Goats	1			1
Horses	2	2		
Pigs	-			
Chicken	15			1
Reindeer	-			
Honey bees	1	1		
Dogs	6			6
Fur	12			12
Fish	-			

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

Includes only native breeds. The filling in of this table is based on the numbers from table 5-1.

	Incentives			Tools				
Species	**Gov.**	**NGO**	**Market**	**Semen storage**	**Embryos storage**	**DNA/Tissue storage**	***In vivo***	**Monitoring system**
Cattle	6	6		6	6	1		6
Sheep	3	3		3	0	0		3
Goats	1	1		1	0	0		1
Horses	2	2		0	0	0		2
Pigs								
Chicken	15	15						
Reindeer								
Honey bees	1	1						
Dogs	6	6		6	0	0		6
Fur	12	12		12	0	12		12
Fish								

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

Includes only native breeds. The filling in of this table is based on the numbers from table 5-1.

	Incentives				Technical tools			
Species	**Gov.**	**NGO**	**Market**	**Private**	**Recording**	**AI**	**ET**	**Others**
Cattle	6	6	6		6	6		
Sheep	3	3	3		3	2		
Goats	1	1	1			1		
Horses	2	2	2					
Pigs								
Chicken	15	15			15			
Reindeer								
Honey bees	1	1	1		1			
Dogs	6	6						
Fur	12	12	12		12			
Fish								

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

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	4	2	4	1
Genetic evaluation	3	1	1	1
AI / ET	2	2	4	2
Molecular techniques	4	4	4	3

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.

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	
Cattle	4
Sheep	4
Goats	4
Horses	2
Pigs	4
Chicken	2
Reindeer	4
Honey bees	3
Dogs	1
Fur	3
Fish	4

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

	Activities			
Species	Use of exotic breeds	Use of locally adapted breeds	Training, research and extension	Organization of breeders/farmers
Cattle	2	4	4	4
Sheep	1	4	4	4
Goats	1	4	4	4
Horses	2	3	3	4
Pigs	3	4	4	4
Chicken	5	1	1	4
Reindeer	1	5	4	2
Honey bees	1	4	4	4
Dogs	1	2	2	2
Fur	1	4	3	4
Fish	1	4	3	3

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

	Required		
Needs	**Immediately**	**Medium term**	**Long term**
Finincial resources		X	X
Knowledge		X	X
Human resources		X	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	2
Sheep	2	2	5	5	2
Goats	2	2	5	5	2
Horses	2	2	5	5	2
Pigs	2	2	5	5	2
Chicken	2	2	5	5	4
Reindeer	2	2	5	5	4
Honey bees	2	2	5	5	2
Dogs	2	2	5	5	2
Fur	2	2	5	5	2
Fish	2	2	5	5	2

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	2
Sheep	2	2	5	5	2
Goats	2	2	5	5	2
Horses	2	2	5	5	2
Pigs	2	2	5	5	2
Chicken	2	2	5	5	4
Reindeer	2	2	5	5	4
Honey bees	2	2	5	5	2
Dogs	2	2	5	5	2
Fur	2	2	5	5	2
Fish	2	2	5	5	2

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.

7. Attachement.
Estimation of the value of fertilizer from animal production.

Alternative 1

	No. of animals per year	Value of fertilizer per animal (in $)	Value of fertilizer from animal production (in $)
Milking cow	298 709	50	14 861 144
Ammeku	40 167	44	1 748 563
younglings > 1 year old	297 749	26	7 777 026
younglings < 1 year old	342 649	6	2 130 902
Grown ewes	1 112 738	6	6 920 012
Milking goat	50 732	11	567 896
Breeding pigs	89 879	12	1 117 898
Sloughtering pigs	1 290 938	2	2 729 595
Laying hens	3 188 920	0.1	396 632
Broilers	33 167 031	0.1	4 950 303
Total value of fertilizer from animal production			**$ 43 20 000**

Alternative 2
It is estimated to be totally 867 449 so-called fertilzer-animal-units in Norway in 2000. One fertilzer-animal-units is equivalent to one milking cow and the value of the fertilizer from a milking cow is estimated to be $ 50 per year.

Total value of fertilizer from animal production: 867 449 * $ 50 = **$ 43 372 450**

Alternative 3
The Ministry of Agriculture states that one fertilzer-animal-units is equivalent to 14 kg phosphorus. The ratio between nitrogen and phosphorus in fertilzer from cattle is 81.6/12.6 = 6.48
The Norwegian synthetic fertilizer labeled ”18-3-15” contains nitrogen and phosphorus in the ratio 6,77. In this setting the ”18-3-15” synthetic fertilizer can be used as a substitute to fertilizer from animal production. And the cost of the “18-3-15” gives a price on the phosphorus to $ 9.14 per kg.

Total value of fertilizer from animal production:
867 449 fertilzer-animal-units * 14 kg P * $ 9.14 per kg P = **$ 110 998 774**

Source: Statistics Norway, Farm Management Handbook 2001/2002 (Norwegian), Norwegian Agricultural Economics Research Institute (NILF).

Conclusion
Alternative 1 and 2 show how Norwegian Agricultural Economics Research Institute values the fertilizer from animal production. Alternative 3 is a tempt to estimate the value of the fertilizer from animal production if it is to substitute the synthetic fertilizer compeltely.

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