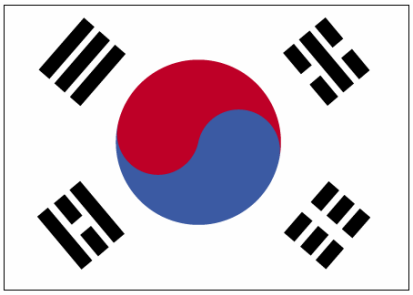
Republic of Korea



National Report on the State of Animal Genetic Resources

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Executive Summary

This report as the state of Agriculture related animal genetic resources was written according to the Guidelines for the Development of Country Reports of FAO. Ministry of Agriculture and Forestry of the Republic of Korea established "Animal Genetic Resources Preservation and Utilization Strategy" and accordingly revised the Livestock Production Act to provide the basic legal regulation in regard to the management of AnGR

According to the directive of "Animal Genetic Resources Management Regulation" of the Ministry of Agriculture and Forestry, Rural Development Administration established the National Advisory Committee at the National Livestock Research Institute. Ministry of Agriculture and Forestry directed the National Livestock Research Institute to draw up this report. Accordingly National Livestock Research Institute constituted the Task Force Team and the Working Committee. Through local self-governing bodies (City, County, and District) and local Agriculture Extension Organizations, National Livestock Research Institute collected data on the state of livestock genetic resources from March 27, 2003 to October 31, 2003. These various findings and survey data are used as the basic material for this Report preparation. The Task Force Team collected the data for Background Questions suggested by the FAO, which was utilized as draft materials for the preparation of this report. The Working Committee prepared the planned structure of the report as suggested by the FAO as well as the draft report, which was based on various materials and statistical data. This draft report was forwarded to the National Advisory Committee, which reviewed the planned structure and the contents of this draft report.

In October 24, 2003, National Livestock Research Institute completed and forwarded the Draft report of National Report on the state of the Korean Animal Genetic Resources to the Ministry of Agriculture and Forestry. Ministry of Agriculture and Forestry made the final revision prior to reporting this National Report to FAO. It is expected that this report will be made use for the preparation of the first State of World Animal Genetic Resources(SoW-AnGR) as a part of the Global Stratigies by FAO for the management of AnGR, and at the same time aid the understanding of the state and the trend of AnGR, cultivate the management capacity, and support the lasting preservation and utilization of AnGR, and finally contribute to the Global food production and Agricultural development.

This Report has 5 Chapters and Appendices and the detailed content and preparation process of each chapter is abstracted as follows:

In preparation of Chapter 1, the major focus was on the state of genetic resources of breeds by species in the Republic of Korea. To better grasp the state of

the AnGR, a nation-wide fact-finding survey was undertaken. The Ministry of Agriculture and Forestry and the Rural Development Administration investigated all livestock farms over certain sizes as well as purebred farms with the aid of municipal and county offices or research institutes of the municipalities and counties. This survey data was compared with livestock statistics of the Ministry of Agriculture and Forestry and other livestock statistics prior to being used for the preparation of this National Report.

In accordance with the preparation guide of the FAO, Chapter 2 reviews the overall policies of the past, analyzes the future demand and predicted trends, and constructs the associated policy, strategy, and management plans while giving due consideration to the conservation state of the diversity of AnGR in the country.

Chapter 3 reviews the state of national capacity to support the future policy, strategy and management plan and examines what is necessary in order to nurture the capacity building required to put it into practice.

Chapter 4 identifies the core tasks in priority under the strategic policy setting as shown in the future plans of Chapter 2, and in accordance to the necessary factors identified in Chapter 3

Chapter 5 estimates the outcome of the on-going international co-operations, evaluates the matters to be improved, and visualizes the plans for international co-operation in the region of East Asia.

Lastly, tables presented in the Appendix are generally in agreement with the design prepared by the FAO, with the exception of buffalo, camels, Lamas and Alpaca being excluded because they are not indigenous to Korea, while deer and quail are added instead.

Working Definitions for Use in Developing this Report

Size of Farms:

Subsistence: less than 50% of production is marketed

Smallholder: small family farms with more than 50% of production marketed

Small-scale-commercial: medium family farms with more than 50% of production marketed

Large-scale-commercial: large farms or companies with all production marketed

Production system:

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, and reproductive rates 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 rates or output. Output and production risks are exposed to major influences, which may go beyond human management capacity.

Breed:

Locally Adapted Breeds: which have been in the country for a sufficient time to be genetically adapted to one or more of the traditional production systems or environments in the country.

Indigenous Breeds: also termed *autochthonous or native breeds and originating from, adapted to and utilized in a particular geographical region*, form a sub-set of the Locally Adapted Breeds.

Recently Introduced Breeds: whose importation was within the last 5 or so generations for the species concerned, and which were imported over a relatively short period of time. These would include breeds that were imported in the recent past but that have not been reintroduced since that time

Continually Imported Breeds: whose local gene pool is regularly replenished from one or more sources outside the country. Many of the breeds used in intensive production systems or marketed by international breeding companies

would be in this category.

Exotic Breeds: which are maintained in a different area from the place they were developed and including breeds that are not locally adapted. Exotic breeds comprise both **Recently Introduced Breeds** and **Continually Imported Breeds**.

Degree of danger of extinction:

Danger of Extinction: Breeding female less than 100 heads, breeding male less than 5 heads. Or mature animal less than 120 heads, and % breeding female mated to purebred breeding less than 80%

At risk: Breeds at risk are those with total number of breeding females and males at less than 1,000 and 20, respectively; or if the population size is less than 1,200 and is decreasing

Endangered breed: Less than 10,000 heads of a breeding animal

Conservation Programmes of animal genetic Resources

***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 are 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 was 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.

Others:

The Goat in this report refers to the domesticated goat (goat, *Capra hircus*), and it does not include the wild mountain goat (goral, *Nemorhaedus caudatus)*

1. The state of agricultural biodiversity in the farm animal sector

The Republic of Korea is located on the southern half of the Korean Peninsula (124011' - 131052' East longitude and 3304' - 430 North latitude), which starts from the Northeast of the Asian Continent toward the South (Appendix-Figure 1). In view of biogeological aspects, the Korean Peninsula belongs to the Sino-Japanese botanical region (Good, 1974), which covers Southern Siberia, Japan, Northern China, Manchuria and a part of the Himalayan Mountains, and the botanical vegetation of the Korean Peninsula is very similar to those countries adjacent in geographic regions such as Japan and China. Also in regard to Zoogeographic regions, the Korean Peninsula covers from the small district of Korean North-east, which belongs to the old-north-district of Siberia to the small district of Korean Southwest which belongs to the China-Asia district. The average annual temperature of the Korean ranges from 14°C in the South to 5°C in the North, the average annual precipitation by regions ranges from 400mm to 1,400mm, with a tendency for an increase from the North to the South. The weather conditions of the Korean Peninsula show diversity from the subtropical zone of the Southern Coast to the Arctic regions of the Northern mountain area.

The total land area of the Republic of Korea is 9.9million ha, where 65% is mountain region, the remaining 35% is comprised of plains and islands (3,400), which are mostly located in the southwest. The population is 46.6 million showing very high density per ha, and the annual average increase of population since 1990 is 0.9% (Table 1.7). The area for cultivation is approximately 1.9 million ha., which is about 19% of the total land area (Table 1.2), while the population that occupies agriculture areas is at about 4.2million, which is only 9% of the total population (Table 1.7) with a rapid trend of reduction. Agricultural production is only 4.3% of the total national GNP, where the major grain crop is rice, major fruits are apples and pears, horticultural produces are cabbage, beets, and spices are pepper and garlic; and the major livestock products are beef, pork and poultry.

Most Korean farmers with less than 2 ha or no land at all (87%) are classified as petty farmers, 12.8% have 2 - 10 ha, and only 0.2% of all farmers have more than 10 ha (Table 1.5). The number of farms has been declining rapidly since 1996 with the increase of specialized farms, however, multipurpose farms still make up 35%.

The consumption of rice as food has been steadily declining, while the consumption of livestock products such as meat, milk and eggs have been on the rise. This is due to the change of diet associated with the increase of income, which demands more and more of animal protein. In terms of ranking all agricultural products by their respective outputs, rice is first, while pork, beef and poultry are

2nd, 3rd, and 5th, respectively, indicating the relative importance of livestock production in total agricultural products. Looking at the fact that even many small farms raise a few livestock animals, it is easy to see that the livestock sector plays a major role in food and agricultural production in Korea.

1.1 Livestock production system and biological diversity

1.1.1 State of Livestock Production

1.1.1.1 Relative weight of livestock production in agriculture

With the increase of family income and demand for animal products, the livestock industry grew steadily. As a result, the output of livestock products reached 25.4% of total agricultural products in 2002 (Table-1.1). However, specialized livestock farms make up only 5.6% of total farms in the country, and the majority of other farms also raise one or two different farm animals. As shown in Table 1.6, the number of small farms raising beef cattle and chicken along with other crop produce is far greater than the total number of specialized livestock farms.

1.1.1.2 Number of animals and farm sizes by livestock species

The number of animals by livestock species is shown in Table 1.6. Major livestock species are cattle, swine and chicken, followed by goats and ducks, which are next in population size, and then the smallest in population which are rabbits, deer, quail, sheep, horses, donkeys, turkeys, and geese etc.

The distribution of farm sizes by livestock species is shown from Tables 2.3 to 2.15. Out of all beef cattle farms, 98% are Smallholders, and this is also similar for sheep, goat and deer farms, of which more than 80% are Smallholders. In poultry, Subsistence takes up more than 80%. Even though the Subsistence and Smallholders represent the majority in numbers out of all types of livestock farms, this does not necessarily mean that the Korean livestock industry is petty. The reasons for the existence of so many Subsistence and Smallholders are because some operate small farms as a side job or as part time farmers, while other groups utilize agricultural byproducts to maximize the use of all available resources, and still others raise animals to create a constant supply of manure for use as an organic fertilizer on their land. This clearly illustrates the important roles that livestock play for the majority of Korean farmers and the agriculture industry as a whole.

Out of the three major livestock industries such as cattle, swine and poultry, a greater portion of beef farmers seem to have side jobs and/or part time operations, even though these numbers are decreasing slowly with the steady increase of the large specialized beef farms (Figures 1). On the other hand, pig farms are becoming

increasingly larger and specialized in their operations (Figure 2), while chicken farms had gone through this specialization already several years ago (Figure 3). The goat and duck industries show quite different aspects in terms of farm size. Duck producing farms have wide range in sizes from small to large, even though the majority of production is from a group of large specialized farms (Figure 5). On the other hand the majority of goat production comes from the smaller farms as more of a side job or part time operation (Figure 4).

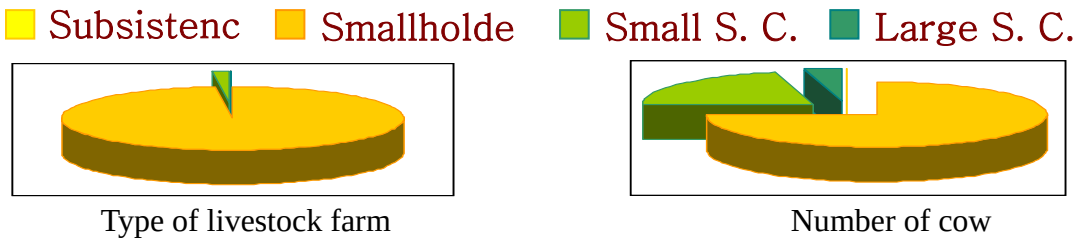


Figure 1. Distribution of Type of livestock farm and number of cattle

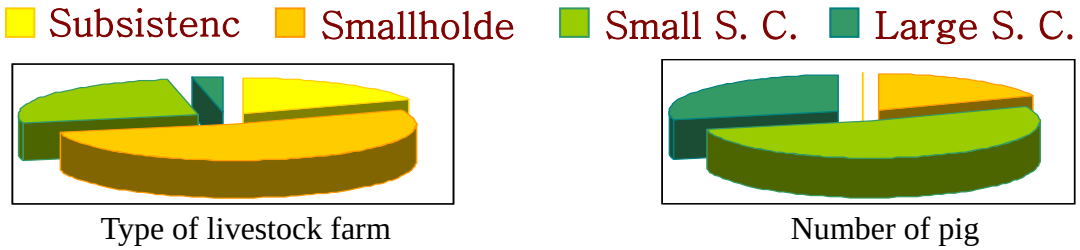


Figure 2. Distribution of Type of livestock farm and number of pig

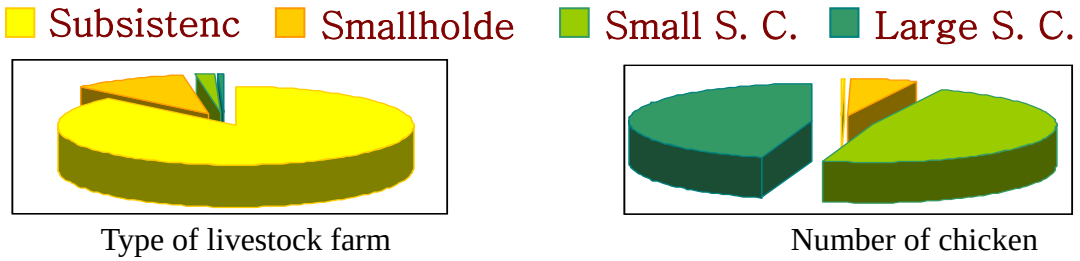
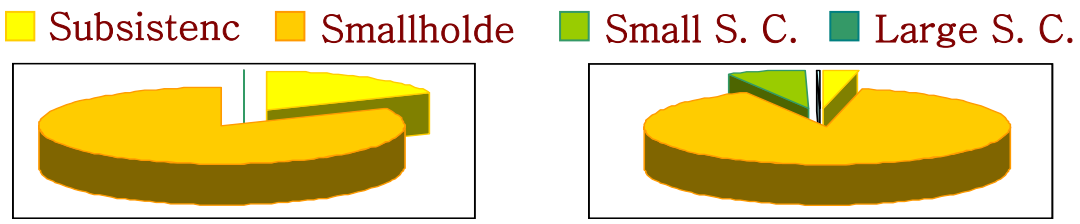
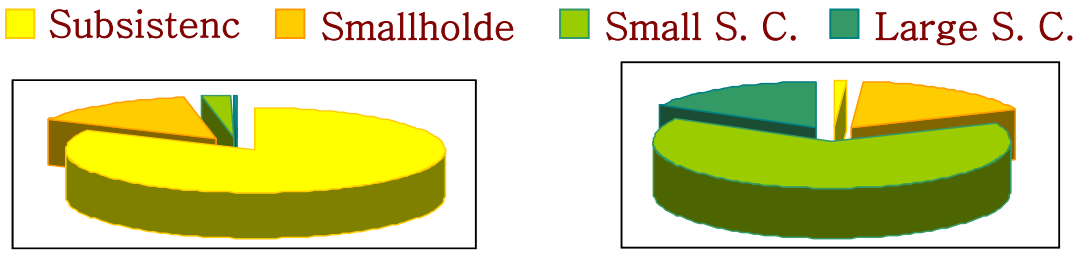


Figure 3. Distribution of Type of livestock farm and number of chicken



Type of livestock farm Number of goat

Figure 4. Distribution of Type of livestock farm and number of goat



Type of livestock farm Number of duck

Figure 5. Distribution of Type of livestock farm and number of duck

1.1.1.3 State of production, trade, and consumption of major livestock products

Beef production increased steadily up until 1998 reaching 264 thousand tons, then decreased drastically to 147 thousand tons by 2002. Since the start of free trade on beef, the import of beef increased sharply reaching 292 thousand tons in 2002 with no export in recent years. Beef consumption per capita increased to 8.5kg in 2000 and maintained that level into 2002.

Pork production increased to 785 thousand tons in 2002. Pork trade reached its peaks in 1999 with 142 thousand tons of import and 80 thousand ton of export, however, with the outbreak of Cholera the export levels dropped to below 18 thousand tons, and the import levels also dropped to around 71 thousand tons in 2000. Pork consumption per capita was 16.5kg in 2000 and 17.0kg in 2002 with a tendency of increase.

Chicken production was at 279 thousand tons in 1996, 238 thousand tons in 1999, and 291 thousand tons in 2002. Imports and exports in 2002 were at 93 thousand tons and 2 thousand tons, respectively, and they have been increasing every year since. Chicken consumption per capita was 6.9kg in 2000 and 8.0kg in 2002 showing a trend of increase.

Egg production has also been increasing steadily and reached to 538 thousand tons in 2002. Trade of the processed egg products is quite substantial in quantity, while the trade of eggs is minimal. Egg consumption per capita was at 10.3kg in 2000 and increased to 11.3kg in 2002.

Milk production has been increasing continuously to 2,536 thousand ton in 2002 with an active trade of 646 thousand tons and 32 thousand tons for imports and exports, respectively. Annual consumption per capita has also been increasing from 59.2kg in 2000 to 64.2kg in 2002.

1.1.2 Major production system

1.1.2.1 Production systems by major livestock species

The production system of primary livestock species is largely based on a high investment; As much as 95% of all beef farms use the High Investment System (Table 2.3), and approximately 98% of all beef cattle are produced from these farms (Table 2.1). This also holds true for pig farms in that 93% of farms have the High Investment System, and almost 100% of all pigs are produced under this system. Even though poultry farms under Low Investment Systems make up almost 73% of all farms, as much as 99.5% of all chickens are produced from farms under the High Investment System (Table 2.1).

In the case of duck production systems, the percentage of farms with Low Investment is slightly lower (67%) than in chicken farms (Table 2.11) and the number of animals produced from High Investment farms (98%) is also slightly lower than what we see in chicken farms (Table 2.1). However, the production systems of goat farms are equally distributed (Table 2.5), where approximately 41% of farms are in the Low Investment System, 28% in the Medium Investment System and 31% in the High Investment System. This is unique and quite different from the production systems of all other species such as goats, which are produced under low-production systems or those produced under a medium-production system that are higher than those of other species. This is believed to be due to the exceptional adaptability of goats to agricultural byproducts and native vegetation in mountain areas. Many farms of Subsistence and Smallholders are encouraged to raise goats.

As can be seen in Tables 2.3 to 2.15, animal species with high incidence of Subsistence farms such as poultry and small animals farms are largely operated

under a Low Investment System, followed by a Medium Investment System and a High Investment System, and the production system of the Smallholders are moving toward a High Investment System, while the majority of the Small-Scale and Large-Scale Commercial farms have High Investment Systems. However, species of medium and large body sizes with low percentages of Subsistence farms tend to use mainly a High Investment System regardless of their herd sizes.

1.1.2.2 Livestock production and production system of the native breeds

The beef production from the native breed is larger than other breeds, and goat meat is also produced largely by native breed and crossed between native and imported breeds. Contrary to beef and goat meat production however, other animal products are largely from imported breeds. Generally speaking, the majority of native breeds are raised under the Lower Investment System compared to those imported breeds/species; however, more than half of the native animals are raised under a High Investment System.

1.1.3 Environmentally friendly animal production

Traditional animal productions in Korea was environmentally friendly, utilizing wild field grasses, agriculture byproducts as feeds, and returning all the manure to the soil without harming environment such as soil, water and air. With the progress of livestock industry, large amount of manure produced in a small area became a major issue of harming environment. The traditional methods are used less and less with the development of modern animal production system.

However, remote area with limited access to public transportation and road services, many farms still use native cattle for cultivation and transportation of products, and many other farms also raises goats, chicken, pigs and even native beef cattle to supply manure to their lands. In these areas not only they use Low Investment Production System, but also use old traditional environmentally friendly production system in order to produce animal products as a side income. They use all the manures to fertilize the land without waist, and reduce the use of chemical fertilizer significantly. Even though these native breeds are low in production efficiency, they are still raised by farmers who have great interest in the environmentally friendly production system, which used to be practiced in the old days. It seems that some animal producers tend to choose the native breed, which has been developed and adapted well to the old traditional production system to avoid the need to deal with the environmental regulation enforcement. In other words, rather than building facilities to handle manure treatments in the area densely populated with people, they choose a remote area separated from human population to raise the native breeds.

Another example of environmentally friendly production can be seen in duck

production. By providing proper number of ducks in certain area of the rice paddy, ducks consumes some weeds and harmful insects while releasing their feces and urine to the rice field benefiting both rice and duck productions.

Recently environmentally friendly and organic animal production drew a lot of interest from the farm community. While environmentally friendly animal production focuses on the production system only, which is environmentally friendly, the organic animal production includes all the processes from the produced material, production method, treatment of products, and the consumption of products. Such products with added values receive great interest by many farmers, but its application remains very low for several difficulties at hand. Lack of the availability of proper genetic resources, conditions for decision makings, farm sizes, feeding and management technique, feed stuff etc. are hindering the application of organic animal production far below to the level of satisfaction.

1.1.4 Raising Medicinal animal

Contrary to general practice of other countries, in several South East Asian countries including Korea and China, the antlers of the deer has been regarded to have medicinal functions and treated the antlers as an important medicinal compound throughout their long histories. The main purpose of raising deer in Korea is the antler production and the deer meat production is only secondary. Today, the self-sufficiency of antler in Korea is only 20 - 30%, indicating the demand exceeds far more than the domestic supply from small number of deer population.

The native goats and Yeonsan Ogols have also been used for medicinal purpose for a long time in Korean history. The meats of these two native animals are consumed as food, but the extracts from both meat and bone have been consumed as medicinal drink.

Wild animals such as bears and badgers are raised for the purpose of medicine production. The badger raised on the farm is classified as a livestock. The bile or gall from the gall bladder of bear is well known as one of the very important medicinal compounds in the oriental medicine. In Korea, bears have been raised on the farm for a long time to produce gall bladder, and the number is growing with the strict restriction of importing gall bladder of wild bears, according to the CITES of forbidding trade of wild animal and plants facing the danger of extinction. However the number of farms raising bears remains stationary. Badgers raised on the farm provide meat for food, fat for medicinal purpose, and recently the gall bladder of badger is under research investigation to see the possibility of replacing the bile of bear. The number of badgers raised on the farm was reported as 4,292 heads in March, 2000.

1.2 State of biological diversity of livestock

1.2.1 State of breeds by species

There are 4 native cattle breeds and 4 import breeds. . The Korean native cattle generally called as "Hanwoo" has 4 different varieties; Korean brown cattle, Korean bridle cattle, Korean black cattle, and Jeju black cattle. Majority of Hanwoo is Korean Brown cattle, and three varieties of Korean Bridle, Korean Black, and Jeju black cattle are endangered breeds facing extinction. As a result of recent effort and interest by government, universities and farmers all three varieties of cattle are increasing in numbers. These three varieties of Korean native cattle are registered under three different breeds to maintain their unique genetics. Holstein has a second largest population after the native Korean Brown Cattle, and Charolais, Angus, and Hereford breeds are beef breeds imported with very small numbers.

In pigs, there is one native breed and 6 imported breeds. Native pigs almost faced its extinction some years ago, but now recovered its population beyond the endangered species level. Imported pig breeds are Yorkshire, Landrace, Duroc, Hampshire, Berkshire, and Large black. Yorkshire, Landrace and Duroc have large populations producing most of the pork in Korea, Hampshire has a small population with continued import, and Large Black and Berkshire have been imported recently.

There are 2 native chicken breeds and 6 imported breeds in Korea. Native breeds are the Korean chicken breed and Yeonsan Ogol. There are several varieties among Korean breed and mixed bred among them for some times and it is difficult to number exactly by varieties. Except one variety, several others are very rare. Yeonsan Ogol is also considered as a rare breed. Among imported breeds there are White Leghorn, Rhode Island Red, New Hampshire, Cornish, Cochin, White Plymouth. Other than Cochin breed, all 5 breeds adapted well in Korea, especially White Leghorn, Rhode Island Red, Cornish, and New Hampshire maintain their populations on steady level. White Plymouth has small population and Cochin breed is recently imported and rare in numbers.

In goats, there are one native breed and 5 imported breeds. Native breed and its cross produce the majority of goat meat in Korea. As imported breeds, there are Saanen, Angora, Alpine, Australian Feral and Boa. Saanen is imported continuously, Angora is facing a danger of extinction, Alpine, Australian Feral and Boer are recently imported and rare in numbers.

There are 3 duck breeds well adapted to Korea after importation and one breed imported recently. Populations of Chunsoo, Campbell, and Pekin breeds have been well established, while Muscovy breed is rare in numbers due to its recent importation.

In deer, there are one locally adapted breed, 2 breeds continually imported, and 2 breeds recently imported. Locally adapted breed, the Formosan deer, and two continually imported breeds, Red deer and Elk represent the majority of deer raised in Korea today. Formosan deer is the largest in number, even though its numbers are slowly reducing. Red deer population is increasing slowly, and the Elk population is increasing rapidly. Recently imported breeds, Dama and Reindeer are still small in population.

There is one native horse breed, called "Jeju horse", and 8 imported breeds. Most popular breeds are Jeju horse and Thoroughbred, while the rests are very small in number. Donkey has been raised in Korea for a long time, but it is not clear when it was imported or which breed it was. Even though it adapted well to Korean environment, it is facing a danger of extinction.

There are two Locally Adapted Breeds of sheep, Corriedale and Merino, which are at a danger of extinction. There is one native rabbit breed and 8 Locally Adapted Breeds. Native breed, Japanese white, California white, California Giant breeds are listed as endangered species, while Angora, Chinchilla, and Rex breeds are rare in numbers. Only New Zealand White is raised in large number.

Two turkey breeds recently imported are Mammoth Bronze and Holland White, which are both rare. In geese, Chinese breed imported long ago face the the danger of extinction, and Recently Introduced Breeds; Embden, Canadian, African Burf are rare in number. Quail is of a Locally Adapted Breed, which is the Japanese breed.

Badger(*Meles meles*), Nutria, Osrich, pheasant(*Phasianus colchicus*) jave beem classofied as farm animals wince October 16, 2001 according to the regulation of the second article, and wide boar(*Sus scrofa*), roe deer(*Hydrppotes inermis).* Wild boar is often raised as cross bred with domestic pigs.

1.2.2 Conservation status of AnGR

1.2.2.1 Conservation state of native species facing extinction

Three strains of Hanwoo cattle; Bridle cattle, Black cattle, and Jeju black are either At Rist or endangered species. This was resulted from the effort of selecting Hanwoo cattle for uniform brown coat collar, while those three strains were excluded from registration as purebred for many years.

Because the native pigs were inferior in production to the imported breeds, they were crossed with Berkshire breeds since early 20th century. As a results purebred native black pigs were near extinction, and even crossbred with Berkshire

with some genetic traits of native pigs survived only in small number of farms due to the development of modern pig industry with newly imported breeds.

Native chicken also had been largely replaced with foreign breeds with the development of poultry industry, and they survived only in remote country of mountain areas in small population. It is same situation for Yunsan-Yeonsan Ogol facing a danger of extinction and only one farm is raising them.

At the beginning of 1980s, with the increase of Gross National Product (GNP) people began to show interest in the local indigenous product including animal and their quality traits. As the 'YunSan' Yeonsan Ogol was designated as a natural monument, the research institutes, universities as well farmers participated to conserve all other native species. One good example was the recovery of native pigs. From the second half of 1980s, with a decisive effort by the Research Institute, Universities and the farmers the native pig began to recover its original appearance and escaped from the endangered species. Native chicken also was restored to its original breed and genetically stabilized from 1992 and was freed from being a danger of extinction. Also three minor strains of Korean native cattle started to increase in number with the effort of Government research institutes and the farmers.

Even though there were several native breeds of dogs, most of them became almost extinction except 'Jindo' and 'Poongsan' breed during the Japanese occupation periods. 'Jindo' breed was designated as a natural monument in 1962 in South Korea, and 'Poongsan' breed was designated as a natural monument in 1964 in North Korea. 'Sapsari' Breed was rediscovered in late 1960, at that time several dogs of this breed were raised by one local dog lover. With a systematic research and reproduction, by 1992 this breed was increased in number and was designated as a natural monument. They are increasing in number but still regarded as an endangered species. Other endangered dog breeds are 'Jeju' and 'Dangkyun' breeds. The former is collected and reproduced in the Jeju Livestock Research Institute, and latter is raised by some dog lovers.

Thanks to the international movement in early 1990 toward animal genetic diversity and preservation of indigenous livestock of many countries, the significance and the merit of animal genetic diversity was recognized in Korea late 1990 and research activities to maintain and to preserve indigenous animal genetic resources have been encouraged ever since.

1.2.2.2 General state of AnGR conservation

Even though domestic AnGR associated with agriculture is not managed under the standardized preservation programs by species, the criteria used to impose a certain measure of preservation are the seriousness of the danger of extinction,

future practical usefulness and the current technical level available for conservation.

The purpose of preserving AnGR is to prepare for the unexpected future changes by preserving the genetic differences within each breed and across all breeds, which was already suggested by other countries and the international organization such as FAO.

Preservation methods are *In situ* and *Ex situ* conservation. *In situ* conservation is carried out by the Federal government, Regional government, designated companies and farms through several genetic improvement programs, while *Ex situ* conservation is mainly carried out by the Federal government. It is rather difficult for government and company to preserve all breeds at risk, and fortunately, there are several breeds maintained by individual farms with personal interests on the breed. Excluding those breeds designated as natural monuments, farmers who maintain other endangered breeds do not get any compensation or support. *In situ* conservation for such breeds is neither secure nor sustainable. On the other hand, reproductive cells are preserved as frozen semen and embryo for all farm animals as long as there is available technology, and DNA of various breeds are also preserved.

1.2.2.3 *In situ* conservation

Preservation of the domestic AnGR associated with agriculture depends largely on the *In situ* conservation. Most livestock breeds are maintained in the farms for a financial gain, therefore, those breeds falling behind in economic competition will face danger of extinction sooner or later without the support under a specific governmental policy. Even though farms raising rare breeds receive partial compensation by imposing a higher price for the product, in many cases they still experience certain economic hardship. Because of this kind of environmental situations under the *In situ* conservation, most farms replace the rare breed with exotic one or cross with other breeds, which will lead the native breeds further into the danger of extinction. This is the on-going obstacle for preserving AnGR by means of the *In situ* conservation.

Eventually the preservation and maintenance of rare or endangered animal genetics are conserved by federal or regional governments, usually in various research centers, because the maintenance of rare breeds by farms pose a great deal of uncertainty. The native breeds preserved in this manner are Bridle cattle, Black cattle, Jeju Black cattle, native pig, native chicken, Yeonsan Ogol, native goat, and Jeju horse.

1.2.2.4 *Ex situ* conservation

Ex situ conservation of AnGR associated with agriculture is entirely relying on freezing method. Germ cells of some livestock species are preserved using freezing

technology, but most of the AnGR are not preserved by means of *Ex situ*, because the freezing technology is not yet developed for them.

Frozen semen and embryos are preserved for most of the cattle breeds including Korean brown cattle, Korean black cattle, Korean Bridle cattle, Jeju Black cattle, Holstein. Frozen semen of native black cattle is preserved, however, the conservation technology of frozen semen of chicken, goats, deer is not fully developed.

For many important livestock species such as cattle, pigs, and chicken, including those not only raised in Korea but also those raised in other countries, blood and DNA of some breeds are preserved. Some breeds of Horse, goats, deer, as well as native species are also preserved as DNA and blood.

1.2.2.5 Problems associated with current AnGR conservation

Even though it is true that the recognition of AnGR conservation associated with agriculture and its importance is spreading wide recently, the conservation strategy in national dimension still remains at the elementary level. As the conservation and management of the AnGR became an international issue, finally the plan for the conservation and management of the AnGR was established. However, there must be a systematic devise, system construction, and financial security in order to carry out above plan without failure.

In situ conservation of the breeds lacking economic worth, which are difficult to be maintained in farms is managed around the maintenance herd of Government Research Institute. However, such conservation method embraces several controversial issues. For economic and rearing environmental aspects, it is difficult and impossible in practice to preserve all breeds in live forms. Also maintaining and conserving a breed in limited area in a small number might reduce its adaptability to diverse environments as a result of losing its genetic diversity. Since it is most desirable to preserve live animals as ***In situ*** conservation in farms under diverse environments, it is necessary to have a systematic support to promote ***In situ*** conservation on the farm.

Even though ***Ex situ*** conservation is more stable and economic than ***In situ*** conservation, it is impossible to use without technology available today. A lot of researches were carried out to establish the technique of freezing sperm and embryo, other than cattle and pig. Now only the embryo of cattle can be frozen successfully but no techniques are available for other species. The techniques of freezing semen of chicken, goat, horse, and deer are not fully applicable, necessitating further studies in this field.

1.2.3 Characteristics of breeds

Indigenous AnGR associated with agriculture in this country have been replaced with many exotic breeds imported as a part of foreign aids policy, and many indigenous genetic resources are already crossed or continuously crossed. Most livestock recourses today are imported breeds except beef cattle and goat.

1.2.3.1 Cattle

Cattle in Korea have been used for farming or transporting goods even 4000 years ago. Korean cattle have a Jang-Aek-Woo(a long face, or skull), which is assumed to become a breed from cross between primitive European cattle and primitive Indian cattle. However, it is not clear whether it was already crossed before it was migrated into Korean peninsular through Northeastern China, or whether the primitive European cattle was crossed with primitive Indian cattle in Korean peninsula. It is assumed that Korean cattle have been fixed for long time under a close breeding system without being crossed with other breeds.

There was no protective policy for Korean native cattle prior to 1960. Korean Cattle Improvement Committee established in 1960 proposed the Korean cattle improvement objectives, judging standard, method of measurement, and in 1969, Korean Livestock Improvement Association was established to register Korean native cattle. From 1978, through performance test and progeny test, proven bulls were selected and used for breeding purpose, in which time the breeding objective was to increase the quantity of meat production. However, in recent years the improvement goal is made public for 5-year intervals and the selection of breeding animals is determined to improve both meat quality and meat quantity

Originally, Korean native cattle had various coat colors, but from 1930 there was an effort to fix the coat color into yellowish brown. Ever since that time, the Judging Standard for Korean Native Cattle was established for registration purpose and the fixation process of external features to the only yellowish brown coat color was established and it is still continuing to this day. This was one way of maintaining the purity of Korean Native cattle preventing them from being crossed with imported beef breeds. As a result, other three stains such as Black cattle, Bridle cattle and Jeju black cattle faced extinction. However, under such situation, few farms maintained these three stains of native cattle. Based on the information obtained from the old literatures on these three strains of native cattle and their superior characteristics over other stains of native cattle, today all these three strains are now recognized as three different breeds of Korean cattle. However, other than their differences in external features, the genetic differences among these 4 different breeds are not yet fully examined.

Several beef cattle breeds were imported and their genetic characteristics and

adaptability were evaluated, but there is no Locally Adapted Breed. Even though there was an effort to develop a new synthetic breed from crossing native with exotic breeds, it was not successful due to the lack of interest in the beef consumer market.

In the mean time, Holstein adapted well locally as a dairy breed and along with the Korean native cattle has been involved in the genetic improvement programs run by Government Organizations, Livestock Improvement Center of Agriculture Cooperative and Korean Animal Improvement Association and proven bulls are selected continuously. Coat color of Holstein is black and while and external appearance, growth and reproductive traits are very similar to Holstein breeds of other countries.

In molecular genetic characteristics of cattle, blood typing research such as blood protein polymorphism, erythrocyte serotype, genetic finger printing study using RFLP method, study on the genetic diversity in Specific loci or zone using methods such as mitochondrial D-loop, Microsatellite etc are tried. Using such studies, genetic distance, variability, degree of differentiation etc are estimated. In order to examine the molecular genetic characteristics of the Korean native cattle and other cattle breeds, and also studies on several loci and DNA polymorphism is carried out.

1.2.3.2 Pigs

Since the time when Korean native pigs migrated into Korean Peninsula from China about 2000 years ago, they adapted well locally and maintained their traditional characteristics till the beginning of 1900. However, from year 1920 they were crossed with Berkshire breed to improve their production efficiency and the number of native pigs reduced drastically. After the Second World War and the Korean War with the progress of the development of modern pig industry involving various exotic breeds, both the purebred native pigs and the cross with Berkshire breed faced the danger of extinction. In the middle of 1980, small number of crossbred pigs between the native and Berkshire breeds were brought in to two Research Institutes of provincial government. Late 1980, National Livestock Research Institute carried out the restoration task of native pigs for 10 years through selecting pigs with phenotypic expression of native pigs, while culling those with phenotypic expression of Berkshire breeds. As a result, from the pig population with diverse external features, today's homologous morphology of native pig was restored, which is very close to the old native pigs.

Native pig is black in whole body including hair and skin color. It tends to have a long nose, erected ears of straight-upward direction, while chin is straight and face has wrinkles. Native pig grows slower than imported breeds and has thicker backfat thickness compared to imported breeds. The feed efficiency is lower,

but the meat has much redder color than those of imported breeds. Muscle fiber is finer and more densely populated than those of imported breed. The fat is firmer and whiter in color compare to those of imported breed. Domestic consumers tend to prefer meat from native pigs than those from imported breed.

Breeds well adapted locally are Landrace, Yorkshire, and Duroc, and the majority of pigs raised today are these breeds and their crosses. Many studies have been conducted to investigate the productivity of these breeds and their crossing ability, mating system, breed characteristics and their utilization. To improve the adaptability to the rearing environment of this country, a couple of new strains have been developed and other strains are on the way of development. Also recently imported breeds are investigated for their breed characteristics, productivity in various research institutes, university and individual breeding companies.

Researches on the molecular genetic characteristics of pigs were carried out for all breeds in nation. Study of chromosome finger printing, study of genetic defect on certain traits such as PSS, identification of marker genes associated with several traits, study on the genetic diversity in Specific loci or zone using methods such as mitochondrial D-loop, Microsatellite, etc. have been carried out to understand the molecular genetic characteristics between breeds and/or between individuals. Also to identify the function of specific gene, QTL(Quantitative Trait Loci) study, or other studies utilizing reference family are on the way and participation to the international project of pig gene map is also on its way.

1.2.3.3 Chicken

It was believed that Korean native chickens migrated either directly from Southeast Asia or Southern or Northern region of China about 2000 years ago. It is unclear from when the native chicken was raised in this country, but its pedigree must have been maintained for long time since this chicken was one of the most frequently observed livestock species from ancient history.

Native chicken reduced in number drastically since early 20th century, especially after the Korean War with the introduction of new breeds, the majority chicken industry was thriving with new imported synthetic breeds, while only few farms in remote areas have raised these native chickens facing the danger of extinction. Late 1970s National Livestock Research Institute started restoration project of native chicken. First the research institute collected chickens from remote farms and started increasing the population size. By the middle of 1980s, not only the research institutes, but also general farms showed interest in native chickens and the population has been increased ever since.

However, as a result of raising native chicken without appreciating the concept of breed, different farms or different regions presented different pedigrees of native

chicken. Since the native chicken lacks the uniformity, and productivity, there was a need to constitute foundation populations for stability of the native chicken. In 1992 research team mainly from National Livestock Research Institute including some from the university, and industry was established to start breeding native chicken, and at the end of the 8th generation, 5 strains of native chicken distinctive in appearance were developed. Also research institutes of two provincial government developed two different stains of native chicken, which were different from the strains bred by National Livestock Research Institute. Later several exemplary good farmers came up with unique native chicken strains after several generations of fixing characteristics, which are different from those developed by research institutes.

Native chicken has several feather colors, but all has single comb, and shin has brown or black colors. Tail feather of native chicken is relatively longer then imports, and the sound of cock-a-doodle-doo is longer than imports. This is believed to be due to the fact that the trace of the characteristics of long tailed fowl or long-lived fowl (Jang-Mi-Kye or Jang-Myung-Kye) is remaining in the native chicken.

Especially there is a unique native chicken breed, called Yeonsan Ogol, which has the feather, comb, beak, shin, claw, and also the muscle, bone and intestinal organs all in black color. Its body type and weight is similar to other native chicken. The origin of this breed is not clear, but according to the records in the literatures, this breed has been raised for several hundred years, and has been used for medicinal purpose. In 1980 this breed was declared as a natural monument (number 265) and maintained as one of the native chicken breed.

At the beginning of 19th century, there were several foreign chicken breeds imported to Korea, which all became extinction after the World War II and the Korean War. In early 1970 these breeds were imported again and became the foundation stocks for chicken industry in Korea for a while and were improved through performance testing, genetic evaluations and planned mating. However, these breeds are either extinct or remains only in a small numbers in the research institutes or in the remote individual farms facing the danger of extinction because of the influx of improved synthetic breeds as Grand Parent (GP) or Parent Stock (PS) forms.

Researches of molecular genetic characteristics of chicken were utilized to investigate the genetic characteristics of native chicken. The information obtained from the researches of blood protein polymorphism was useful in restoration of native chicken.

1.2.3.4 Goats

Even though the origin of native goats is not known for sure, it seems that they were migrated through Southern China or through Taiwan and have been locally well adapted to Korean Peninsula for more than 700 years. Until the beginning of 1990, most of goats raised in this country were this native breed, and there were steady demand of this goat meat for health food or medicinal food for a long time. Native goats throve in many small farms without having to worry about extinction nor having concerns for a need for improvement. Beginning in early 1990 with the increasing demand on goat meat, some farms imported exotic breeds of goat and crossed with the native breed. As the trend of crossing native goats with exotic breeds to enhance the growth rate was increasing in recent years, there have been some concerns for need of preserving native goat in pure breed.

Saanen breed was imported and widely distributed among many farms as dairy breed in the early 1900, however, as the milk supply from Holstein cattle increased, the economic benefit of raising dairy goat was diminishing with years, and eventually the number of dairy goats reduced drastically and faced the danger of extinction several years ago. Recently with the increasing demand of goat milk, Saanen breed is increasing in number with recent import from foreign country.

Recently Introduced Breeds, Boa and Australian Feral are meat breeds, which were introduced for the purpose of improving native goats. Even though Boa as a meat breed is effective in increasing the growth rate of native goat, because the color of crossbred progeny is not the same as parents, farmers are interested in crossing other new imported breed to the native goats in order to have crossbred with black coat color. This prompted the importation of Black Australian Feral breed, which has same black color as the native. Because these two exotic breeds were widely used crossing with native goats, not many goats of these exotic breeds are available in purebred.

Molecular genetic characteristics of goats are not studied as much as the external appearance and the production efficiency. To examining the genetic characteristics and the location by the taxonomical classification, study on the blood protein polymorphism was done, and for the same purpose, studies on mitochondrial D-loop, and Microsatellite are in progress.

1.2.3.5 Horse

Native horses have been raised for military use, horseback riding, and transportation, however, the origin of breed is not known. Another native horse, called ‘Jeju horse’ is a pony, one of the small horse breeds, which was believed to a crossbred with Mongolian horse during the period between 1200 and 1300. In 1960 there were about 12,000 Jeju horses, but with the advancement of the farm tractor

and means of transportation, the number of Jeju horses was reduced to 1,300 heads. In 1986, Jeju horse was declared as a natural monument for their protection, and since 1990 horse race track was built for this breed, and pony race started. The number is increasing slowly, and two Research Institutes and one university in Jeju Province are doing researches on the Jeju horses today.

There are 8 imported horse breeds for horse race and horseback riding, but 7 breeds other than Thoroughbred are very small in number. Racing horses are raised mainly by Korea Racing Association, and the performance testing of racing horse is also executed by Korea Racing Association. Horseback riding breeds are raised and managed by few cooperate companies.

Two research institutes of Jeju Province, university, and Korea Racing Association are carrying out researches on the molecular genetic characteristics of Jeju and race horses. Blood typing and Microsatellite polymorphism analysis are used to examine the characteristics of breeds.

1.3 Utilization of AnGR

1.3.1 State of utilization by breeds

1.1.3.1 Cattle

In beef cattle, Korean Brown cattle is the largest in number, accounting for approximately 62% of total cattle population, and next popular cattle is the dairy breed, Holstein which take up 37% of all cattle population. Other breeds of Hanwoo such as Black cattle, Bridle cattle and Jeju Black are still facing the danger of extinction, or at risk. Three exotic breeds are recently imported for meat production but not for breeding purpose. Even though some farms and research institutes tried to raise imported beef breeds and cross between Hanwoo and imports, but these exotic breeds were not distributed to many farms.

Holstein is raised for milk production, but male calves and culled cows are raised to produce beef and some breeding cows are also used as recipients for embryo transfer of Hanwoo breed.

1.3.1.2 Swine

Major swine breeds are Landrace, Yorkshire, and Duroc. Even though these 3 pure breeds make up only 13% of pig population, most of breeding sows are cross between Landrace and Yorkshire, which are bred to Duroc boars. These 3 breeds and crosses among them take up almost 99% of total pig population. Hampshire is sometimes crossed with Duroc and produce 4-breed cross fattening pigs, but most

popular cross is 3-breed cross (¼Yorkshire x ¼Landrace x ½ Duroc).

Together with an increasing demand on port from native black, some farmers were interested in raising pigs of other black pig breeds such as Berkshire, Large Black, cross between Duroc and Hampshire, Native pig cross, but pork produced from these breeds is very small in quantity.

1.3.1.3 Chicken

Synthetic breed imported for GP or PS farms and commercial chicken accounts for 94% of whole population. Native chicken, Yunsan Yeonsan Ogol, a few other imported purebred has been maintained and distributed by research institutes to farms, but have no significant effect on whole poultry market.

In egg production, because of the preference of public to brown eggs over while one, White Leghorn almost diminished from the industry. In recent years the White Leghorn breed is coming back slowly. In chicken meat production, native chicken meat takes up only just over 2%. Sometimes, a brown colored meat breed and a dual-purpose breed are crossed with native chicken and these chickens provide small income to small farmers.

1.3.1.4 Goat

Up to 10 years ago, the majority of goat population in Korea was native goats, with only a small numbers of Saanen and Angora breeds. Recently to meet the increasing demand of goat meat, native goats have been crossed with recently introduced goat breeds. Consequently number of native goat has been declined because of the crossbreeding, but still represents the majority. On the other hand as the demand for goat milk by consumer increases, Saanen breed has been imported again, and now represent just above 1% of all goat population.

Australian Feral breed is crossed with native goat to meet the consumer's demand for goat meat similar to native black breed but the purebred Feral breed is reducing in number. Boa breed is raised only in few farms for meat purpose. Angora is not increasing in number for the price of goat hair is not high enough to be profitable in Korea.

1.3.1.5 Horse

About 95% of Jeju horse is believed to be a crossbred, only 5% is registered as purebred Jeju horses. Prior to 1980 Jeju horse had been used for farming and transportation, but not anymore. Since Jeju horses were not needed for such services, its number reduced drastically to become an endangered breed. From 1991

Jeju horse racing has been in operation and Jeju crossbred horses under certain height were qualified for the race. Later in 2002 only the registered Jeju horses were qualified for race in order to protect and to increase the number of purebred Jeju horses. Jeju crossbred horses are used for horseback riding and for the production of horsemeat, however, horsemeat market is very limited and small in size. On the other hand, Thoroughbred is mainly bred in Jeju Island and used for horse race.

1.3.2 The State of Livestock Improvement

1.3.2.1 Livestock improvement objectives and target traits

Seven target traits of Korean Brown cattle for improvement are 6-month weight, 18-month weight, 24-month weight, carcass weight, backfat thickness, rib-eye area, intramuscular fat (marbling score), while 7 target traits of Holstein breed are milk yield, kg-milk fat, %milk fat, kg-milk protein, %milk protein, and kg-solid-none-fat, and %solid-none-fat.

Two different improvement objectives are used for swine; one for purebreds and another for multipliers. Target traits for the improvement of purebreds such as Landrace, Yorkshire, and Duroc breeds are average daily gain, days to 90kg, backfat thickness, feed required for gain, loin eye area, and total litter size and litter size alive. Target traits for multipliers producing fattening pigs are number of pigs weaned per year per sow.

Objectives for improving chicken are different for breed for laying egg and for breed for meat production. For breed of laying egg, %survival of hen, age at first laying, number of eggs per year, index of laying egg, average weight of eggs, feed required per egg, and body weight, are target traits, and for breed of meat production, %survival at the age of 6 weeks, body weights at 5-week, 6-week and 7-week of age, feed required to 6-week of age are target traits.

1.3.2.2 Evaluation of Genetic potential

Genetic evaluations of AnGR are carried out routinely for Korean Brown cattle, Holstein and three breeds of Yorkshire, Landrace and Duroc.

Statistical model used to evaluate Korean Brown cattle for their genetic potentials was Sire Model prior to 1998, but now the Individual Animal Model is used. Pedigree information is recorded by Korea Animal Improvement Association, and, Livestock Improvement Center of Agriculture Cooperative Federation, performance records are collected in National Livestock Research Institute and Livestock Improvement Center of Agriculture Cooperative Federation. Statistical analysis and genetic evaluation is done at the National Livestock Research Institute.

Genetic evaluation for Holstein is routinely performed at National Livestock Research Institute using Individual Animal Model, using pedigree information recorded by Korea Animal Improvement Association, and performance data and the pedigree information collected by Livestock Improvement Center of Agriculture Cooperative Federation.

National Livestock Research Institute carries out swine genetic evaluation program for Yorkshire, Landrace and Duroc breeds. Performance data is collected both by pig breeding companies and National Livestock Research Institute, and the pedigree data is collected by the Korean Animal Improvement Association.

1.4 The State of Utilization of AnGR

1.4.1 Cattle

Korean Brown cattle bred for farming and drafting purposes throughout history were changed toward beef production through genetic improvement during the last 2-3 decades. Today, only in remote areas, cattle are used for farming and drafting. Korean Brown cattle tend to grow slower than other beef breeds in the world, but these cattle have been successfully preserved in large numbers through genetic improvement for more efficient beef production.

Major beef production is from Korean Brown cattle and its meat is sold at a higher price than international market. With the free trade in place, the preservation of Korean Brown cattle is facing a challenge for its continued existence. To improve the ability of Korean Brown cattle to compete against the imported beef, the objective of genetic improvement is changing toward the meat quality from the quantity of meat. As a result, the meat quality of Korean Brown cattle has been improved. However, the number of Korean Brown cattle raised in Korea had declined from 1996 to 2001 with a slight increase ever since. However, due to the increase of crossbreds and recently imported breeds, the concerns on free trade among cattle farmers are not resolved. Therefore it is necessary more than ever to improve meat quality trait to its maximum in order to improve the competitiveness of Korean Brown cattle against the imports

In the mean time, dairy cattle in Korea are from only one breed of Holstein. This was probably derived from the fact that Holstein breed produce largest amount of milk among all other dairy cattle breeds. With this kind of narrow genetic pool, it will be difficult to meet the requirements of both rearing environment and changing preference of consumers. In recent years, consumption of milk with distinctive characteristics is on the rise, however, with only Holstein breed it is rather difficult to satisfy the ever-changing demand of consumers.

1.4.2 Swine

With the efforts of improving productivity and standardization of pigs, there are only three breeds of Landrace, Yorkshire and Duroc contributing to the majority pork production in Korea. Breeding sows are reciprocal crosses between Landrace and Yorkshire, and the terminal sire is Duroc boar. Even though there have been several other breeds imported and well adapted to local environment, most of them disappeared not because of their lack of adaptability to the local environment, but because of lack of application to the general swine production system.

As the demand for Korean native pork was increasing, the number of native black pigs was continually increasing to meet the demand for a while. However, because the native black pigs are slow to grow and small in litter size, people started to cross native pigs to other breeds or to replace native pigs with similar exotic breeds to satisfy the demand of such pork. Consequently, the number of native pigs started to decline to the level that it is At Risk. . In order to preserve the national black pigs in years to come, there must be some solution to improve the productivity and economic capacity of native black pigs and at the same time promote demand through marketing differentials for the quality and food safety of native pork

1.4.3 Chicken

Most of chicken raised in this country is largely the imported synthetic breed and commercial strains derived from it. In the past synthetic breed and commercial strains were developed in Korea through genetic improvement program based on several pure breeds imported. However, due to its slow genetic improvement and techniques it never settled as a synthetic breed competitive against those imported from foreign company, and these base purebreds disappeared quickly.

Even though Smallholders maintain these purebreds, it is possible to lose productivity or characteristic genes peculiar to these breeds because of increasing inbreeding and lose of vigor.

1.4.4 Goats

Native goat has been utilized as medicinal food for a long time, however, with the increase of goat meat consumption, farmers are trying to crossbreed native breed with exotic breeds to increase the goat meat production. Crossbreeding with Boer breed was common, but because of preference to black coat color, crossing with Australian Feral is increasing.

Native goats are still large in number, and for a while it will not be too difficult to preserve enough number of purebred native goats. However, with the

import of black exotic breed and continued crossbreeding, someday it might become difficult to distinguish purebred native goats from the cross, which might become an obstacle for preserving native goat in the future.

2. National policy, strategy and programs for the utilization, development, and conservation of AnGR.

2.1 Realities of Past policy, strategy, program and management practice

2.1.1 Policy, strategy and program associated with each species

Legislation associated with preservation, management and utilization of AnGR associated with agriculture are inclusively regulated to all livestock species, however policy applied to each species took different measure.

2.1.1.1 Cattle

Policy applied for Korean native cattle was mainly toward the establishment of the foundation population, price stability, genetic improvement and utilization. To establish optimum population size when the population declined drastically since 1997, a comprehensive measures for Hanwoo industry development was established in which Calf-Production-Security-Program and others are in practice. To sustain the high price of Korean native cattle produced by farmers, government apply new policy to protect Hanwoo farmers by differentiating prices for different cuts, and assisting the development of identifying imported beef from Korean beef in order to prevent imported beef from being sold as Korean beef and to improve the orderly distribution of beef. Since 1970, the policy was to improve Korean cattle of drafting characteristics toward beef breed and established several Livestock Production Legislations to assisted Hanwoo farms to achieve the improvement objectives. Through performance test, superior young bulls and proven bulls were selected and used to satisfy both the producers and the consumers, and also several business associated with Hanwoo improvement such as the registration of Hanwoo, superior semen production and supply, artificial insemination industry went ahead. Such improvement program and objectives were reset every 3 years after analyzing improvement trends for the past period. Beef carcass grading system was renewed to pay proper price for high quality beef, and promoted the understanding of consumers on Hanwoo beef through education and public information as a measure of policy.

Policy for dairy cattle and its industry, after the expansion period of 1960-1970 were supply and demand stability, business rationalization through enhanced productivity, improvement of milk quality and distribution system in order to provide fresh drinking milk of high quality. Since there was no dairy cattle breed in the country in the early days, to meet the increasing demand of consumers for milk and milk product during 1960-1970, many dairy cattle, Holstein breed had to be imported and distributed to farmers. Soon after importation, dairy cattle improvement program started with milk recording, young bull and proven bull selection, Artificial Insemination, registration and pedigree service, etc. As a result

average milk yield of heifer cows reached to 8,000kg(305-day milk), but with a halt of milk consumer market, the unbalanced supply and demand developed in cycles over the years. In order to stabilize the market, government executed policy of distributing public information to promote milk consumption, and to reduce milk production by working with dairy farmers. Going through this kind of experiences, dairy industry already started self-reliance fund system. With time, consumers demand for fresh and safe food, especially in drinking milk, increased, and milk grading standards were established where price of milk was depended on the number of microorganisms, and somatic cell count. At the same time in order to lower the cost of distributing milk and to maintain the quality, the milk collection was unified instead of having several milk processing centers to collect their own milk to process, and at the same time the milk inspection was done under the public management.

2.1.1.2 Swine

Policy associated with swine also focused on the stability of supply and demand, establishment of improvement goals, setting up the rational improvement system, quality improvement and improvement of the meat distribution structure. Before free trade, government carried out the adjustment project of supply and demand, in which quantity of pork in the market was controlled by buying and storing pork produced by domestic swine producers during a time of surplus, and releasing or importing pork whenever there was a need beyond production, and at the same time, government controlled the consumer price of pork. However, with the start of free trade, Supply and Demand Adjustment Committee of private sector was established and the supply and management was voluntarily regulated through a strong campaign of publicity using self-reliance fund, and the government provided only complementary measures on the systematic defects and supplied fund.

Swine genetic improvement goals were set every 10 years, and to achieve these goals, the station test and on-farm test programs were carried out continuously. In the mean time, to establish improvement system, Specialized Pig Breeding Company Support Program was started, where several GGP-farms were developed with loans, which was also conditional to establishing several GP farms under each GGP farm. Through this affiliation, rational improvement of breeding pigs and distribution system was completed. Pig registration system and Boar test stations for performance test were also important means of accelerating swine improvement. To improve quality of pork, not only genetic improvement but also feeding and management improvement were explored to satisfy consumer’s demand on food safety and quality pork. At the same time, enforcement of policy on improvement of slaughter plant, operation of carcass grading system, and continued supplementation of the pork grading system, improvement of pig trading standard, and improvement of distribution structure were carried out.

In order to relieve the environmental issue, an effort was made to change the production system from small farm to large scaled hog operation, and at the same time to accelerate the operations such as the cooperative hog farm, hog complex, and specialized hog farm. In recent years, the enforcement of police on prevention of infectious diseases for hog is in place in order to quarantine influx of swine diseases by supplementing the systematic deficiency.

2.1.1.3 Chicken

Policy associated with chicken focuses only on the enhancement of efficiency of poultry industry for egg production and meat production through economic performance testing, because most of the breeding chicken in the country depends on importation rather than domestic production through its own improvement program. Egg producing farms have been already specialized for a long time, but poultry meat production has been still produced in small farms with inadequate facility. Therefore policy on poultry meat production focuses on enlargement of production scale and improvement of facilities in order to standardize the broiler chicken production and to improve its quality. Similar to swine, a policy was in place for chicken industry to maintain the stability of supply and demand and quality enhancement.

Chicken meat produced from the native breed has been distributed through different market then broiler. Policy for native chicken focuses on the accelerating its consumption so that production of native chicken and the indigenous chicken genetic resource can be preserved through *In situ* conservation. Also there are enforcement of policy supporting improvement activities such as evaluation of productivity of native chicken by strains, meat productivity and quality traits evaluation of cross, establishment of production system for commercial chicken, high quality meat production technique of original native chicken, and development of sales strategy based on the survey on consumer preference.

2.1.1.4 Others

Other policies associated with AnGR are the policy of preservation, the policy of acceleration of utilization, and the policy of prohibiting utilization. The policy for supporting the preservation of AnGR associated with agriculture is the Declaration of Natural Monument (The Cultural Properties Protection Law, Article 6), policy of accelerating utilization are agriculture research and development, and rural development (Rural Development Law and Rural Community General Law), for the prevention of development and expansion of livestock infectious disease, and for improving the livestock hygiene are the Livestock Infectious Diseases Prevention Act and Veterinarian Jurisprudence. Polity for hygienic treatment, processing and distribution of livestock products is the Livestock Processing Act, Legislation associated with promotion of Livestock product consumption, is the Legislation for

Dairy Industry Development, for supporting the development of traditional food, there is The Agriculture Product Processing Industry Support Act. Polity for feed production and quality control is Feed management Act and the Grassland Act. Also there is the Korean Jindo Breeding and Protection Act. Policy to improve the hygiene of livestock products and to prevent environmental pollution by manure, to enhance the utilization of manure as resources for environmentally friendly livestock industry is Sewage, Feces and Urine, Waste water Treatment Law from Article 24 – Article 34, and other policy for protecting animals from being abused and mistreatment is Animal Protection Act.

2.1.2 Effectiveness of Policy and Strategy

2.1.2.1 Effects on farms

Policy associated with the livestock genetic resources in this country have made an enormous influence on the development of livestock industry. From the standpoint of farm, productivity is improved by increasing the production scale and enhanced management technique of AnGR. With the expansion of interest on genetic improvement of livestock, breeding stock and commercial stocks were managed and utilized separately to maximize the output per a unit of input, and the livestock farm's awareness on the importance of genetic resources is heightened.

Even though the farm economics has been improved in general, there have been some negative sides such as increased dependency on imported feedstuffs, price instability of livestock products, importation of facilities and equipment, added expenses and pressure on environment management etc.

2.1.2.2 Effects on the preservation and management of the AnGR

Policies in the past enforced on the productivity improvement and the stepping-up of the farm income. As a result, development and utilization of AnGR associated with agriculture centered only on the breeds few in numbers, fitted to the specified production system, and as a result, the diversity of breeds decreased.

However, with the expansion of national economics, the consumption pattern has been changed from quantity to quality. Therefore, the direction of policy has been changed toward high-quality and diverse livestock products with increasing emphasis on the AnGR diversity. Even though the direct policy on the preservation and maintenance of AnGR is only at the stage of beginning, the general tendency on the policy development is positively working toward the preservation and management of genetic diversity.

2.2 Analysis of future demand and tendency

2.2.1 Change of Social Economic conditions

The Increase of income level brought about the change of consumption pattern. The demand on large quantity at low price is slowly diminishing while demand for diverse high quality livestock products is on the rise. At the same time people's concern on environmental management became strong and the livestock production is beginning to appear as an issue for its adverse effects on environment. Firstly, inadequate treatment of feces and urine from animals results in an environmental contamination, especially the eutrophication of water resources and secondly deteriorates the pleasant environment such as fresh air modern urban dwellers want. As the awareness on the nature and environment increased, people began to have interest on the international movement such as the Biodiversity Agreement, and their interest spread to the agriculture and rural society. At the same time the awareness of public on the genetic resources heightened.

2.2.2 Effect of condition changes on AnGR and production system.

2.2.2.1 Effect of change in consumption pattern

Change in consumption pattern induced the need to enhance the quality of livestock product and its diversity. High quality livestock products will most likely be produced through mass production of High Input System, but will also be produced quite effectively by utilizing the differences in product characteristics among different breeds. This can be a motive for maintaining the breed diversity of AnGR. Consumer's demand for high-quality products might end up preserving several specific breeds, and at the same time it might put a negative pressure on other breeds lacking in merit for given high quality products.

As far as the production system is concerned, High Input for mass production system will be the main stream, but there will always be Small-Scale-Commercial farms producing livestock products with higher prices in small quantity for a specific niche market. These farms will likely belong to either Low Input or Medium Input production systems.

2.2.2.2 Effect of awareness change on environment

Both the awareness on the environmental protection and the demand for a pleasant environment to live will likely change the livestock production toward reducing the quantity of pollutants responsible for the environmental contamination. Even though High Input Production System is suitable for the improvement of productivity, at the same time it is also associated with the rising treatment cost of livestock waste. Therefore, farms interested in Medium Input or Low Input Production System will eventually increase in numbers. It might be possible that exotic breeds with high production efficiency be suitable for High Input Production

System, while other breeds may have possibility of adapting better to Medium and Low Input Systems. Especially indigenous breeds can be increased if their production is linked to the Low Input System, for these breeds have been adapted to Low Input System for a long time in the past throughout the history of this country.

On the other hand, the demand on the animal farm for a view is on a rise, in which case, animals of rare breeds are more in demand than other popular breeds. This demand will have a positive effect on preserving the breed diversity.

2.2.2.3 Effect of Awareness change on the genetic resources

Change in awareness being resulted from the cultural and social inspiration, which will likely to stimulate the nostalgia of the past and will have enormously positive influence on the preservation of indigenous breeds. Furthermore, if the public understands the meaning of genetic diversity and its value, it will have a great impact on the policy decision. Such policy will not only increase the number of animals of these indigenous and rare breeds, but also improve the utilization of production system suitable for these rare breeds.

2.2.3 Suitability of national management plan on the change

Because the current national management plan on the AnGR associated with agriculture is at the beginning stage, it tends to be partial as well as restrictive. With current plan it is not only difficult to support diverse policies, but also even more difficult to deal positively with the fast changing circumstances. As this report is being prepared, it is expected to establish a new national management plan, which is more systematic and comprehensive than the current one, and AnGR will be preserved and managed better in the future.

2.3 Alternative strategy on preservation, utilization and development of AnGR.

2.3.1 Alternative plan on the side of the species and breeds

Registration system will have to be established for all livestock species including the rare breeds, which means the setting up the standards for registration and judging animals within breed and establish the Registration Service Association. For species and breeds in Danger of Extinction or At Risk, there must be a policy enforcing compensation of financial aid to farms as well as the extension service on the method of rearing. Also exploration or importation of new AnGR associated with agriculture will be continued.

2.3.2 Alternative plan on the side of technology

As an information bank, a database of AnGR will be built, maintained and utilized. And the preservation and utilization of AnGR will be fortified by developing new techniques for improving and evaluating AnGR.

2.3.3 Alternative plan on the side of supporting system

With a national strategy for the management of AnGR in place, the Livestock Genetic Resource Center (to be established) supported systematically will play a role coordinating interaction among all organizations of private and public sectors, and will build and manage the network for the mutual benefits among all parties for preservation, development and utilization of AnGR. The national database for AnGR must be built with a secured financial resource sufficient for the development of education and training programs and for a delivery of public information.

2.4 Overview on the future national policy, strategy and management plan

2.4.1 Strategy

Along with the establishment of system for the preservation and management of AnGR associated with agriculture, there must be some corrective measures both on the roles of various stakeholders in public and private sectors as well as on the network beneficial to all parties. Establishment of comprehensive management plan, setting up the regular monitoring system of AnGR, further expansion on the public awareness on the importance of AnGR, and securing financial resource both from government and private sectors.

2.4.2 Policy

Future direction of policy is to support the organization of AnGR management system and its operation. There must be the development of NGO or organizations of various stakeholders, establishment of the registration systems by breeds and by species, financial support to the research activity of identifying the degree of endangerment for breeds at risk, and capacity building of preservation, utilization and management of AnGR, fortification of public information, especially through cultivating men of talents and specialty.

2.4.3 Management Plan

Future management plan of the AnGR will focus on 6 different angles:

Periodical surveys on the state of AnGR, which entail the information gathering such as the quarterly figures on the number of animals maintained in organizations, registered livestock farms on a yearly base, non-registered farms once every two years (alternate years by species).

Enforcement on the monitoring farms raising rare breeds, which entails the designation of the subjective farms, designate a monitoring personnel by region and regular training, liaison with current state survey.

Molecular genetic analysis and breed evaluation, which entail the frequency survey on the allelic gene characteristics on the specific region by using Microsatellite, mitocondrial D-loop etc, genetic diversity analysis both by regions and population, the estimation of genetic distance between breeds within country and across countries.

Increasing the population for breeds facing the Danger of Extinction or At Risk, which entail a development and use of AI technique, and use of embryo transfer.

Increasing the use the *Ex situ* conservation, which entail the development techniques for freezing germ cells, preservation of blood or DNA of rare breeds, collection of frozen resources maintained by private sectors.

Establishment of the development of technique for utilizing genetic resources by breeds, which entails the multiplication of rare breeds raised in the country and development of feeding technique, and bringing in new AnGR.

3. Current state of national capacities and assessment of future capacity building requirements

3.1 Evaluation of national capacities

3.1.1 Current state

3.1.1.1 Governmental and private organizations associated with AnGR preservation, maintenance, and utilization

Governmental organizations, private organizations, and various associations involved in the preservation, maintenance and utilization of AnGR associated with agriculture are listed in Table-1. Even though the comprehensive system for mutual cooperation has been in search for sometimes, it happens only at the level of ad hoc bases. With the expansion of awareness of the importance of preservation and management of AnGR among research institutes, universities and government organizations, there is a movement toward setting up a concrete plan for developing a cooperative system among all stakeholders.

NGO in this country is an organization acting as a spokesman for the producers, and its role on preservation and management of AnGR is relatively low. This is because only recently the importance of the preservation and management of AnGR has been spread to the public and there tends to be a belief among people that it is the role of government and not the role of private sector.

AnGR in this country have been managed mainly by placing focus on utilization. Therefore, roles of all organizations and associations involved in the improvement of the AnGR are well established and on this base, cooperative system has been constructed (Figure-6)

3.1.1.2 Legal device associated with livestock genetic resources

Dealing with the AnGR associated with agriculture in this country as a subject of preservation and management began only recently, and the related laws and regulations largely focus on the development and utilization. The related laws are Livestock Production Acts, Livestock Product Treatment and Processing Act, The Livestock Infectious Diseases Prevention Act, and Animal Protection Act, , Legislation associated with promotion of Livestock product consumption, Legislation for Dairy Industry Development, the Korean Jindo Breeding and Protection Act ,and Animal Protection Act.

Livestock Production Act regulates general items related with the development of livestock industry such as livestock improvement and multiplication, structural improvement of livestock industry, adjustment of supply and demand of livestock,

Table-1. Governmental and private organizations, associations involved in the preservation, maintenance and utilization of livestock genetic resources

Name of organization	Business	Remark
Ministry of Agriculture (Livestock Policy Division)	Policy Decision and adjustment, Establishment of improvement objectives	Federal Government
Rural Administration Bureau Research Management Branch	Agricultural genetic resources generalization and adjustment of related policy	Federal Government
National Livestock Research Institute	Livestock genetic resources preservation and Overall management. Policy adjustment, Livestock improvement generalization	Federal Government
National Cheju Agricultural Experiment Station	*In situ and Ex situ* conservation Development of utilization technique	Federal Government
9 Provincial Livestock Research Institute	*In situ and Ex situ* conservation, Development of utilization technique, Local genetic resources development	Regional Government
Korean Animal Improvement Association	Livestock registration Service and judging	
Agriculture Cooperative Livestock Improvement Center	Performance test and improvement business for Hanwoo and Holstein	
Animal Products Grading Service	Grading system for animal products	
Korean Artificial Inseminator Association	Participation to Hanwoo and Holstein improvement Program	
Korean Horse Association	Rearing of Horse and improvement	
Hanwoo association	Hanwoo *In situ* conservation and utilization suport	
Korean Dairy-Beef Association	Hanwoo and Holstein *In situ* conservation and Utilization support	
Korean Swine Association	Swine *In situ* conservation and utilization suport	
Korean Poultry Association	Poultry *In situ* conservation and utilization suport	
Korean Deer Antler Association	Deer *In situ* conservation and utilization support	
Korean Meat Import-Export and Distribution Association	Meat import-export and related matter	

and products, price stability and distribution improvement etc. Livestock Product Treatment and Processing Act rule all the processes dealing with slaughter and treatment of livestock, processing of livestock product, distribution and inspection.

The Livestock Infectious Diseases Prevention Act regulates necessary aspects for preventing the development and spread of livestock infectious diseases, and Animal Protection Act regulates items necessary to protect and treat animals properly.

Recently basic article for the preservation and management of AnGR was added to Livestock Production Act, and accordingly AnGR management rules were established, and other associated rules are to be established in a near future.

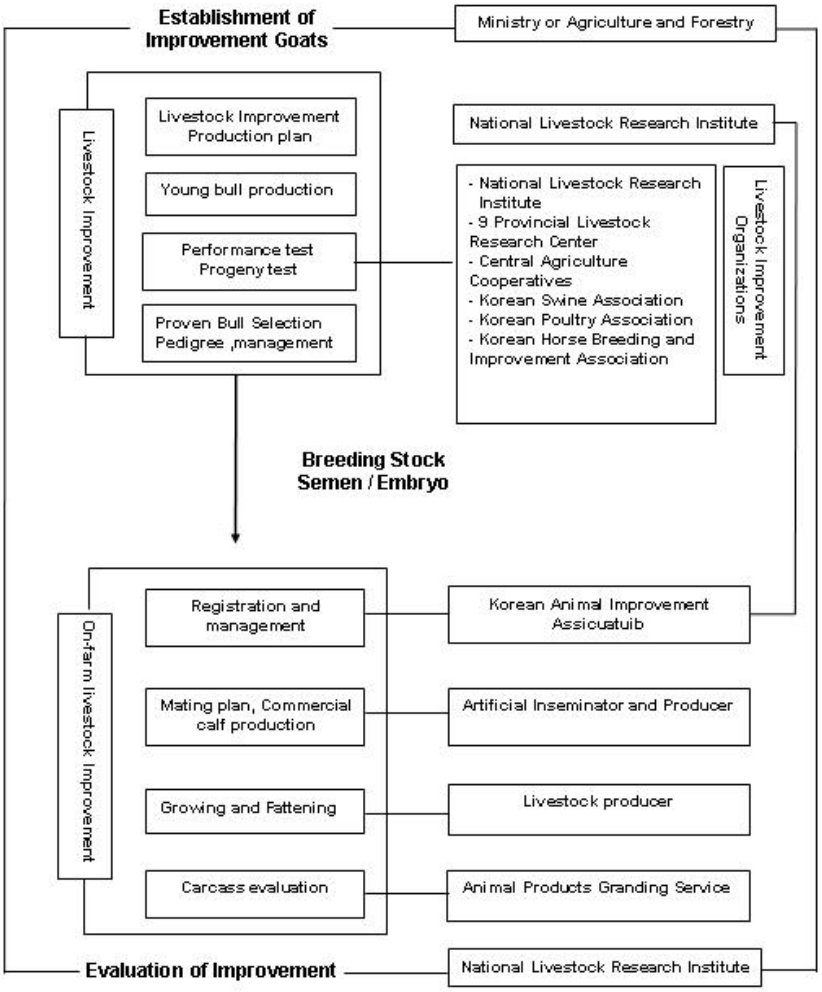


Figure 6. Improvement system and the roles of various Organizations

3.1.1.3 Communication basis

Information communication technology in this country is world class in terms of production and manufacturing technique. The substructures necessary for informationization such as ultra-speed internet, number of internet members, hand-phone users and PC users are world class. However, the core technology is largely dependant on foreign countries. That is, techniques such as operating system, package software, and other new technology are having control over domestic market, and even network equipment also depend foreign countries. Much support and investment are given to the vulnerable area such as the hardcore elemental technology of basic design, application design, materials, system architecture etc. Internet usage is still limited in the area of agriculture and fisheries industry due to its distance, topographical and physical environments, but technical development and investment to solve this problem have been reinforced.

3.1.1.4 Other environment for preservation, management, and utilization of AnGR

This country has secured enough research foundation based on the high level of public educations. There are 3 federal research institutes, 9 provincial government research institutes, 1 government-contributed research institute associated with AnGR. Out of all the national, public, and private universities, 39 of them are conducting researches associated with AnGR, and also research centers in the private sector are working for the preservation, development and utilization of AnGR.

In technical support Rural Development Administration maintains Agricultural Technology Guidance System. Under this system, the business unit is Agriculture Technology Center established in the cities and counties. Also recently some universities established and managed Technology center to strength technology guidance to farmers. Private sector also dealt technology guidance seriously, and several affiliated groups in some fields operate technical guidance systematically.

3.1.2 Capacity building requirements

3.1.2.1 Areas to improve

In the capacity building for preservation, management and utilization of AnGR associated with agriculture, areas to be improved in this country are as follow.

- System for preservation and management of AnGR
    1. Management system for AnGR
    2. Network between government organizations and organizations

- Development of personal resources
    1. Adjustment for preservation and management of AnGR
    2. Secure specialists for the preservation, evaluation and management of AnGR
    3. Monitoring the *In situ* conservation of AnGR and technique guidance
- Technology development
    1. Database for AnGR and Information system
    2. Capacity of breed characteristics examination
    3. Research on *Ex situ* conservation technology by livestock species

3.1.2.2 Security of financial resource

Because most business for the preservation, management, and utilization of AnGR associated with agriculture in this country have been carried out with the initiative of the state, financial resources necessary for capacity building has also been dependant on governments. Recently as the participation of the private sector on research and guidance has increased, financial investment of private sector also has increased. It is important to note that such investments from private sector do not necessarily injected into the area in the order of national priority bases, but rather into specific area for profitability, while state budget is injected into mainly constituting the base.

There is no project prepared for the security of the financial resources necessary for capacity building. With the expansion of awareness on the genetic resources, the fact that the government is adjusting their investment direction is a good sign for the future financial security. For now financial resources was secured by governments connected with agriculture and forestry, but other governments associated with biological resources, environmental improvement, development of governmental personnel resources will likely provide financial support according to their missions. Also it is expected to receive an increasing financial support from the private sectors.

4 Identifying National priorities for the conservation and Utilization of AnGR

4.1 Priorities in Strategy and policy

National priorities for the preservation and management of AnGR associated with agriculture are (1) establishment and execution of comprehensive measures for the management of AnGR, (2) the preparation of systematic devices through the improvement of associated legislations, (3) Understanding of the present condition, classification and conservation measures of AnGR and the validation of breed or strains in a danger of extinction through the fact-finding survey and registration, (4) establishment of international cooperative system, (5) the development of the monitoring system, information management and gene bank operation for AnGR, (6) the expansion of public awareness among Korean people on the importance of AnGR, and (7) establishment of systematic organization and security of financial resources for the management, utilization of AnGR and researches necessary to develop technology.

4.1.1 Establishment of national strategy for the preservation and management of AnGR

An Agency in charge for the diversity, systematic management and utilization of AnGR associated with agriculture must be designated and the national comprehensive strategy must be followed continuously. Such comprehensive strategy must involve government, local government, professional organization, private organization, and all the stake-holders managing and utilizing AnGR. The strategy must be established as a realizable plan based on the thorough discussion and advice from the professionals.

4.1.2 Actualization of legal and systematic device for the preservation and management of AnGR

It has been several decades since the interests on AnGR conservation started to grow into reality, yet there has not been any practical measures on the preservation and management other than collections of rare AnGR and researches in a few governmental organizations. The reason for this is because the direction of policy was toward the importation and utilization of foreign genetic resources rather than the preservation and management of those indigenous to the country.

Even though there have not been many rules dealing with preservation and management of AnGR up to now, recently the ground of systematic device for the preservation of AnGR was laid in the revised Livestock Production Act and an Enforcement Ordinance for the Livestock Production Act, with which enable the financial support for the collection, evaluation, preservation and management of AnGR. Also Korea will positively participate to the international movement of

preservation and utilization of AnGR and will plan to supplement detailed legislation and rules associated with AnGR.

Legal and systematic device is the foundation of systemizing the preservation and management of AnGR, and also become a basis of mobilizing financial resources. Furthermore, to accomplish the preservation, management and utilization of AnGR efficiently, the Livestock Genetic Resources Experiment Station was newly established. Livestock Genetic Resources Experiment Station will establish the preservation and management system of AnGR linking with university, research centers, private organization and farm, and utilizing provincial Livestock Research Institutes as local Livestock Genetic Resource Experiment Stations, will have to position own specialized staffs and develop program and equipment for inputting AnGR. Since there is lack of specialist and organization necessary for preservation, evaluation and management of AnGR in this country, further enforcement will be placed in this area of positioning specialist and the establishment of management system.

4.1.3 Confirmation of breeds and strains in danger of extinction and conservation measure

Even though native pig and native chicken was dragged out of the danger of extinction, several sections are in need of urgent measure. For examples, a few breeds of Hanwoo (Korean native cattle) are still in danger of extinction, and several strains of native chicken are not even confirmed about their seriousness of risks for their existence.

4.1.4 Expansion of international cooperation for AnGR

While increasing information and technology exchange through the establishment of network with international organization and neighboring countries, Korea will expand international cooperation in the area of developing and training livestock artificial insemination and embryo technology to the neighboring nations in order for them to improve the livestock production

4.1.5 Development of system and method monitoring AnGR and establishment of gene bank

Monitoring of presevation, management and utilization of AnGR is an essential mean for the sustainable utilization of AnGR. Since Korea has an excellent communication foundation, the monitoring system must be developed utilizing this technology. The possibility of establishing Gene Back for preservation and utilization of AnGR must be examined. Data Base establishment by means of DNA analysis of AnGR necessary for protection through Gene Bank, conservation of reproductive cells, and the information of AnGR must be managed extensively.

4.1.6 Expansion of awareness of the importance of AnGR and the technology development

Awareness of the general public is an important factor for making policy decision. In other words, it will be difficult to put forward a major related policy without an agreement or lack of interest from the public on the management of AnGR. Therefore, it is very important to expand public awareness on the importance of AnGR before establishing and executing the national strategy. Especially as the interest of public on environment and safety and quality of animal food is increasing, their interest on the value and importance of AnGR diversity will also likely to increase, which will make it ease to make policy decision and to reserve financial resources under such conditions.

Most of all the researches for the technology development associated with AnGR, freezing preservation of AnGR, reproductive technology of frozen AnGR, gene analysis, and the development of management system must be pursued continuously. Agricultural Technology Development Center makes the selection of research topics and support research fund toward the technology development associated with AnGR to national and public research organizations, university and private research center.

4.2 National priorities by animal species and breeds

4.2.1 Multiplication and preservation of rare breeds of Hanwoo

Artificial insemination and embryo transfer techniques for cattle is well developed, and using these techniques Native Black, Bridle and Jeju Black should be multiplied as quickly as possible. Using recipient of different breed for Embryo Transfer will enhance the speed of multiplication of these rare breeds. For this project, all animals of rare breed raised by individual farms and organizations must be evaluated for the relationship among all animals, individual inspection, breed evaluation, molecular-genetic characteristics etc. When the genetic purity and diversity are secured simultaneously, the meaning of preservation and effects of multiplication will be great.

In a way, compensation system for individuals or groups who raise these rare breeds can take diverse forms such as giving financial aid, or to give certain rights for those progenies and profit sharing among those associated with multiplication and preservation of those rare breeds.

4.2.2 Stability of native black pig conservation

Even though the restoration of native pigs was successful and the numbers of farm raising these pigs are on the rise enough to get away from the danger of

extinction, the population is still not over the stage at risk. Especially because several black imported breeds similar to native pig in appearance are disturbing the distribution order, even the established native pig farmers are replacing native black pigs with exotic breeds, or crossing with the imported breeds. This is posing a major threat to the preservation of pure native pigs beyond the level of at risk.

Policy, which establish a compensation system for raising purebred native pig, or support a higher pricing system at the market will encourage the will of farms raising native purebred, and will be one of the means of stabilizing the native pig conservation.

4.2.3 Classification of strains from native chicken population

Even though several different strains of the native chicken different from each other in the characteristics of external appearances have been established, the genetic differences among these strains have never been confirmed. Looking back the circumstances where the native chicken has been raised throughout the history of Korea, it can certainly be expected that there would be location differences as well as the population differences among them, and it is a great concern that specific genes might be in lose due to their small population sizes. Therefore, it will be necessary to define the differences and similarities among them, to classify them into either breeds or strains and to obtain their population stability in order to maintain the genetic diversity of native chickens.

4.2.4 Examination of native chicken characteristics

Recently technology such as microsatellite, Mitocondria D-loop, allele analysis of non-functional DNA can be used to define the genetic diversity analysis, or to define the genetic distance among breeds, or among strains. It will be important to define the positions of breeds, and promote their unique values as genetic resources by using such new techniques. At the same time, those loci associated with the characteristics of native chicken can be studied comparatively against those of other foreign breeds.

4.2.5 Protection of Conservation Groups for rare breeds

Rare breeds including native breeds need to be preserved for their maintenance by designating conservation groups. It will be necessary to have compensation or support measure toward native breeds or rare imported breeds adapted for a long time in order to maintain the breed diversity.

4.2.6 Exploration and Introduction of New livestock species/breeds

Diversity of livestock species or breeds should be secured in order to respond

to a new demand or to be prepared for the change in environment. Livestock species and breeds introduced to this country but not confirmed much be surveyed and properly managed, and also those species and breeds necessary to satisfy the demand must be imported continuously. At the same time, wild animals raised on farms must be monitored for better management depending on the degree of domestication.

4.2.7. *Ex situ* conservation technique development

Other than semen and embryo of cattle, freezing conservation technique is difficult to use. However, to preserve genetic diversity among individuals within breed, reproductive cell freezing technique for several livestock species must be developed. Freezing technique for embryo of pigs, semen and embryo of goat, semen of chicken and of horse is urgently needed. This technique is also needed for the preservation and multiplication of rare breeds or breeds in danger of extinction.

5. Recommendations for enhanced international co-operation in the field of farm animal biodiversity

5.1 Recommendations

5.1.1 Evaluation for the international co-operation in progress

5.1.1.1 Co-operation with International Livestock Research Institute (ILRI)

Since 1996 when Korea concluded a co-operation agreement with ILRI, fifteen researchers have been dispatched to ILRI and received training through 11 projects, including the analysis of genetic diversity of native livestock. However, most research subjects were short term, where Korean researchers were simply participating to the researches of ILRI instead of working for the independent or collaborated subjects. Therefore, there have not been continued studies afterward.

Since Korea has concluded an agreement with ILRI to dispatch a research resident in ILRI, a long term and independent project will be conducted, so that practical and mutually supplementary research can be executed. Further systematic co-operation with foreign research institutes and universities in liaison with ILRI would be more than welcome.

5.1.1.2 Philippine Agriculture and Forestry Resources Development Committee (PCARRD)

In order to find mutual co-operation plan on genetic resources, livestock improvement system of Philippine, a possible co-operative research with PCARRD was discussed. However, there has not been any co-operative work so far. In the future, for a continued and practical collaborated study by both parties, a special measure might be needed to exchange or dispatch researchers.

5.1.1.3 Others

Co-operation not only with China, Japan, and Thailand in Asia, but also with countries in Europe and North America were carried out. Co-operation with these countries were information collection, exchange of technology, and collaborated researches, and have been successful in maintaining co-operative relationships. However, there seem to be a limitation to go ahead with a plan for systematic and continued co-operation. To have a practical co-operation with these countries, there must be a systematic co-operative relationship.

5.1.2 Co-operation within South Asia

5.1.2.1 Co-operation in the taxonomical classification and evaluation of indigenous genetic resources

It seems that Korean native breeds may have some taxonomical relationships with native breeds of China and Japan, for examples, Korean native horse with Mongolian horse, Korean goats with Taiwanese goats. Therefore, it will be very important to have co-operative studies with these countries in order to examine breed characteristics of Korean native livestock.

Even though there are some recordings in several literatures about the origin of native livestock in this country, there are some difficulties to explain the evolution process of current breeds. Recently, the migration path or evolution process of breed of livestock can be explained through molecular genetic survey and analysis. By analyzing all genetic resources in the estimated route possible for animal migration, the genetic distances between breeds or populations can be estimated and this information will be essential to understand the genetic resources of those, especially the indigenous breeds to Korea.

Adjacent countries have a great possibility for AnGR to migrate through, and it is quite frequent to have genetically common characteristics among those breeds. In order to evaluate native breeds accurately, and to confirm the genetic identity or similar characteristics, it will be important to use common method and standard on the genetic resources in existence among all adjacent countries.

5.1.2.2 Co-operative development of national genetic resources information system

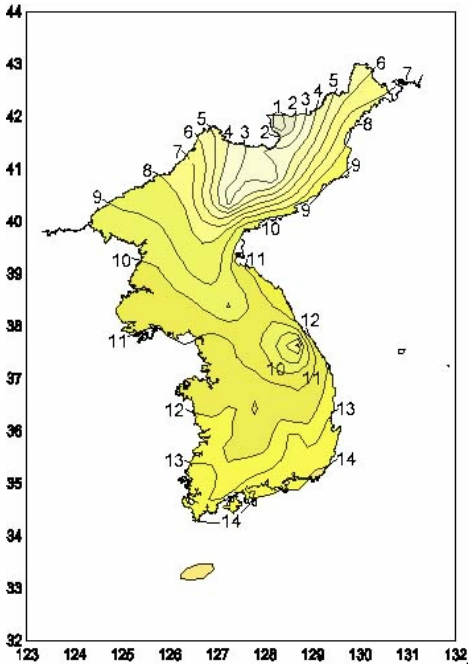
In order to exchange and even to have a joint ownership on the genetic resources information among countries, there must be a development for network with mutually realized interface systems, and therefore, it will be desirable to develop the genetic information system of each country in co-operation.

National genetic information system is necessary to manage genetic resources of each country, and to supply related information. With the construction of interface realized systems among countries it will be easy to exchange associated information of genetic resources. The importance of interface between genetic resources information system of adjacent countries can be also realized with the fact that co-operative researches among adjacent countries will eventually extend to the exchange of indigenous breeds between countries.

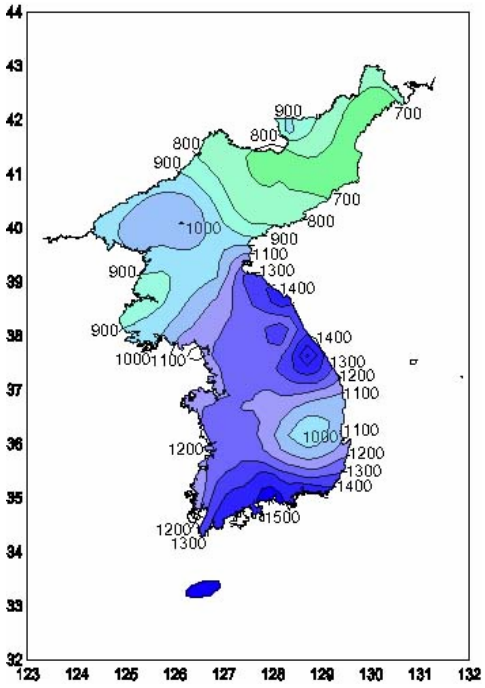
Furthermore, the easy access to genetic resource information system of other countries through network will promote the international co-operation on the preservation and management of AnGR of all countries.

Appendix 1. Maps of Korean Peninsular

1.1 Geographical location of Korean Peninsula



1.2 Annual average temperature of Korean Peninsula



1.3 Distribution of annual rainfall in Korean Peninsula

Appendix 2. Tables predefined by FAO

Chapter 1. Introducing the Country

Table 1.1 Importance of livestock to the gross domestic product in agriculture

Activity	$US(millions)	Data from Year
Livestock production (official statistics)	6,927	2002
Other agricultural production(official statistics)	20,344	
Best estimate of additional value of livestock*		

Comments:

* Best estimate of additional value includes the value of all perceived contributions of livestock to agricultural services, other than food production, e.g. value of fertilizer from animal production, draught, and transportation, forage production, etc., which usually are not costed in standard calculations.

Table 1.2 Land use and current trends (1000ha)

	Area(1000ha)	Area(1000ha)	Current trend**
categogy*	1990	1999	
Arable land	1,819	1,648	-
Permanent crops	200	197	0
Permanent pasture	90	54	--
Agricultural area	2,109	1,899	-
Land area	9,927	9,943	0
Total area		9,980	

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 limber.

  Permanent pastures: 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 river and lakes.

  Total area: the total are of the country, including area under inland water.

** **Current trend**: indicate current trends in relation to the latest available year (-- = strongly decreasing, - = decreasing, 0 = stable, + = increasing, ++ strongly increasing).

Table 1.3 Land use for livestock and current trends

	Area (1000ha)	Area (1000ha)	Current trends
Category	1990	1999	
Cropping for food	1,478	1,325	-
Cropping for feed	181	87	--
Cropping for food and feed	1,659	1,412	-
Natural pasture	-	-	
Improved pasture	90	54	--
Fallow	40	17	+
Forest	6,476	6,430	-
Non-agricultural		7,963	
Total			

Comments;

Natural pasture 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.

Current trends: 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

Category	Area (1000ha)	%
Private		
Government and communal		
Total		

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

Category	Number of farms/ households	%	Number of farms/households with livestock	%
Landless	19,314	1.4	19,122	25.2
> 0 to 2 ha	1,159,092	85.6	49,890	65.7
> 2 to 10 ha	172,522	12.8	6,836	9.0
> 10 to 50 ha	2,759	0.2	82	0.1
> 50 to 100 ha	-		-	
> 100 to 500 ha	-		-	
> 500ha	-		-	
Unknown	-		-	
Total	1,353,687	100	75,930	100

The Bureau of Statistics (2001)

Table 1.6 Livestock population, number of owners/house-holder and employment by species

	Livestock Population (1000)	**Number of owners/ householders**	**Number of persons additionally employed**	
Species			**Fully**	**Partially**
Cattle	1,953.8	224,033	1,283	920
Sheep	0.8	29	1	0
Goats	444.2	45.234	43	27
Horse	14.1	713	268	36
Donkeys	0.2	24	1	0
Pigs	8,974.4	17.437	3,266	652
Chicken	101,692.9	176.206	1,094	951
Turkey	24.4	1,153	0	0
Ducks	7,823.5	11,697	62	40
Geese	10.3	1,656	0	1
Rabbit	362.3	14,298	12	7
Deer	153.4	12,337	110	50
Quail	6,484.9	171	25	13

Livestock statistics (2002), Other livestock statistics (2003)

Table 1.7 Human population in the country

Year	Total (millions)	Rural or Farming (%)	Urban or Non Farming (%)	Total
1990	42.8	15.5	84.5	100
1999	46.6	9.0	91.0	100
Average annual growth rate(%)	0.94%	- 4.64%	1.95%	

Comments:

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

The Bureau of Statistics (2002); non farming population = total population – farming population

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

	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (t)	
Species	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Cattle	94.9	226.9	1,752	2,244					N/A	N/A
Sheep	0.0	0.0	N/A	N/A					N/A	N/A
Goats	2.0	3.07	N/A	N/A					N/A	N/A
Horse	N/A	N/A	N/A	N/A					N/A	N/A
Donkeys	N/A	N/A	N/A	N/A					N/A	N/A
Pigs	506.5	701.4							N/A	N/A
Chicken	171.7	238.0			393	462				
Turkey	0.1	0.1			N/A	N/A				
Ducks	N/A	31.4			N/A	2.1				
Geese	N/A	N/A			N/A	N/A				
Rabbit	2.5	1.5					N/A	N/A	N/A	N/A
Deer	N/A	N/A							N/A	N/A
Quail	N/A	N/A			N/A	N/A				

N/A : not available

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

	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (t)		Animals (no)	
Species	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Cattle	84.0	162.6	0.0	455.9					382	255	17	35
Sheep	22.3	6.2	N/A	N/A			40.5	23.7	19.5	14.5	N/A	N/A
Goats	0.3	0.0	N/A	N/A			0.6	0.4	N/A	2.2	N/A	N/A
Horse	0.0	N/A	N/A	N/A					N/A	N/A	1,100	424
Donkey	N/A	N/A	N/A	N/A					N/A	N/A	N/A	N/A
Pigs	2.6	142.3							4.4	6.3	857	1,692
Chicken	0.0	46.0			5.1	0.6					857000	865000
Turkey	3.3	9.2			N/A	N/A					N/A	N/A
Ducks	0.3	2.1			N/A	0.3					11000	N/A
Geese	0.0	0.0			N/A	N/A					N/A	N/A
Rabbit	0.8	0.0					1.1	0.7	2.2	0.0	13	4,567
Deer	0.0	0.0							N/A	N/A	N/A	N/A
Quail	N/A	N/A			N/A	N/A					N/A	N/A

N/A : not available

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

	Meat (t)		Milk (t)		Eggs (t)		Fiber (t)		Skin (t)		Animals (no)	
Species	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999	1990	1999
Cattle	0.0	0.0	N/A	4.7					5.8	0.4	1	300
Sheep	13.9	2.3	N/A	N/A			0.1	1.1	0.1	0.0	N/A	N/A
Goats	N/A	N/A	N/A	N/A			0.0	0.0	N/A	0.0	N/A	462
Horse	0.1	N/A	N/A	N/A					N/A	N/A	11	2
Donkey	N/A	N/A	N/A	N/A					N/A	N/A	N/A	N/A
Pigs	5.8	80.3							2.3	4.1	N/A	325
Chicken	0.0	0.7			0.0	0.0					N/A	189000
Turkey	0.0	0.1			N/A	N/A					N/A	N/A
Ducks	0.0	0.1			N/A	N/A					N/A	N/A
Geese	N/A	N/A			N/A	N/A					N/A	N/A
Rabbit	0.0	N/A					0.0	0.0	N/A	0.0	N/A	N/A
Deer	N/A	N/A							N/A	N/A	3	N/A
Quail	N/A	N/A			60.4	N/A					N/A	N/A

N/A : not available

TABLE 2.1 Distribution of livestock by production system (%)

	Production systems			
Species	**Low input**	**Medium input**	**High input**	**Total**
Cattle	0.7	0.9	98.4	100
Sheep	2.7	0.0	97.3	100
Goats	22.7	16.6	61.0	100
Horse	0.0	0.0	100.0	100
Donkey	1.7	39.9	58.4	100
Pigs	0.0	0.0	100.0	100
Chicken	0.4	0.1	99.5	100
Turkey	10.8	8.5	80.7	100
Ducks	1.2	0.4	98.4	100
Geese	42.3	22.1	35.6	100
Rabbit	7.4	5.2	87.4	100
Deer	2.1	7.3	90.6	100
Quail	0.0	0.0	100.0	100

Production system:

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, reproductive rate 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 Distribution of livestock by production system (%)

	Production systems			
Species	**Low input**	**Medium input**	**High input**	**Total**
Cattle	--	-	++	++
Sheep	--	0	+	--
Goats	--	-	+	+
Horse	--	--	+	+
Donkey	--	--	+	--
Pigs	--	--	++	++
Chicken	--	-	++	++
Turkey	--	--	++	+
Ducks	--	-	++	+
Geese	--	-	++	-
Rabbit	--	--	++	+
Deer	--	--	++	++
Quail	--	--	++	+

-- = strongly decreasing, - = decreasing, 0 = stable, + = increasing, ++ strongly increasing

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	0.0	0.0	0.0	0.0
Smallholder	2.8	2.6	92.9	98.2
Small-scale-commercial			1.7	1.7
Large-scale-commercial			0.1	0.1

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 (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	3.5	0.0	13.8	17.3
Smallholder	10.3	0.0	72.4	82.7
Small-scale-commercial				
Large-scale-commercial				

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	10.2	5.1	2.1	17.4
Smallholder	30.5	23.3	28.7	82.5
Small-scale-commercial	0.0	0.0	0.1	0.1
Large-scale-commercial				

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence			10.8	10.8
Smallholder			61.5	61.5
Small-scale-commercial			25.8	25.8
Large-scale-commercial			1.9	1.9

Definitions of production systems are given at the bottom of table 2.1

Table 2.7 Type of livestock farm by production system for donkeys (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	6.7	6. 7	33.3	46.7
Smallholder	6.7	13.3	33.3	53.3
Small-scale-commercial				
Large-scale-commercial				

Definitions of production systems are given at the bottom of table 2.1

Table 2.8 Type of livestock farm by production system for pigs (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	3.0	1.6	13.9	18.5
Smallholder	1.2	0.8	50.9	52.9
Small-scale-commercial			25.8	25.8
Large-scale-commercial			2.8	2.8

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	72.1	11.2	4.0	87.3
Smallholder	1.3	1.0	8.1	10.4
Small-scale-commercial			1.7	1.7
Large-scale-commercial			0.6	0.6

Definitions of production systems are given at the bottom of table 2.1

Table 2.10 Type of livestock farm by production system for turkey (%)

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	48.0	25.3	17.4	90.7
Smallholder	2.0	2.6	4.3	8.9
Small-scale-commercial			0.4	0.4
Large-scale-commercial				

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	61.7	15.1	5.8	82.6
Smallholder	5.8	2.8	6.1	14.7
Small-scale-commercial			2.5	2.5
Large-scale-commercial			0.2	0.2

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	77.2	14.0	4.9	96.1
Smallholder	1.3	1.6	0.9	3.8
Small-scale-commercial			0.1	0.1
Large-scale-commercial				

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	43.7	23.2	0.0	66.9
Smallholder	2.5	3.1	27.4	33.0
Small-scale-commercial			0.1	0.1
Large-scale-commercial			0.0	0.0

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence	4.5	1.3	0.3	6.1
Smallholder	8.6	22.0	59.7	90.3
Small-scale-commercial			3.5	3.5
Large-scale-commercial			0.1	0.1

Definitions of production systems are given at the bottom of table 2.1

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

Type of operation	Production systems			Total
	Low input	Medium input	High input	
Subsistence			3.2	3.2
Smallholder			28.0	28.0
Small-scale-commercial			66.4	66.4
Large-scale-commercial			2.4	2.4

Definitions of production systems are given at the bottom of table 2.1

Chapter 3. The State of Genetic Diversity

Table 3.1 Breed Diversity (Number of Breeds)

Species	Number of breeds									
	Current Total		At risk		Widely used		Others		Lost (last 50 yr)	
	L	E	L	E	L	E	L	E	L	E
Cattle	5	3	3		2			3		
Sheep	2	0	2							
Goats	2	4	1		1			4		
Horse	1	8			1	1		7		
Donkeys	1									
Pigs	4	3	1		3			3	1	6
Chicken	7	1			4		3	1		2
Turkey		2						2		
Ducks	3	1			3			1		
Geese	1	3	1					3		
Rabbit	8		4		1		3			
Deer	1	4			1	2		2		
Quail	1				1					1

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 its 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	5	5	5		5	5	2
Sheep	1				1		
Goats	2	2	2		1	2	1
Horse	3	2	2		2	2	2
Donkeys							
Pigs	6	6	6		7	6	4
Chicken	7	5	5		5	5	4
Turkey							
Ducks	3	3	3		3	3	1
Geese							
Rabbit							
Deer	3	3	3		3	3	3
Quail							

Comments:

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

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

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

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertilizer manure	Draught	Culture	Recreation	Fuel	Feather	Environmental management	Total
Cattle	25.0	74.2			0.2		0.0	0.5	0.1	0.0			0.0	100
Sheep		30.0		70.0									0.0	100
Goats	0.1	84.8			0.1				15.0				0.0	100
Horse		0.1						2.0	3.0	94.9			0.0	100
Donkey								99.5	0.5					100
Pigs		99.9			0.0		0.0		0.1					100
Chicken		74.5	25.0				0.3		0.2	0.0			0.0	100
Turkey		90.0	10.0											100
Ducks		70.0	24.0						1.0			4.8	0.2	100
Geese		95.0	5.0											100
Rabbit		90.0		2.0	7.5				0.5					100
Deer		30.0							70.0				0.0	100
Quail		30.0	70.0											100

Comments:

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

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

Species	Milk	Meat	Eggs	Fiber	Skin	Risk management	Fertilizer manure	Draught	Culture	Recreation	Fuel	Feather	Environmental management
Cattle	99.9	25.0			79.5		10.0	95.0	2.0	5.0			10.0
Sheep		0.2		90.0									1.0
Goats	0.1	5.0			0.5				20.0				10.0
Horse		0.0						4.8	3.9	99.0			4.0
Donkey								0.2	0.1				
Pigs		40.0			15.0		5.0		8.0				
Chicken		23.4	97.0				85.0		10.0	0.5			10.0
Turkey		0.1	0.0										
Ducks		5.0	2.9						6.0			100	50.0
Geese		0.0	0.0										
Rabbit		1.0		10.0	5.0				5.0				
Deer		0.2							45.0				15.0
Quail		0.1	0.1										
Total	100	100	100	100	100	100	100	100	100	100	100	100	100

Comments:

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

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

Species	Total number of breeds	Breeding strategies		
		Purebred selection	Cross-breeding	Both
Cattle	8	2		
Sheep	2			
Goats	5			
Horse	9	1		
Donkey	1			
Pigs	7	4		
Chicken	8			
Turkey	2			
Ducks	6			
Geese	4			
Rabbit	8			
Deer	5			
Quail	1			

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

		Breeding strategies		Tools				
Species	Breeding goals	Designed	Desined and implemented	Individual identification	Recording	AI	ET	Genetic evaluation
Cattle	2	2	2	2	2	2	2	2
Sheep								
Goats								
Horse				1	1			
Donkey								
Pigs	3	3	3	3	3	3		3
Chicken								
Turkey								
Ducks								
Geese								
Rabbit								
Deer								
Quail								

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

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 Optimization tools for breeding plans		
Electronic database related to recording schemes		
Genetic evaluation Software for: Phenotypic selection breeding values Reproductive technologies (AI,ET,etc)		
Microsatellite linkage maps for QTL identification for Marker Assisted		
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	4	5	5	4	4
State Government	1	1	1	2	1
Local Government	1	1	1	1	1
Breeder's	3	2	4	3	2
Private companies	2	2	3	3	2
Research	5	3	3	2	5
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 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	5	5	5	3	3
State Government	2	2	3	2	2
Local Government	1	1	1	1	1
Breeder's	3	3	4	5	4
Private companies	2	2	2	2	2
Research	4	4	3	4	2
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	2	3	3
State Government	3	3	3
Local Government	4	3	3
Breeder's	1	3	4
Private companies	2	3	5
Research	3	3	3
NGO's	2	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 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	4	2	2	3
Genetic evaluation	5	3	4	4
AI/ ET	3	4	5	2
Molecular techniques	4	4	5	2
Breed organization techniques	5	4	3	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 the development of AnGR.

Chapter 5. The State of Conservation of AnGR

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	3			3
Sheep	2	2		
Goats	1	1		
Horse				
Donkey				
Pigs	1			1
Chicken				
Turkey				
Ducks				
Geese	1	1		
Rabbit	4	4		
Deer				
Quail				

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

	Incentives			Tools				
Species	**Gov.**	**NGO**	**Market**	**Semen storage**	**Embryos storage**	**DNA/Tissue storage**	**In vivo**	**Monitoring system**
Cattle				5	2	8		
Sheep								
Goats						2		
Horse								
Donkey								
Pigs				1		4		
Chicken						5		
Turkey								
Ducks						1		
Geese								
Rabbit								
Deer						3		
Quail								

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

	Incentives				Technical tools			
Species	**Gov.**	**NGO**	**Market**	**Private**	**Recording**	**AI**	**ET**	**Others**
Cattle					2	2	2	
Sheep								
Goats								
Horse								
Donkey								
Pigs					1			
Chicken					1			
Turkey								
Ducks								
Geese								
Rabbit								
Deer								
Quail								

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	+	+
Breeder's associations	+	+
Private companies	+	
Research institutions/universities	+	+
NGO's	+	

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

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

Technology	**Needs**			
	Knowledge	**Training**	**Financial resources**	**Breeder's organization**
Recording	3	2	3	2
Genetic evaluation	4	4	3	5
AI/ ET	2	3	3	2
Molecular techniques	4	5	4	4
Breed organization techniques	3	3	2	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

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

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

	Urban/peri-urban system		Rural production	
Species	**Industrial systems**	**Small-holder systems**	**Industrial systems**	**Small-holder systems**
Cattle	5	4	5	4
Sheep	1	1	1	1
Goats	4	3	4	3
Horse	3	3	3	3
Donkey	1	1	1	1
Pigs	5	4	5	4
Chicken	5	4	5	4
Turkey	1	1	1	1
Ducks	3	2	3	2
Geese	1	1	1	1
Rabbit	2	1	2	1
Deer	3	2	3	2
Quail	1	1	1	1

Assign scores (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	3	5	4	4
Sheep	1	1	1	1
Goats	1	3	2	2
Horse	2	3	2	2
Donkey	1	1	1	1
Pigs	4	2	4	4
Chicken	4	3	3	3
Turkey	1	1	1	1
Ducks	2	1	2	2
Geese	1	1	1	1
Rabbit	1	1	2	1
Deer	3	1	3	2
Quail	1	1	1	1

Assign scores (1 = none, 2= little, 3 = regular, 4 = more, 5 = high) to indicate the extent that current policies support the use and development of AnGR

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

	Required		
Needs	**Immediately**	**Medium term**	**Long term**
Establishment of AnGR center	O		
Construction of resource monitoring system	O		
Establishment of rare breed conservation company		O	
Establishment of rare breed registration system		O	
Establishment of reproductive cell freezing technique for preservation			O

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	4	4	5	5
Sheep	3	3	3	3	3
Goats	5	5	5	5	5
Horse	4	4	4	4	4
Donkey	2	3	2	2	2
Pigs	5	5	5	5	5
Chicken	5	4	5	5	5
Turkey	2	2	2	2	2
Ducks	4	5	4	5	4
Geese	2	2	2	2	2
Rabbit	4	5	3	4	4
Deer	5	5	4	5	5
Quail	2	2	2	2	2

Assign scores (1 = none, 2= little, 3 = regular, 4 = more, 5 = high) to indicate the extent that current policies support the use and development of AnGR

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	3	4	3	4	4
Sheep	2	3	3	3	2
Goats	4	5	5	5	4
Horse	3	3	3	3	3
Donkey	2	2	2	2	2
Pigs	4	4	3	4	4
Chicken	4	4	3	4	4
Turkey	2	2	2	2	2
Ducks	4	4	4	5	4
Geese	2	2	2	2	2
Rabbit	3	3	3	4	4
Deer	4	5	5	5	4
Quail	2	2	2	2	2

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

Appendix 3. Personnel participated to the preparation of Report

3.1 Animal Genetic Resources Management Advisory Committee

Affiliation	Position	Name	Remark
National Livestock Research Institute	Director General	Kim, Kyung Nam	Chairperson
Jeju Agricultural Experiment Station		Kang, Sang Hyun	Vice chairperson
Ministry of Agriculture and Forestry	Livestock Policy Division	Choi, Hyung Kyu	
Rural Administration Bureau	Director of Genetic Resources Division	Kim, Chang Young	
Agriculture Cooperative	executive director	Kim, Byung Yook	
Korean Animal Improvement Association	Secretary general	Lee, Moon Yun	
Special Livestock	Publisher	Lee, Hee Hoon	
Korea Animal Resource Science Association	President	Kho, Young Doo	
Animal Breeding and Genetic Research Association	President	Baek, Dong Hoon	
Korean Livestock Reproductive Association	Director	Lee, Kyung Kwang	
Korean Embryo Transfer Academy Society	President	Choi, Sang Yong	
Choong-Book University	Professor	Kim, Nae Soo	
Kun-Kuk University	Professor	Chun, Byung Tae	
Seoul National University	Professor	Lee, Hang	
JeJu University	Professor	Kang, Min Soo	
Choong-Nam University	Professor	Park, Chang Sik	
National Livestock Research Institute	Director of Genetic Resources Division	Yoo, Choong Hyun	Secretary General

3.2 Task Force Team

Affiliation	Position/classification	Name	Remark
NLRI	Livestock Improvement – Assistant Director General	Kim, Nam Chul	Team leader
NLRI	Director of Genetic Resource Division	Yoo, Choong Hyun	
NLRI	Senior Researcher	Na, Seung Whan	
NLRI	Senior Researcher	Moon, Hong Kil	
NLRI	Senior Researcher	Seo, Ok Suk	
NLRI	Senior Researcher	Kim, Dong Hoon	
RAB	Senior Researcher	Sung Whan Hoo	
NLRI	Researcher	Kim, Sang Woo	
NLRI	Researcher	Choi, Soon Ho	
NLRI	Researcher	Yun, Sung Heum	

NLRI : National Livestock Research Institute
RAB : Rural Administration Bureau

3.3 Working Committee

Affiliation	Position/classification	Name	Remark
NLRI	Senior Researcher	Na, Seung Whan	Squad leader
NLRI	Senior Researcher	Moon, Hong Kil	
NLRI	Researcher	Kim, Si-Dong	
NLRI	Researcher	Lee, Hyun Joon	
NLRI	Researcher	Kim, Jong Dae	
NLRI	Researcher	Yun, Sung Heum	

NLRI : National Livestock Research Institute

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The Republic of Korea