Regional Workshop on Underutilized Animal Genetic Resources and their Amelioration – East Asia

1. Introduction

Livestock and poultry breeds are an important part of the biological genetic resources. They are renewable or changeable, and are influenced by the natural ecological environments and by social development. Having been subjected for long historical periods to varied environments, the survivors of the original local animal and poultry breeds have acquired many excellent characteristics. They are not only well adapted to their own local environments, enduring to extensive management and resistant to diseases, but also have acquired the properties of early maturity, high meat and hair production, high milk production, good reproductive performance and meat quality, all of which are of great economic importance. Doubtless, these genetic resources are of great significance both to mankind and nature.

East Asia is at the forefront of global trends of increasing livestock demand and production (1). A global "revolution" in demand for animal-based products has been predicted (2). As wealth increases, especially in less developed countries, the annual consumption of animal products is predicted to rise in 2020 to 303 million metric tons (mmt) of meat and 654 mmt of milk. This is an increase from levels of 168 and 391 in 1993, respectively. In East Asia, the livestock sector is experiencing consistent growth. The annual growth of meat consumption is 3 percent for China and 2.4 for other East Asia countries. Growth levels for milk are predicted to be 2.8 and 1.7 percent, respectively. This growth in consumption creates great opportunity for livestock sector development in the countries of the East Asia.

China is one of the countries that have the richest animal and poultry breed resources as a gene pool in the world. The genetic diversification of domestic animal species in China, especially the excellent germplasm characters of native breeds, was left over by our ancestors under several thousand years' diversification in natural and ecological environment. These native breeds were playing an important role in history, for example, Chinese native pig breeds were introduced to Rome as early as two thousand years ago, Chinese Langshan Chicken were introduced to the United Kingdom in 1970s. More than 30 Chinese superior domestic animal and poultry breeds such as Beijing Duck, Meishan Pig, Guanzhong Donkey, and Qinchuan Cattle have been exported to some countries in Asia, Europe, America and Oceania. These native breeds exert a profound influence on the development of the genetic diversification of domestic animal and poultry breeds and animal husbandry industry throughout the world. They are essential raw materials in developing new types and new breeds and will be contributing to the sustainable development of animal production in the future.

Japan is located between longitudes 123˚ and 149˚ east and latitudes 24˚ and 46˚ north. Situated in East Asia, the country is made up of a group of islands surrounded by the Pacific Ocean to the east and the Japan Sea to the west, extending far longer in the south-north direction than in the east-west direction. It has a natural land area of 378,000 km2. The climate differs greatly between the southern and northern regions; some regions belong to the subarctic zone while others are subtropical. Rice cropping is mainstream in Japanese agriculture though the form of cultivation varies from region to region.

Livestock and poultry sanctioned by the Taiwan government include pig, dairy cow, sheep, horse, rabbit, chicken, duck, goose and turkey (3). Other major poultry raised by local farmers include quail and ostrich yet to receive government sanction. Due to high land prices and rising environmental awareness, most local farmers operate on a small scale in rural areas of Central and Southern Taiwan. Coupled with import-dependent feeds and expensive laborers, the local livestock industry operates at a rather high production cost. Fortunately, local livestock farmers are highly diligent, and have advanced feeding and breeding skills. As a result, domestic livestock products such as pork not only meet domestic demand but also supply foreign markets. Since the outbreak of the Food-and-Mouth Disease (FMD), however, government policy priorities have been shifted to the domestic market, reducing livestock export to a role of balancing production surpluses. Despite the challenges, livestock farmers and the government have been working closely throughout the years to readjust the structure of the industry and to modernize its production and marketing. Such efforts have seen fruitful results, particularly over the past three years. Therefore, it is expected that the overall livestock industry in Taiwan will maintain its edge in the face of global competition.

Given the high population density in Korea, the destruction of habitats caused by development and industrialization is the primary threat resulting in biodiversity loss (4). The need for sustainable development for shelter and social advancement is extremely crucial. Although various environment conservation programs have been carried out nationally, there still prevail the conflicts between conservationists and those in favor of continuing economic development. Strengthening environment policies such as environmental impact assessment and discharge system for pollutants in order to minimize the effects on natural habitats, and promoting the integrated national plans for the restoration of ecosystems will be essential. Agriculture and fishery, which have extremely high level of dependence on the ecosystem, require special measures to protect biological diversity. Environmental changes due to the loss of species and reduction of genetic diversity can bring catastrophic results. Due to degradation of traditional agriculture, the destruction of habitats and excessive inshore and coastal

fishing, biodiversity essential for human livelihood has been threatened. The food security and sustainable use of biological resources must be executed through safe use of biodiversity, and excessive harvesting and over-fishing practice must be refrained.

2. Importance of livestock in economy and food security of the sub-region

An analysis of livestock production shows dramatic increases throughout the region over the past 15-20 years. Demand for and production of livestock products in East Asia has been increasing significantly over the past 20 years and this trend will continue. This growth is in almost all types of livestock, although variation is significant. Sheep and beef have not been an overall large source of growth, while pigs, eggs, poultry and milk (dairy sector) have all been significant sources of growth. Trade has not been a significant source of overall growth for the livestock sector, with most products produced domestically being consumed domestically and relatively small overall imports. Predictions of livestock product consumption indicate that domestic demand can largely absorb any further production increases.

We must pay serious attention to the fact that local livestock breeds and varieties are now being improved through cross-breeding and substituted by some “specialized” high yielding breeds. Livestock and poultry breed resources are diminishing drastically at present in the developed countries, causing the reduction or even exhaustion of genetic resources and placing an alarming situation before mankind. We must take emergency measures in a planned way to protect the indigenous livestock and poultry breeds, especially those resources of great significance. Ill-considered methods of protection or preservation and improper utilization could cause the exhaustion or complete extinction of these resources and irretrievable loss (5).

Taiwan

Under the influence of maritime climate, the subtropical island of Taiwan features high temperatures and humidities. Despite adverse environmental factors, domestic animals including livestock and poultry grow well. As a result of continuous economic development and improved living standards in recent years, the demand for animal protein in the daily diet of local citizens has increased sharply, making animal husbandry one of the most prominent industries in local farming villages (7).

a. Production and consumption

With Taiwan's entering the World Trade Organization (WTO), livestock products are bound to suffer tremendous pressure under global competition. Major challenges for production and consumption facing include:

(1) As certain parts of meats in Taiwan have long enjoyed a price advantage over

imports, it will take time for us to adjust to new market parameters for domestic livestock products. For example, the imported drumsticks, chicken wings and pork bellies, which cost little in the U.S., could be sold at a much higher price here, while the chest meat and other pork cuts are on the reverse. The opening up of the domestic market to foreign imports therefore will prompt the prices of the whole hogs and chickens to drop and result in serious losses to the local farmers.

(2) Taiwan's livestock farms remain largely small in scale and large in number; therefore, to compete with multi-national enterprises, further consolidation is required.

(3) Because Taiwan is surrounded by oceans and has long coastal lines, smuggling is difficult to curb, which poses a risk of the invasion of exotic diseases. Local farmers hence have no complete control over the safety of the animals they raise.

(4) The limited availability of pastoral land has resulted in heavily concentrated livestock farming in Taiwan. The vast amount of solid waste thus generated poses yet another difficulty for farm operators.

(5) With consumers' product safety awareness on the rise, effective elimination of residual hazardous substances in food has become a pressing need.

(6) Given the growing awareness of animal welfare, highly concentrated animal breeding will no longer be acceptable. However, renovation of animal houses involves new investment and will increase the production cost.

China

According to "Animal Genetic Resources in China and Asia" (6) by Changxin Wu in 1996, the livestock and poultry genetic resources in China mainly include the following 12 species pig, yellow cattle, yak, water buffalo, sheep, goat, horse, donkey, chicken, duck, goose, special fowl, totaling 282 breeds (Table 1, the figure comes from "Animal and Poultry Breeds in China" in 1986, not including other breeds from provinces of the country), of which, there are 194 native breeds (accounting for 68.8%), 45 developed breeds (accounting for 16.0%) and 43 introduced exotic breeds (accounting for 15.2%).

Table 1. Status of China’s animal and poultry genetic resources

	Original native breeds	Developed breeds	Introduced exotic breeds	Total
Pig	48	12	6	66
Yellow cattle	28	4	7	39
Yak	5	0	0	5
Water buffalo	1	0	0	1
Sheep	15	7	8	30

Goat	20	2	1	23
Horse	15	11	7	33
Donkey	10	0	0	10
Chicken	27	9	11	47
Duck	12	0	2	14
Goose	13	0	0	13
Special fowl	0	0	1	1
Total	194	45	43	282
% in the total	68.8	16.0	15.2	100.0

According to "Animal Genetic Resources in China and Asia"

China has a large livestock population, with pigs and poultrys being the most common. China's pig population and pork production mainly lie along the Yangtze River. In 2011, Sichuan province had 51 million pigs (11% of China's total supply). In rural western China, sheep, goats, and camels are raised by nomadic herders. In Tibet, yaks are raised as a source of food, fuel, and shelter (Number of Livestock.stats.gov.cn). Cattle, water buffalo, horses, mules, and donkeys are also raised in China, and dairy has recently been encouraged by the government, even though approximately 92.3% of the adult population is affected by some level of lactose intolerance.

Increased incomes and increased demand for meat, especially pork, has resulted in demand for improved breeds of livestock, breeding stock imported particularly from the United States. Some of these breeds are adapted to factory farming. In China, with the development of a commodity economy in animal husbandry, the challenge faced by the local breeds has been increased. Large numbers of foreign breeds introduced from abroad for cross-breeding and improvement have caused a reduction in the number of breeds or species, making some of the breeds become endangered livestock.

Japan

Agricultural production in Japan is valued at 9.12 trillion yen, 72.3% of which is accounted for by field husbandry (8). That is to say, 26.9% (2.45 trillion yen) of the value of total production is generated by livestock farming, which exceeds the figure for rice production (25.5%). The population of Japan is 127 million, with 47.06 million dwellings. Of these, the farming population totals 13.46 million people with 3.12 million dwellings, while households involved in livestock farming account for 160,000 dwellings. Agricultural households account for 10.6% of the population and 6.6% of all dwellings, while households involved in livestock farming account for 5% of these figures, which is equivalent to 0.7% of the total national figure. The self-sufficiency rate of animal products:

- Beef cattle: The percentage of Japanese Black in beef cattle breeds is increased after the import liberalization of beef started in 1991. As a result, the proportion of Japanese Black among beef breeds, which accounted for approximately 85% from around 1970 to1991, rose to 93% in 1999, resulting in the sharp decrease in other breeds. In 2000, beef production amounted to 3.64 million tons and of which derived from breeds reared specifically for beef accounted for 1.67 million tons, with national self-sufficiency for beef being 33.5%.
- Dairy cattle breeds: Domestic milk production amounted to 8.41 million tons in 2000, with the imported volume in the form of dairy products amounting to 4.00 million tons on a fresh milk basis, 70% of which is cheese.
- Pig: Consumption of pork produced in Japan is currently 8.78 million tons and consumption of the imported pork amounts to 6.51 million tons, with a 57.4% rate of self-sufficiency.
- Chicken: Domestic production and self-sufficiency rate of chicken and egg in 2000 were 1,195,000 ton (67.6%) and 2,540,000 ton (95.5%), respectively.

Livestock raising is a minor activity. Demand for beef rose in the 1900s, and farmers often shifted from dairy farming to production of high-quality (and high-cost) beef, such as Kobe beef. Throughout the 1980s, domestic beef production met over 2% of demand. In 1991, as a result of heavy pressure from the United States, Japan ended import quotas on potatoes as well as citrus fruit. Milk cows are numerous in Hokkaido, where 25% of farmers run dairies, but milk cows are also raised in Iwate, in Tōhoku, and near Tokyo and Kobe. Beef cattle are mostly concentrated in western Honshu, and on Kyushu. Hogs, the oldest domesticated animals raised for food, are found everywhere. Pork is the most popular meat. Most of the imported beef comes from Australia, since beef from the USA and Canada was banned after the first cases of BSE in those countries. Those bans were lifted in 2006. In Japan, according to the information given by the preservation committee, only 2 breeds of cattle, 6 breeds of horse, 4 breeds of sheep and 17 breeds of chicken are on the endangered list (9).

Korea

In Korea, like other countries, ecosystem service has decreased due to the overuse of natural resources. The national efforts to evaluate and integrate the value of ecosystem service have been lacking, which generates the need to foster the industries related to ecosystem with high priority; supporting to make right decisions on investments based on evaluation of the right value of ecosystem service, improving the function of the environment regulating services in the urban areas of high population, and executing ecotourism by making good use of cultural service.

3. Status of AnGR

Taiwan

Livestock and poultry in Taiwan include pigs, cattle, water buffalo, goats, horses, rabbits, chickens, ducks, geese, and turkeys. Other major poultry raised by local farmers include quails and ostriches. Due to high land prices and rising environmental awareness, most local farmers operate on a small scale in rural areas of central and southern Taiwan. Coupled with import-dependent feeds and expensive labor, the local livestock industry operates with rather high production costs. Fortunately, local livestock farmers are highly diligent, and have advanced feeding and breeding skills.

China

China has a long history of livestock and poultry with rich gene resources. According to archaeological studies, the Chinese people had started animal domestication as early as the neolithic age or, say, ten thousand years ago. As a major source of livelihood, animal-raising was well developed about seven or eight thousand years ago. Since the livestock and poultry were raised under complex ecological conditions, and affected by different social economic situations for a rather long period of time, they had been artificially selected and raised for different purposes, so that different livestock and poultry breeds evolved with their own characteristics. Furthermore, some Chinese livestock and poultry breeds have had great influence on the evolution and development of some livestock and poultry breeds in foreign countries. Much attention has been paid to develop animal husbandry and the utilization of livestock and poultry resources. There are more than 300 domestic livestock and poultry breeds and groups of varieties, including 29 horse breeds, 20 ass breeds, 42 cattle breeds, 18 buffalo breeds, 5 yak breeds, 4 camel breeds, 35 sheep breeds, 37 goat breeds, 64 pig breeds, 72 chicken breeds, 30 duck breeds and 21 goose breeds (10).

The genetic resources of China's domestic animals have certain changes in 20 years. The population of 41.9% of native breeds has decreased by different extent. In1993, The Ministry of Agriculture (MOA) had confirmed 10 extinction breeds. In 1999, MOA had confirmed 7 extinction breeds, 11 critical breeds and 40 endangered breeds. There are many factors that are responsible for the population decline of domestic animal genetic resource. For example, the production performance of some native breeds could not meet the demand of current market as well as an inadequate recognition of the special characters of some native resources, therefore, the people introduced foreign exotic breeds to simply substitute or blind cross with native breeds for improvement. As such, it caused the quantity and homogeneity of the population decline of some native breeds or even caused crisis in some native breeds. Once a breed disappears, the

loss would be invaluable. Therefore, it is essential to adopt powerful conservation measures for preservation of them, otherwise, a relatively big risk exists in the conservation of Chinese native animal and poultry breeds.

The domestic animal and poultry breeds of China have varied good performance characteristics such as meat output, milking, wool and cashmere production, egg production, draft, high reproduction, small body size, medicinal purpose and ornamental purpose, etc. Many breeds are well known in the world for producing traditional style products.

We shall describe the characters of China's native domestic animal resources as follows:

- Pig: Most of the Chinese pig breeds are dual-purpose pigs. They are classified into large-, medium- and small-types. Jinhua Pig has the characters of thin skin, fine bone and tender pork. It is the raw material for making Jinhua hams. Gilts can be mated at the age of 3 months (body weight of 20 kg) with a litter size of 14.25 piglets for sows. Wuzhishan Pig has small body weight and good resistance, with a body weight of 35 kg for adult pig, lean meat percentage of 47.3%, litter size of 6-8. It can be used as laboratory material for life science, nutrition science, birth control and comparative medicine. Tibetan Pig is suitable to be used for all-year-round grazing and has the characters of small in body size, thin skin and high lean meat percentage with an average body weight of 40 kg for adult pigs. Rongchang Pig has the characters of good quality strong white coarse and long bristles with a length of 11-15 cm and a maximum length of 20 cm. The output of bristle is 250-300 grams per pig. Taihu Pig has the characters of big litter size and quality pork, with a litter size of 14.9 piglets for sows. The pre-slaughter weight is 61.5 kg with a dressing percentage of 66.7%, lean meat percentage of 43.9%. It has good reputations for its high fecundity in the world.
- Yellow Cattle: Famous excellent native breeds include Qinchuan Cattle, Luxi Cattle, Nanyang cattle, Jinnan Cattle and Yanbian Cattle. Nanyang Cattle and Yanbian Cattle are located in hilly regions, and the other three breeds are distributed in plains. These native cattle breeds are high in confirmation and very strong with good draft capacity, fine meat performance. They are the basis for developing and cultivating China's beef cattle.
- Water Buffalo: China has a population of more than 20 million buffaloes. All of them belong to Swamp type, but they are divided into four categories. Some of them are produced in Jiangsu, Zhejiang and coastal regions, and are called Haizi water buffalo. Some of them are beach-lake buffaloes produced in Boyang Lake, Dongting Lake and Honghu Lake regions, with strong constitution, suitable for working in paddy field in South China. Wenzhou Buffalo has good milking

performance and high butter fat percentage.

- Yak: Yaks are produced in the high frigid region above the altitude over 3000 m in the Qinghai-Tibetan Plateau and has the characters of dual-purpose of milk and meat, pack transportation and producing hairs. It is very essential animal for herdsmen in Qinghai-Tibetan Plateau frigid pastoral region. It is not only a production means but also living means. The white yak, produced in Tianzhu Prefecture, Gansu Province, is a rare yak breed. According to statistics of 2001, China has a total population of more than 14 million yaks, accounting for 95% of the world yak population.
- Sheep: China have sheep breeds of wool purpose (carpet wool), meat purpose (coarse wool and fat tail), fur purpose and lamb skin purpose. Of which, the Tibetan Sheep produced in Qinghai-Tibetan Plateau and the Hetian Sheep from Xinjiang have the characters of long wool and good elasticity and belong to sheep breeds of quality carpet wool. Aletai Sheep from Xinjiang has well-developed fat rump and the Tan Sheep from Ningxia produces white fur coat after first shear, which is famous worldwide. In addition, the Black Fur Sheep from Qinghai and Gansu, Hu Sheep from Jiangsu and Zhejiang are famous breeds producing lambskin. Hu Sheep and Small-Tail Han Sheep have the characters of early maturity, multiple lambs and high fertility.
- Goat: The famous goat breeds include Zhongwei Goat, Liaoning Cashmere Goat, Jining Black Goat, Inner Mongolia Cashmere Goat, Chengdu Ma Sheep. Zhongwei Goat produces white fur coat after first shear with beautiful curl and evenly arranged wool Liaoning Cashmere Goat has the characters of high cashmere output with long cashmere. Qingshan Goat from Jining has a hair coat of black and white mixture with a color of black, pink black or iron black, with quality black fine long wool and a productivity rate of 270% per lambing and two lambings per year. Chengdu Ma Goat has a milk production of more than 150 kg per lactation, with milk fat of 6.47%, dense wool, durable and can be divided in layer for use. The lambing percentage is 210% with two lambings per year.
- Horse: Chinese horses belong to dual-purpose type. Mongolian Horse is high in speed during short distance. Kazak Horse has good milking performance. Wuzhumuqin Horse is a dual-purpose of riding and drafting, adapted to hard conditions among the Mongolian Horses. It is good in walking with strong forces and working sustainable. Hequ Horse is suitable for working as a shaft horse. Its draught force is equivalent to 80%of the body weight and sustainable. Yushu Horse is adapted to plateau climate, and can walk freely in swamp, steep slopes, and narrow winding trail In Yunnan, Guizhou and Sichuan provinces as well as Baise Prefecture, Guangxi Zhuang Autonomous Region, most of the adult horses has a

height of about 1 meter, and is called short horse. These horses have been used in developing urban tourism.

- Donkey: The famous donkey breeds include Guanzhong Donkey, Dezhou Donkey and Jiami Donkey. Guanzhong Donkey can be used as draft, ride and pack purpose. Male donkey has a draught force of 93.8% of the body weight while female donkey can be used in pack and riding in mountainous road.
- Poultry: Most of the poultry breeds belong to dual-purpose breeds. Of which, some breeds, such as Beijing You Chicken and Huiyang Chicken, have the characters of thin skin, fine bones, tender meat and good flavor, and can be used as broiler breeds. Beijing Duck is a large-size meat purpose duck famous in the world and can be used as the raw material for making "Beijing Roast Duck." Gaoyou Duck can be used to make pressed salted duck, and is famous for its double yolk egg. China has many excellent native breeds of egg layers, Xianju Chicken has an annual egg output of 200 with egg weight of 50 grams; Shao Duck has an annual egg output of 280-300 with egg weight of 60-65 grams; and Huo Goose has an annual egg output of 100-120 with an egg weight of 128 grams. In addition, they also have Taihe Silk Fowl, which is a precious breed using as medicine. The Chinese Fighting Fowl is used as ornamentals.

In the aspect of animal and poultry breed character identification, in addition to conventional distribution, population, confirmation and production performance investigations, China has unfolded germplasm study of major native poultry breeds. The study has systematically measured the physiological and biochemical targets: meat quality, fat composition and carcass composition and studies on some other flavor related materials. In recent 10 years, related research institutions have conducted molecular level research on major animal and poultry genetic resources in China, and found some genetic labeling of major economic characters. For example, the genetic labeling includes the high fertility of Taihu Pig, quality flavor of native chicken breeds, and high fertility of Small-tailed Han Sheep and microsatellite DNA genetic diversity on different breed of animal species. This has provided scientific basis for the conservation, development and utilization of genetic resources.

Japan

Japan has relatively rich and varied livestock and poultry resources among countries of East Asia. Breeds covered in livestock-related statistics and other native species and populations include: 9 beef cattle breeds, 7 dairy cow breeds; 12 pig breeds (including wild boars and counting Kagoshima Black Pig and Berkshire separately), 12 horse breeds and populations; 3 goats breeds and populations; 2 sheep breeds; one breed of rabbit, and 6 other mammal species. There are 38 chicken breeds and 6 other bird

species, of which quail is the only animal species that has been domesticated in Japan. The exotic breeds and crossbreds play an important role in animal production. Lots of species and breeds of livestock and poultry have been introduced into Japan, but breeds other than major breeds of cattle, pigs and chickens have decreased in number and have not played an important role in animal production.

- Cattle: Since the Meiji era, exotic cattle breeds have been introduced and crossbreeding between Japanese cattle and exotic breeds have been promoted in most regions nationwide. As a result, there are only two cattle populations that escaped hybridization with exotic breeds, Mishima Cattle, which have survived in Mishima Island off the coast of Hagi city inYamaguchi Prefecture and Kuchinoshima Cattle living on Kuchinoshima of the Tokara Islands in Kagoshima Prefecture. Cattle other than the above-mentioned populations were categorized into 4 breeds depending on the types of exotic cattle introduced into the region; Japanese Black, Japanese Brown, Japanese Shorthorn, and Japanese Polled were developed through crossbreeding.
- Pigs: Before Japanese people began to eat pigs nationwide, a native pig called Shima-buta or Aguh existed in Kagoshima and Okinawa. At present Black Pig (it is thought to be of Berkshire origin) has gained popularity as a special brand product in Kagoshima Prefecture. In the case of Aguh, almost all of native Aguh disappeared due to ground fighting in Okinawa at the end of the World War II and the donation and introduction of exotic breeds having high productivity after the war. Given these circumstances, the collection and conservation of a few barely surviving individuals having a shape similar to the native Aguh was carried out. As a result, the population increased to 100, and the F1 is now being marketed as a brand pig. Ohmini is being preserved by private businesses and the F1 of Ohmini is being marketed as a laboratory animal.
- Chickens: The cutting off of Japan from outside contact in the Edo era (from 17th to the mid-19th century) had a significant impact on the establishment of the Japanese Chicken as birds either for pets or cockfighting. The Japanese Chicken as a chicken for practical use came about under the influence of exotic breeds introduced in the Meiji period. Since the liberalization of imports for breeding chickens in 1960, native chickens for practical use have fallen into a disastrous condition. Some native chickens are now being used to breed brand chickens. Brand chickens using native chickens are referred to as Jidori Japanese old style native), a name that helps consumers to differentiate this chicken from the others on offer. Chickens permitted to use the Jidori label are limited to chickens containing at least 50% of the blood of 41 native breeds designated by the Japan Chicken Association (38 native breeds according to JAS). The major native

chicken breeds including these Japanese old-style natives are Rhode Island Red (44.8%), Nagoya (3.8%), Shamo, Hinaidori, Barred Plymouth Rock, and Satsumadori These 6 breeds account for 58% of all native breeds.

- Horses: After World War II, farm horses that had been actively raised till then and native horses used for conveyance lost their roles, resulting in a corresponding decline in their numbers. In spite of this, 8 native populations comprising Hokkaido Horse, Kiso Horse, Noma Horse, Tsushima Horse, Misaki Horse, Tokara Horse, Miyako Horse, and Yonaguni Horse are left and all are protected by conservation groups.
- Goats: As native goats, there are Tokara Goat and Shiba Goat. The Japanese Saanen breed has been produced by successive crossbreeding with a native goat. The Shiba Goat is bred as a laboratory animal in universities and research institutes. Its present status is "endangered-maintained." With regard to Tokara Goat, 35 purebred individuals exist at Kagoshima University and Hirakawa Zoo. Toshima village, the birthplace of Tokara Goat, has opened a goat farm. However, even here, there are only a few purebred individuals. The present status of Tokara Goat is "critical-maintained."
- Quail: Quail are the only indigenous poultry species that have been domesticated in Japan. There are about 7.71 million quailbeing bred focusing on the use of eggs.

Korea

There are only a small number of livestock and poultry breeds native to the of Korea. They were low in productivity and have been improved by crossing with imported breeds. As the vulnerability of endangered species in Korea becoming an alarming issue, institutionalized protection and management are necessary. With the potential value of biodiversity in mind, an intensive level of care should be given to endemic species of Korea. According to the Red List of Korea, 27 mammals, 58 birds, 5 reptiles and amphibians, 27 fishes and 224 vascular plants are extinct or critically endangered, and the number of species needed to be protected is 2,177, which is 5.6% of total species in Korea. Since the number of critically endangered species are increasing due to catch, overhunting, poaching and loss of habitats, mid and long-term conservation plan for endangered species and marine organisms are strongly requested to be established at national level. Protection systems for endangered and legally protected species by relevant government agencies: Endangered species (249 species), rare plants (571 species), wildlife protected by local governments (305 species by municipal governments; Seoul 49, Daegu 47, Incheon 24, Gwangju 56, Daejeon 41, Ulsan 49, Gyeonggi 29, Chungbuk 10). The protection and management plan should be established on the basis of the surveys of endangered species periodically and endemic

species annually, overcoming the extinction crisis and conserving biodiversity by in situ and ex situ conservation measures for critically endangered and endemic species.

a. Unique underutilized AnGR

In East Asia, Taiwan, Japan, and China are the countries that have carried out better and earlier the protection and preservation of livestock and poultry resources than other countries.

Taiwan

The existence of threats to AnGRs in developed countries due to globalization is generally accepted, and AnGR conservation is likely to be consistently undervalued. Native breeds generally maintain one or more adaptive characteristics to the living environment, which may provide useful or potentially useful genes or combinations of genes for future needs. Examples of useful genetic traits are prolificacy and early maturity of pigs, heat tolerance of Taiwan yellow cattle, disease-resistance of Formosan buffalo, roughage tolerance of native geese, and the meat flavor of native chickens. Furthermore, most native breeds of animals in Taiwan are still raised in grazing production systems. This was recognized at the 8th Board Meeting of the Advisors for Science and Technology - Agriculture Group in April 1986, which formally recommended that life resources be preserved so that their genes will not be forever lost due to concentration on limited and highly selected strains. Consequently, a large-scale pilot national project, “Germplasm Preservation and Utilization in Domestic Animals”, was initiated in 1987. There are three methods for preserving livestock germplasm: maintaining live populations, cryopreserving germ cells, and establishing DNA stores. Animal resources are bounteous and are preserved for improving exotic breeds in terms of future production performance and efficiency. Conservation and integration of germplasm for new variants were attempts to adequately use the gene pool in Taiwan since then.

b. Germplasm collection, characterization, evaluation, conservation and documentation

Protocols on conserving livestock germplasm are as follows:

(1) Establishment of standards for visible characteristics of conserved breeds;
(2) Collection of native animals from small farms;
(3) Selection of places for conservation;
(4) Propagation using a small population at random; if animals have economic traits for improving production performance of exotic breeds, then intercrossing programs are implemented;

(5) Phenotypic measurements and data collection on animal growth, reproduction, living habits, and genetic polymorphism;
(6) Preservation of germ cells with emphasis on semen and embryo cryopreservation; Information exchange of utilization and provision for public needs;
(7) Typical animals after propagation with benefits of cooperative germplasm research being released to the private sector;
(8) Promotion of public extension and education with intellectual property rights for this germplasm relative to arts and culture; and
(9) Sharing the world's genetic diversity resources and turning potential into reality.

China

In China, many breeds of Chinese domesticated animals and poultry have various characteristics. For example, Yunnan Zebu is well adapted to the tropical and subtropical climates in the south and resistant to external parasites; Erlunchun horse and Ming pig in the North-east are adapted to cold climate and severe environment in the north; Nanyang cattle and Luxi cattle are good for both meat and draught purposes and can be fed on roughage; Tibet range sheep, Liaoning cashmere goat and Inner Mongolia cashmere goat have good performance in producing cashmere wool; Jinding duck, Shao duck, and Gaoyou duck are excellent in egg production; Jianchang duck and Xupu duck are good for liver production; Chinese fighting cocks are for entertainment purposes.

The genetic resource preservation of domestic animals is a long-term, public welfare and social cause. First of all, the Chinese Government has actively given support by enlisted it into the development plan of national economy and social development, encourages enterprises and individuals to take part in the conservation and scientific development of animal genetic resources. Secondly, it is overall arranged and is responsible by governments at different levels. The central government and local governments should formulate perfect, practical plans for animal and poultry breed resources conservation and development. Thirdly, the conservation work is combined with development and utilization, with preservation as the major objective and combining conservation with utilization and promoting conservation by utilization. Fourthly, combination of traditional means with modern biotechnology, it is essential to bring into full play the roles of the conservation farms and conservation areas while unfold conservation work by making use of embryo, sperm, DNA and other modern conservation technologies and methods.

At present, the "Animal Husbandry Law" has integrated the conservation of animal and poultry genetic resources as an important content in the Law. It has concrete

stipulations on the legal responsibility of conservation work, and this has made the conservation work to follow legal procedures. Meanwhile, MOA has formulated the "Plan of Animal and Poultry Genetic Resource Conservation", conscientiously implementing and improving the system and science of our breed conservation work.

The living body conservation is undertaken by the method of constructing conservation farm and conservation areas in the original producing place or other established place of animal and poultry genetic resources, for example, the Poultry Conservation Gene Bank in Jiangsu Province has conserved 21 chicken breeds, with conservation scale of 200-300 chickens in each breed. These places of genetic resources are responsible for formulating corresponding conservation policies, such as forbidding cross with exotic breeds, formulating scientific and effective breeding programs, avoiding inbreeding and other technical measures, etc. At present, this method is fairly popular and play an active role in resource conservation work. In order to further select and purify the quality of native breeds, the producing areas of various species have established numerous selection breeding farms for horse, cattle, sheep and poultry through special funds allocated by the government Meanwhile, China has also divided some corresponding conservation areas. Through years of breeding and purification work, the quality of native breeds has been improved significantly. These breeds have not only conserved, but also performance tested, which has enabled China to further understand the characters of these breeds.

Chinese MOA established the Center of Preservation and Utilization of Germplasm Resources of Domestic Animals and Forage in 1996. The center develops conservation technologies very rapidly. At present, it has conserved frozen embryos and frozen semen of 16 breeds of cattle, sheep and other animals. Each breed has conserved 1500 ampoules of frozen semen and 100 frozen embryos. There are two yak breeds in conservation, storing about 1500 ampoules of semen in each breed. In the Center of Preservation and Utilization of Germplasm Resources of Domestic Animals and Forage, they have preserved the blood samples of 58 Chinese native pig breeds, corresponding extracted DNA samples of nearly 3600 individuals, some genetic materials of ear tissues and the blood samples of 56 Chinese native cattle breeds including yellow cattle, yak and water buffalo. Awareness of the value of genetic resources has stimulated the molecular level study of the genetic diversity of indigenous breeds in recent years. In June of 2002, the center finished the project "Measurement of Genetic Distances between Chinese Indigenous Pig Breeds". Its objectives are to confirm the order of conservation among these breeds, to propose effective methods to maintain and utilize them, and to estimate the diversity and genetic relationships local pig breeds by means of twenty-seven microsatellite recommended by the International Society of Animal Genetics (ISAG) and the Food and Agriculture Organization (FAO). Measurement of

genetic distances between Chinese indigenous cattle breeds are still going on.

Japan

The number of native livestock animals which have been kept for generations in Japan is decreasing rapidly in pursuit of productivity improvement, etc. For example, there are now only about 2,000 native horses in eight varieties. As for livestock in general, the popularization of superior varieties and strains among livestock farmers has reduced the genetic deviation of livestock. On the other hand, livestock breeding businesses are preserving genetically diverse livestock for the purpose of securing materials for future livestock improvements. Nineteen varieties of livestock and poultry native to Japan have been designated as natural monuments. All of these are chickens except for Mishima Cattle and the Misaki Horse. Of these, only Onagadori in Tosa has been conserved as a special natural monument. Moreover, financial assistance to support measures for strain conservation was provided targeting the Hokkaido horse and 14 chickens that are kept for research in three universities. A liaison meeting for the project to conserve 8 native horse groups including Misaki Horse hosted by the Japan Horse Council has been held every year since 1977. In Japan the major form of animal protection has been to preserve the indigenous livestock breed resources. Three ways of protection are adopted, i.e. protection by the broad mass of people; protection by the local production area of breeds; and at the national level, keeping these animals as a heritage of nature. These breed resources represent basically the endangered livestock.

- Artificial insemination (AI): According to 2000 statistics, the prevalence rate of AI is 99% and the frozen semen is used in all the case of AI for 2.48 millions cows in total the rate of artificial insemination for dairy cows is 99.4%, with frozen semen being used exclusively. For beef cattle the percentage for AI is 97.8%, and again only frozen semen is used in this procedure. Contrast this with pig and horse, where the corresponding figures are less than 10%.
- Embryo transfer (ET): the embryo transfer was carried out for 62 thousands cows which corresponds to 2.5% of artificial insemination of cattle including Japanese Black in which ET was conducted the figure corresponding to 6.3% of 740 thouthands AI.
- Clone livestock: Cattle, fertilized-ovum clone, in 40 organizations, 629 animals, somatic cell clone, 293 in 38; Pig somatic cell clone, in one organization, five animals; goat, somatic clone, in one organization, two animals are produced.

Korea

Genetic resources such as seeds indigenous to the region and strains of breeding of

long history have great potential values to play a vital role to the human survival. Collection of genetic resources is weighted toward some specific crops and the collection of native genetic stocks has been poor. It is also urgent to analyze economically valuable characters even for the collected genetic resources. The foundation for the beneficial use of genetic resources should be established by examining and studying genetic resources preferentially, collecting, conserving and managing genetic resources from native organisms and operating genetic resources banks systematically. According to 'Master Plan for Agriculture and Fisheries Genetic Resources (2009–2018), Korea is targeting to strengthen its position as the 5th county in genetic resources through securing 330,000 collections for 6,000 species of agriculture plant resource and completing examination of characteristics for 77% of genetic resources by 2018. Collecting and and expanding integrated management system for livestock genetic resource from 1,000 to 5,000 resources by live and frozen storage method.

c. Processing, value addition and product development

Taiwan

In recent years, food safety incidents have put the issue under the spotlight and have gradually changed Taiwanese people's consumption habit. More and more consumers are willing to purchase agricultural products with label or certificate of origin. Thus, in order to boost local production and consumption of livestock product, the Council of Agriculture (COA) actively promoted the labeling and production traceability system of cattle and goat products, which serve as a reference basis for local consumers when purchasing livestock and dairy products. Moreover, the system helps consumers to differentiate between domestic and imported products. In order to elevate the quality of livestock products and encourage manufacturers to utilize domestic livestock products as raw materials so that the interests of farmers and consumers can be protected, the COA has introduced the production traceability system since November 2007, which provides consumers with relevant information about domestic livestock production, slaughtering, and sales for reference when purchasing products. All these measures aim to prevent the possible confusion created by merchants mixing imported dairy and meat products to fake as domestic livestock products.

China

Domestic animal genetic resources are an important basis for livestock industry development. Over a long period of time, China has always followed the principle of combining development and utilization with conservation in the aspect of development

and utilization of domestic animal genetic resources. Chinese MOA is responsible for the administration of genetic resources of domestic livestock and poultry, with corresponding administrative institutions established in different provinces, autonomous regions and municipalities and with the bureaus and stations of animal husbandry established in different prefectures, cities, counties and towns. The National Examining and Approving Committee for Livestock and Poultry Breeds has been established by MOA and the corresponding committees have also been established in some local areas, which are responsible for examining and approving new breeds and new lines.

Japan

The image of high quality Livestock products from Japan is established. Livestock animals in Japan have been raised carefully in good faith just like Japanese traditional culture. Both the updated technology and the thorough feeding management in each individual animal are the secret to supply delicious and safety livestock products.

4. Marketing, commercialization and trade

Taiwan

In order to improve the quality and safety of agricultural and derived processed product, the COA promulgated the Agricultural Production and Certification Act and promoted the Traceable Agricultural Products (TAP) and Certified Agricultural Standards (CAS) systems (11).

For the purpose of elevating the quality of livestock traceability system and its certified products, the COA continues to subsidize municipal and county governments for carrying out administrative inspection and random product quality check on certified livestock farms, slaughterhouses, meat-packing facilities, and sales points. In the future the COA will continue to organize relevant promotional events about livestock product certification as well as administrative inspection on products to ensure domestic livestock product quality and increase consumer's awareness and support on domestic livestock products.

The value of enforcing label, certification, and production traceability system:

1. Effectively achieving market segmentation between domestic and imported product:

   Through the implementation of certification label and mark of origin, consumers are able to effectively identify products. The systems protect the interests of both producers and consumers, and can be favorable for the promotion of local production and consumption.

2. Increasing the safety of livestock product:
   When problems with agricultural products occur, it is possible to quickly track down the cause and product source so that the responsibility of each party involved may be clearly determined. The application of identification label or number on product management could facilitate information relay during the process of production and improve product quality and safety.
3. Improving product production and business management technology:
   In addition to the integration of label, certification, and production traceability system into production, consumers' growing demand on the quality of domestic livestock products would encourage the industry to invest in novel production systems and more sophisticated management methods in order to elevate overall farming management efficiency, and expedite industrial upgrading.
4. Raising profit for the industry and promote mutual trust with the consumers:
   Producers could establish brand image, build up product trustworthiness, meet consumers' demand, and increase product competitiveness. On the other hand, consumers are guaranteed to eat healthy food when they purchase certified and safe livestock products with transparent information.

Japan

The consumption of livestock products in Japan is one-third lower than the USA, and half that of the EU. However, the Japanese people eat a lot of fish and shellfish, so the intake of animal food compares favorably with developed western countries. In terms of the demand for livestock products, dairy products such as cheese are expected to increase, but fresh milk, meat and eggs are unlikely to increase due to a leveling off or downward trend in the population. However, in terms of quality and in response consumer needs, there are increasing efforts to expand production and consumption through product differentiation. The trend among consumers is to purchase fresh, safe, palpable and healthy livestock products rather than just focusing on the price. Accordingly, livestock producers are endeavoring to meet consumers' needs by developing brand livestock and products. Brand products are being produced from beef, pork, chicken and eggs, with 141, 178, 158, 636 brands known respectively. There are a few brands that use native breeds as a point of difference. Native breeds such as Mishima Cattle, Kagoshima Berkshire, Aguh, Hinaidori, Tosa Jidori, Nagoya, Gifu Jidori and Shamo are being utilized to produce brand products, a situation which is greatly contributing to the conservation of these breeds at the present time.

Japan has high standards and strict market requirements, imports a large volume of food, has a public that is responsive to food safety issues, has a production system based on small farms, and uses a high technology traceability system (12). Japan is the biggest

food importer in the world, importing more than 60% of its food, increasingly from developing countries. Compliance with Japan's food safety standards and traceability requirements opens the door to increased business opportunities. To protect consumers, the public sector moved relatively quickly to support food safety systems. Moreover, unlike other developed countries where food production is often done on large-scale farms, Japanese farms are generally small, providing experiences that are more applicable to farms in developing countries. The high rate of IT adoption in Japan provides a wide range of examples of ICT support in traceability systems. Introduction of ICT in Japanese food traceability systems has had to take into consideration the level of IT skills among the smallscale rural producers—a challenge also faced by developing countries. The public and private sectors have collaborated in addressing the food safety issues through food traceability systems using ICT.

- Beef cattle: In 1999, the population, excluding cattle for fattening, totaled 669,000, 93% of which are Japanese Black. With regard to other breeds, Japanese Brown constitutes 4.8%, Japanese Shorthorn 1.2%, and other species constitute less than 1% in total Cattle being fattened for beef production totaled 1.84 million head. Holstein and its cross are also included in the statistics, accounting for 57.7% of the total Japanese Black accounts for 39.8%.
- Dairy cows: In 1999, Holstein totaled 1.73 million head, accounting for almost 100%, while the second most common breed was Jersey with only 9,202 head, and species other than Holstein totaled 10,287 head, accounting for less than 1%.
- Pigs: Although there is the high popularity breed, the Kagoshima Kurobuta in Japan. In addition to this breed, three way cross hybrids among Large White, Landrace, and Duroc, and partially among Large White, Landrace and Berkshire (in place of Duroc), or commercial pigs, which have been produced utilizing imported parental hybrids stocks pigs imported from foreign pig breeding companies.
- Chickens: For chicken production, meat production using broilers produced from imported parental hybrid stocks imported accounts for 89.4%. Adding waste chickens (9.0%) to this figure takes the percentage to 98.4%. For eggs, White Leghorn and other laying chicken breeds account for 7.21 million fowls, while native chickens and other breeding chickens for meat and eggs account for 340,000 fowls in total (probably used mainly for meat).

China

In recent years, there have been many problems in food safety from mad cow disease and foot-and-mouth disease (FMD) in foreign country to water injected meat, inferior milk powder and Sudan red event in China which has been attracted the attention of the

world (12). Food safety has been the concerned issues by the consumers and the businessmen together and become the important factor that affected the international competitiveness of Chinese agriculture and food industry. As the biggest developing country and WTO membership country, China actively coped with various food problems, carried out the preliminary study on food safety traceability, made some related standards and guides, preliminarily created some food traceability institutions and issued some regulations in some local governments and enterprises. Article Numbering of China (ANCC) cooperated with China National Food Industry Association (CNFIA) to build the food safety traceability platform by bar code, establish a great deal of traceable foods and enterprises and develop a series of traceability subsystem (Honghua Chen et at., 2007). Food safety traceability system (FSTS) is referred to an information management system that can connect the production, inspection, supervision and consumption etc processes to let the consumers know about the sanitary and safe production and circulation process and improve the safety trust of consumers on the food. FSTS provides the traceability mode ―from farm to table‖, selects some common traceable factors concerned by the consumers from production, processing, circulation and consumption etc supply chains, creates food safety information database, once there is food safety problem, it can effectively control and call back the food according to the traceability so as to ensure the legal rights and interests of consumers from the food source (13).

Strategies adopted to harness their potential

Taiwan

Domestic animals supply 30% of total human requirements for food and agriculture, and 70% of the world's rural poor depend on livestock as a component of their livelihoods. As an example, there have been tremendous movements of livestock germplasm from the northern hemisphere to Taiwan driven by global production systems as compared to that from the southern hemisphere to Taiwan. Exchanges of genetic materials among regions have been a very valuable mechanism for breeding and livestock development. Taiwan farm animals such as dairy cattle, pigs, and layers, preserve a high percentage of exotic blood through long-term agriculture trade relationships.

Research and utilization using molecular techniques to verify AnGRs are understood to encompass animal genetic resources that are or have been maintained to contribute to animal protein supplies and farmer livelihoods. Comprehensive assessments of genetic diversity of local breeds using molecular genetic markers are required. Genetic variations within livestock species are partly attributed to differences between breeds and partly to differences among individuals within breeds. A breed or population

becoming extinct means the loss of its unique adaptive attributes. The potential of new and emerging technologies, such as DNA libraries of local breeds, is being applied to reveal the genetic bases of disease resistance, adaptation to environmental stresses, and production efficiency. Molecular methods will provide new tools such as new generation sequencing (NGS) technology would certainly facilitate conventional and trans-formative genetic improvements.

China

In order to continuously develop and improve the quality and performance of domestic animals, MOA has established associations, technical organizations and breeding centers of breeding committee for some breeds. These organizations of association and breeding committees have played an important role in improving the quality of domestic animal breeds in China. By using the techniques of computer and Internet and on the basis of the supplementary survey on animal and poultry breed resources, they have established the "China Information System of Domestic Animal Genetic Resources." The software package of the information system can be applied in the administration of animal and poultry genetic resources throughout the country.

Here, the Chinese Government is willing to unfold cooperative research in the domain of domestic animal genetic resources, and spare common efforts in the conservation and utilization of global domestic animal genetic resources and for a sustainable development of livestock industry.

In order to strengthen the conservation of native breeds, the Chinese Government has input large quantities of funds and established a big batch of excellent native breed resource farm and bull stations in various parts of the country.

Japan

Animal genetic resources indispensable in agriculture and bioindustries are conserved in collaboration with the sub-banks to facilitate efficient preservation and maintenance appropriate for a specific animal. The conservation methods include the ex situ conservation method that involves collecting fertilized eggs or semen for cryopreservation in liquid nitrogen, and the in situ conservation method that involves maintenance of live population of animals in their adaptive environment. Livestock and poultry genetic resources are preserved ex situ using fertilized eggs, semen and somatic cells or in situ using live populations of animals. In the case of chicken, the primordial germ cells (PGC) which will differentiate into ova or spermatozoa are also used because long term conservation of chicken eggs is difficult.

Korea

To the present, projects on traditional knowledge have been carried out in several

research institutes such as the Korean Intellectual Property Office. However, systematic management and streamlined research attempts have so far been insufficient. Korea is moving toward developing a nationally unified approach on the protection and use of traditional knowledge that are fully in line with the Nagoya Protocol. Since the evaluation and the monitoring of biodiversity are the basic tools for the conservation and management of biodiversity, the results of a wide range of biodiversity surveys have been used as evaluation measures for ecological zoning maps and conservation policy making in Korea. Changes in domestic biodiversity should be monitored regularly, which will be used for the establishment of conservation plan.

Several national research projects in place include Survey on Current Inhabitation of Wild Animals (1967–), National Natural Environment Survey (1986–), National Distribution Survey of Endangered Wildlife (2001–) and Survey of Native Species (2006–).

5. Major focus areas

Taiwan

Understanding the diversity and status of AnGRs provides the basis for raising public awareness. However, raising awareness without ensuring capacities to realize actions will not produce the effective management and sustainable utilization of local breeds. Animal conservation activities were further posted on the web site of ANGRIN (www.angrin.tlri.gov.tw) for documentation of pictures and videos of conserved and selective breeding animals. The importance of the conservation and sustainable use of AnGRs was recognized by policy makers and major stakeholders in the livestock sector. Strengthening the breeding capacity and programs for local breeds were established and stimulated in situ conservation. On the other hand, ex situ conservation in cell/tissue banks requires appropriate infrastructure and organization, technical capacity, legal arrangements, and sustained funding. The Taiwan Animal Germplasm Center (TAGC) is a capacity building for managing AnGRs via cell/tissue banks with liquid nitrogen, and it serves as a conservation center of the animal conservation project.

China

In China, to facilitate timely exchange of these livestock and poultry breeds resources at home and abroad, the Chinese Ministry of Agriculture organized almost a hundred renowned professors and experts to compile a book of “Breeds of Domestic Animals and Fowls in China”, which has been published in separate volumes, namely: “Horse and Ass Breeds in China”, “Bovine Breeds in China”, “Pig Breeds in China”, “Sheep and Goat Breeds in China” and “Fowl Breeds in China”. In order to transfer the

advantages of rich Chinese animal and poultry breed resources into economic advantages, while strengthening conservation work, China have given focus on the breeding and industrialization of animal and poultry breeds. In recent 20 years, they have used modern breeding techniques and means in developing a huge batch of specialized lines and new breeds. During the period of 1996-2001, the State had examined and approved a total number of 17 new animal and poultry breeds. Meanwhile, the methods of animal and poultry recourse development and utilization move to the orientation of integration of breeding, production and processing. This has enabled China to keep the excellent characters of many local native animal and poultry breeds and improved the production performance by a big margin.

Japan

For livestock and poultry within Japan, data has been accumulated on fundamental and production-related traits from all the studies ever conducted, while NIAS genebank project is also promoting characterization of animal genetic resources held at the genebank. Genetic relationships among domestic animal breeds and populations have been studied by using molecular information, polymorphism of protein, blood type, mitochondrial DNA, and genomic DNA markers. Individual identification and parentage tests that have conventionally been conducted using blood groups and protein polymorphisms is shifting after a trial period to tests using microsatellite DNA polymorphisms. DNA diagnosis of inherited disease is started on 5 genes of cattle and one gene of the pig. Moreover genome research, genetic map and QTL analysis on livestock and domestic- fowls are also performed (14).

The focus is also included the conservation of livestock, poultry, and insect genetic resources, collection of relevant data such as geographical distribution, maintenance of mutants or lines with useful physiological traits, and implementation of an efficient long-term preservation system to the maintain genetic diversity. The animal genetic resources are available for research purposes and have been utilized for genetic analyses, studies on diversity, physiology, ecology, and the development of novel foods and other products.

Korea

Examining phylogenetic relationships of native species by the analyses genetic information. Elucidating phylogenetic relationships among native species by the analyses of genetic information with the foundation of big data. Establishing convenient identification system using genetic ID by constructing DNA barcode system. Strengthening examination and research of genetic diversity for important biological resource and establishing improvement by inspecting actual condition of conservation

policy and examining the areas of high genetic resources. Protecting the habitats of good genetic diversity by designating as new protected areas in connection with previously designated areas. Expanding collection, storage, and ex situ conservation of genetic resources. Collecting genetic resources and natural products by intensive examination of special habitats for collecting diverse genetic resources. Strengthening management technology such as evaluation, management and preservation of useful genetic resources. Developing the discriminating criteria for useful and rare genetic value and revising the related official regulations, promoting developments of management manual for genetic resources of vital importance, and developing the technique of cryogenic frozen storage.

6. Infrastructure, capacity building and financial investment

Taiwan

Genetic resources are usually conserved in living form or frozen genetice materials. Preserving germplasm in living form must conserve a considerable number of mature individuals with reproductive potential, and continued funding and breeding space are necessary. Based on the afore-mentioned restraints and consideration of risk diversification, living germplasm are preserved in LRI branches and breeding stock reproduction sites throughout Taiwan. Genetic materials preserved in frozen form include germ cell (sperm, egg and embryo), tissue, somatic cell, cell line, DNA and gene pool. Those conserved for less than 5 years are kept in freezers at -20 or -80 degrees Celsius, while those preserved for long term are conserved in liquid nitrogen storage tank at -185 to -196 degrees Celsius.

The livestock Germplasm Center now conserves genetic resources of 77 livestock species and strains, including 19 native and 38 foreign species as well as 20 new species/strains produced by breeding. These species are provided by breeders, preservation sites, importers, local veterinary staff and farmers' association promotion staff. The germplasm bank preserves livestock genetic resources in animal, vegetation and microorganism categories. Livestock are divided into domestic animals and birds, vegetation are mainly feed crops, and microorganism include those in livestock digestive system and fermented compost of manure and urine.

China

In a room of the Animal Husbandry Station of Beijing Municipality, samples of embryos, blood and DNA of livestock and poultry are stored in liquid nitrogen tanks. The purpose of storing these genetic materials is so they can be used by advanced biotechnology to revive the species if they were extinct. Known as a “life bank” for

livestock and poultry, this modern “Noah's Ark” is the Livestock and Poultry Germplasm Resources Bank of Beijing Municipality, or the Centre of Livestock and Poultry Germplasm Resources in Northern China of China National Genebank. When genetic resources are needed, they can be taken out of the tanks and released. “The germplasm resources stored here can be used for pure breeding or cross breeding of livestock and poultry through exchanging genetic resources. If necessary, select the best samples to create a high quality breed. For example, sperm, embryos and gene samples can be used for artificial insemination, transferring embryos and genetic research of biodiversity respectively. The germplasm bank stores 1,380 blood samples and tissues of Peking Chicken and Beijing Duck, 600 and 2,628 blood samples of high quality pigs and Holstein cows respectively, and 700 samples of semen of bulls of Holstein, Limousin, Angus and Simmental; collects 600 DNA samples of Qinghai Finewool Sheep, Karakul Sheep, Tibetan Sheep and Small-tailed Han (a breed of sheep), and 120 genetic samples of Equus (a genus of mammals in the Equidae family).

Japan

The Ministry of Agriculture, Forestry, and Fisheries (MAFF) genebank project started in 1985 as a nationwide network. From 2001, the National Institute of Agrobiological Sciences has been the main body conducting research and collection of genetic resources both inside and outside Japan, along with implementing characterization and conservation of resources. The conservation of livestock and poultry is practiced at the National Institute of Agrobiological Sciences, the center-bank, and independent administrative institutes such as the National Agricultural Research Organization, the National Institute of Livestock and Grassland Sciences, the National Institute of Animal Health, and the National Livestock Breeding Center, as sub-banks. The center bank is involved with cryo-preservation, mainly focusing on frozen semen. The sub-banks are concentrating more on maintaining live animals, in combination with cryo-preservation. Collection and conservation are being carried out focusing on breeds and strains that have been established in Japan, and approximately 200 accessions have been conserved.

The NIAS Genebank is the main repository of genetic resources of plants, animals and microorganisms of agricultural importance. It also coordinates management of these resources in collaboration with a network of sub-banks throughout Japan. The Genetic Resources Center, NARO (NGRC) is in-charge of collecting and introducing valuable genetic resources from domestic and overseas sources, maintaining passport and evaluation data, and to providing access to these resources for research and development for food and agriculture. The center also carries out diversity studies and develops preservation technology to conserve genetic resources, and creates new

genetic and breeding materials using irradiation mutagenesis and other methods. To date, the conserved genetic resources include about 215,000 plant accessions, about 28,000 microorganism accessions, and about 1,000 animal accessions.

Korea

It is necessary to establish adequate financial measures by accurately understanding the current status of biodiversity. Existing state-funded subsidies on agriculture, fishery, transport or energy, etc. could provide short-term economic benefit, but may well be harmful to the health of biodiversity due to environmental damage and resource depletion. OECD countries are still providing environment harmful subsidies of over 400 billion US dollars per year to traditional industries such as agriculture and energy. However, actions to bring reforms on this damaging practice are now in place, imposing ecosystem conservation cooperation charges (4). Thorough examination on the state funded subsidies and their impact on environment must be carried out. Also needed is step by step approach to increase government subsidies that are beneficial to biodiversity. Exemplary case of beneficial subsidies: "Biodiversity Management Contract" was developed by local governments and residents. Under this contract, farmers left some crops for migratory birds and then local governments compensated them for the loss (6.66 billion and 3 billion KRW in 2011 and 2012, respectively). Korean government is fully recognizing the importance of developing techniques and training professional manpower to achieve the conservation and sustainable use of biodiversity. By establishing NIBR in 2007 and National Ecology Institute (NEI) in 2013, the information sharing system as well as the workforce training has seen significant improvements. The dependence on some of biological resources such as agriculture, health and medical care, and forest resource is quite high in Korea compared to low level of existence of biological resources.

7. Case studies/success stories for improvement of health and livelihoods (if any)

Taiwan

The indigenous livestock breeds is proven to be used for more than producing food products, the Lanyu miniature pigs was bred for biomedical and laboratory research. After introducing the black-coated miniature pigs from Lanyu in 1980, the LRI began breeding a selection of the species and has since bred four mini-pig breeds. It is recognition by the Association for Assessment and Accreditation of Laboratory Animal Care (AAALAC) bodes well for the nation's development of laboratory animals and its efforts to bring the industry in line with international standards (15). The application of the mini-pigs in future medical research will also help boost the international

competitiveness and visibility of Taiwan's medical technology industry. During the breed selection of the spotted mini-pigs in 2001, the first batch of white-coated pigs, which the facility named Lanyu White, appeared. The Lanyu White are particularly suitable for experimental research related to transplant medicine, plastic surgery and cosmetic products and they have become a popular breed of laboratory mini-pig. Several hundred Lanyu White was supplied to research centers both in Taiwan and overseas.

China

In China, for producing Chinese traditional animal by-products, the domesticated animal and poultry breeds used are: Jinhua pig for ham; Beijing roast duck; Anhui ma chicken for roasting; Chaohu ma duck for pressed salted duck; Tan sheep and Zhongwei goat for fur; Hu sheep and Jining grey goat for lamb and rich fur. There are also the Taihu pig and the small-tailed Han sheep and big-tailed Han sheep, well-known for their high fertility. And also, there are the silky blackbone chicken of pharmaceutical significance; dwarf and miniature breeds, such as mature horses with body height under one metre; Wuzhishan pig and Xiang pig with body height 35–40 cm and weight around 40 kg. The characteristics of several breeds are rare not only in China, but also in rest of the world.

Japan

Since research into other livestock by veterinarians and zoologists is broadly based, it is important to increase the number of personnel that have an interest in these areas and are involved in genetic resource studies and projects, rather than mere capacity building. The Ministry of the Environment released the New National Strategy of Japan on Biodiversity in March 2000. The Ministry of Education, Culture, Sports, Science and Technology released the "National bio-resource projects" that aims at the improvement of bio-resource systems such as those for laboratory animals and plants These projects assume the viewpoint of the comprehensive promotion of bio-resources. The NIAS genebank projects are required to review how effective measures to conserve genetic resources have been, utilizing the characteristics of individual projects and linking these projects and systems effectively to take the entire nation into consideration.

Korea

Korea has established a pan-government measure for the Nagoya Protocol in 2011 and has been pursuing implementation legislation to rectify the Protocol. It is also necessary to provide information and to improve awareness among stakeholders such as government agencies and private sector for the implementation of the access and

benefit sharing. Reshaping the national legislation on the access to genetic resources and equitable benefit sharing seems to be a crucial task for the country. Establishing genetic resource information system to promote foreign parties to gain an access to Korean generic resources holds significant importance as well.

8. Future thrusts

China

China is an East Asian country with very rich livestock and poultry genetic resources. In Asian and East Asian countries, local breeds have been influenced to some extent by being hybridized with and replaced by foreign breeds. Yet China has a vast area and a rather complicated natural ecological environment. Especially in the south-east and the south-west and the Huang-Huai-Hai regions in China, natural protection regions have formed where a lot of specific animal and poultry breeds have been distributed and protected now, so that many breeds in those regions have been preserved. China is also a developing country. The economic resources used to protect and preserve effectively the genetic resources of livestock and poultry breeds are not sufficient. The Ministry of Agriculture of China has established several protective regions, sperm banks, and embryo banks for some endangered livestock and poultry populations and species that have become almost extinct or greatly reduced in number. This is also required to carry out studies on the development and utilization of these genetic resources in China.

Taiwan

Further losses of local breeds are probably inevitable, even though local breeds are important components of our future food security and cultural heritage. Conservation of local breeds should certainly be a public concern. In the future, a global bio-identification system and exchanges of genetic resources will continuously be carried out to develop a backup system of genetic materials and samples at the regional and global levels (16). Therefore, effective and efficient handling and documentation of AnGRs such as DNA samples, cells, and tissues generated from various germplasms in AnGR conservation, cryobanking, bioutilization, and management as follows:

a. To provide a venue to discuss the status of documentation activities of the various cryobanks of animal and forage plant genetic resources in the Asia and Pacific region;
b. To familiarize participants with various documentation systems available, germplasm documentation, data analysis, and information management for AnGRs;

c. To reinforce the capabilities of participants for conservation banking techniques, cell freezing methods, data processing, genetic analysis, and interpretation of results;
d. To provide a venue to discuss and clarify issues concerning international, regional, and national laws and policies of relevance to the conservation and management of AnGRs;
e. To increase the knowledge and understanding of participants on intellectual property rights (IPR) issues, mechanisms of access, and benefits of sharing genetic resources; and
f. To reinforce the capability of participants in dealing with said issues in relation to research and development of AnGR conservation and management.

Japan

Many of Japanese native livestock are in a critical situation. As an auxiliary means for in situ preservation by live animal population, ex situ preservation by live animal, frozen embryo and frozen semen are being conducted. The conservation of frozen embryos and semen is not necessarily satisfactory because the number of individuals being able to collect is limited and freezing technologies have not been well established in some species. The leading technologies of the next generation applicable for ex situ and in vitro preservation should be somatic cell cloning in the mammals and primordial germ cell (PGC) for producing chimeras in the reproductive cell line in avian species. The associations of native livestock and domestic fowls are playing an important role. Policies need to be prepared to provide further incentives to the Conservation Group to continue its efforts. In addition, it is necessary to provide detailed information on livestock location wherever possible, particularly for chickens, by ongoing research on the locations where these breeds can be found and their conservation status.

Appropriately conserve and manage ecosystems and halt the extinction and the population decrease of threatened species. Furthermore, achieve and maintain improvements in the conservation status of species which are experiencing particular declines from among those threatened species. In addition, improve the conditions for biodiversity by conserving the genetic diversity of crops, livestock animals, and wild species that are closely related to them, including those species that are valuable in a socioeconomic or cultural sense. For the genetic resources of livestock animals, move forward with securing and using a diverse array of breeding resources that possess genetic advantages by focusing primarily on varieties that are unique to Japan, such as Wagyu beef, locally raised chicken, and Japanese horse breeds.

Korea

Expanding establishment of genetic resource management banks. Genetic resource bank of wild animals, Korean Collection for Type Cultures operated by Korea Research Institute of Bioscience and Biotechnology, Agriculture Genetic Resource Bank, Registration Authority for Marine Biological Resource Deposition, and Pathogen Resource Bank. Establishing new genetic resource banks for wild plant seeds, natural products, and seed vault for long-term storage. Establishing the system for strengthening roles and activating operation of genetic resource banks. Resolving problems in overlapping collections and similarities among banks, and establishing "Development Plan for Genetic Resource Banks." Since diverse animal resources inhabit in the Korean Peninsula, the collaboration between South and North Korea holds inevitable significance for the conservation and sustainable use of biodiversity. Especially, DMZ, as one of three core eco-belts in Korea, attracts attention globally as the symbol for the peace and biodiversity. Currently, comprehensive data collection will be useful for biodiversity cooperation between two Koreas.

9. Conclusions

Biodiversity faces threats from increasing agriculture and livestock production (17). Agriculture depends on biodiversity for a variety of reasons, including as a source of present food security and insurance for future outbreaks of pests and diseases and climate change losses. Growing area devoted to agriculture and livestock and increasing reliance on monocultures, high yields and fast growth in turn lowers biodiversity. Key agro-biodiversity functions may be lost that negatively affects long-term sustainability of agricultural systems' food security.

High-output breeds or so-called international trans-boundary breeds have resulted in impressive production increases, and many countries regard them as a means of enhancing their livestock production to replace local breeds (5). The capacity to characterize, sustainably use, and conserve AnGRs in many countries varies due to a lack of inventory and monitoring. The inventories of AnGRs are the basis for planning development programs of local breeds. Collaboration in breeding activities between countries with similar production conditions is an opportunity to share costs and make breeding programs more sustainable. Animal health is the most regulated aspect of livestock management on a global scale. Hence, effective disease control is essential, and trade potentially presents challenges for AnGR risk management and backup systems. This backup concept for global genetic resource management should take the same approach among countries and regions. A global program should be formulated to provide the institutional capacities and resources needed for its implementation at the regional level and to accept the global responsibility.

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