

INTERNATIONAL COLLABORATION FOR CONSERVATION AND UTILIZATION OF PORCINE GENETIC RESOURCES

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ABSTRACT

Porcine genetic resources in local regions have been in dangerous situation for quite sometime because their numbers of breeds and individuals are reducing dramatically after the introduction of commercial breeds for expecting high productivity. For overcoming these situations, intense activities such as cryobanking of gametes, gonadal tissues and early-stage embryos of rare (endangered) breeds are necessary. For example in Japan, the National Institute of Agrobiological Sciences or NIAS has established a Genebank Project with the financial support from the Ministry of Agriculture, Forestry and Fisheries, Japan. In the project, 1908 items have been conserved (from NIAS database, FY2013); those resources are now used for creating new products such as brand chicken or pork, of which values are highly-evaluated by consumers. Furthermore, pigs especially mini-pigs are expected as experimental animals for biomedical use (e.g. xenografting of organs) in developed countries. Sustainable utilization of porcine genetic resources will help the advanced conservation of porcine genetic resources at low cost. However, in some cases in developing countries having rare porcine breeds, conservation and utilization of genetic resources have remained at the primitive stage; in other words, international collaboration between these types of countries is now necessary. In the present symposium, we introduce one possible project plan about “Establishments of cryobank system for native porcine resources and of sustainable production system” between Japan and Vietnam.

Keywords: Pig, Bio-diversity, Cryobank, Sustainable Preservation

INTRODUCTION

Domestic animals, such as pigs, cattle and chickens had been introduced to Japan in late Jomon era (BC500) to Yayoi era (BC500–AD300). However, the government banned slaughtering of animals because Buddhism had been introduced (AD538) and the religion prohibited the eating of meats. The main purpose of breeding animals had been for transportation of goods, farming, or military power such as horses and manure production. The utilization of animal products had not become popular until the Meiji era (1868–1912). The milk and meat have been consumed in Japan only for recent 140 years. The history of the raising of domestic animals for practical food production in Japan is extremely short compared to those of European and other Asian countries. The number of breeds of genetic recourses, especially native breeds, is limited in Japan.

GENE BANK PROJECT IN JAPAN

Present status of Japanese native breeds

Japanese native mammalian and avian breeds are summarized (Tables 1 and 2, respectively; modified from Minezawa, 2002 and 2007).

Table 1. Present status of Japanese mammalian genetic resources

Status	Widely used and popular	Locally used and popular	Widely used but not popular	At risk -maintained
Cattle	Japanese Black	Japanese Brown Japanese Shorthorn		Mishima Cattle, Kuchinoshima Feral Cattle, Japanese Polled
Pig		Kagoshima Berkshire (Black Pig)		Aguh, Ohmini, Shimabuta
Horse		Dosanko		Kiso, Noma, Tsushima, Misaki, Tokara, Miyako, Yonaguni
Goat			Japanese Saanen	Shiba, Tokara

Table 2. Present status of Japanese avian genetic resources

Status	Used for brand (chicken) production	State unknown or at risk	Other use
Chicken	Nagoya, Shamo (O-shamo), Hinai-Dori, Satsuma-Dori, Tomaru, Jidori (Gifu-jidori, Tosa-jidori) Ukokkei, Jittoko, Kurokashiwa, Tosa Cochin, Kumamoto, Mikawa, Ingii	Shamo (Ko-shamo, Yagido), Japanese Long-tailed Fowl, Totenko, Japanese Rumples Bantam, Japanese Long-Saddled Bantam, Koeyoshi, Minohiki Shokoku, Japanese Bantam (Katsura-chabo Shojo-chabo), Kawachiyakko, Kureko-Dori, Gankei, Utai-Chahn, Miyaji-Dori, Sado Hige-Jidori	Chabo (26 varieties)
Duck		Osaka-Duck	
Quail			Japanese Quail

Cattle:

Since the Meiji era, exotic cattle breeds had been introduced and crossbreeding between Japanese native cattle and those breed had been promoted nationwide. As a result, only two populations (Mishima cattle and Kuchinoshima feral cattle) escaped hybridization with exotic breeds. Other than these two breeds, Japanese cattle were categorized into four breeds depending on the type of exotic cattle introduced into the region; Japanese Black, Japanese Brown, Japanese Shorthorn and Japanese Polled.

Pigs:

Before the Meiji era, a native pig called Shimabuta or Aguh existed in Kagoshima and Okinawa. At present, Black Pig, which is considered to be of Berkshire origin, has gained popularity as a special brand product in Kagoshima Prefecture. In the case of Aguh, almost all native Aguh disappeared at the end of the World War II, and thereafter exotic breeds were introduced in this area. The collection and conservation of a few barely surviving individuals having a shape similar to the native Aguh was carried out. At present these pigs were used for brand pigs. Ohmini is a mini-pig being preserved by private businesses and marked as a laboratory animal.

Horses:

After World War II, farm horses and native horses used for conveyance lost their roles, resulting in a marked decline in their numbers. In spite of this situation, eight native populations were left and all have been protected by conservation groups.

Goats:

There are two goats (Tokara and Shiba Goats) which are considered as native in Japan. The Shiba Goat is bred as a laboratory animal in universities and research institutes, categorized as “endangered-maintained”. The Tokara Goat, only limited (< 100) purebred individuals exist in a university and a zoo, the status is “critical-maintained”. Japanese Saanen has been recently increased in number.

Chickens:

During Edo era (1596–1868), the cutting off of Japan from outside contact had a significant effect on the establishment of the Japanese chickens as birds either for pets or for cockfighting. In the Meiji era, those had been used practically under the influence of exotic breeds. Since the liberalization of imports for breeding chickens in 1960, native chickens for practical uses have fallen into a disastrous condition. Some native chickens such as Jidori (several breeds, Japanese old style native), Nagoya, Shamo (O-shamo), Hinai-Dori, Satsuma-Dori and Tomaru are now being used to breed brand chickens. Chabo is a bantam chicken; there are 26 varieties with different plumage patterns and are being raised as a hobby (Nirasawa et al., 1997).

Quail:

Japanese quail is the only indigenous poultry species that have been domesticated focusing on the use of eggs. Recently, this bird has become being popular because it has been regarded as an experimental animal.

Management system for animal genetic resources in Japan

Gene Bank Project by MAFF/NIAS:

The conservation of animal genetic resources had been conducted in each organization. In 1985, The Ministry of Agriculture, Forestry and Fishery in Japan (MAFF) started the Gene Bank Project (<http://www.nias.affrc.go.jp/eng/genresources/index.html>). In the project for animals, the central-bank had been located at the National Institute of Animal Industry [present name; National Institute of Livestock and Grassland Science (NILGS)]. Since 1988, the central-bank for animal genetic resources had relocated in the institute, NIAS (former name; National Institute of Agrobiological Resources), as well as central-banks for plant, microorganism resources. The divisions for DNA conservation and the informatics have also been joined several years later (1993). After reorganization of the national institutes into agencies (2001), NIAS has conducted mainly these projects. We cooperate with sub-banks [NILGS, National Institute of Agro-Environmental Science (NIAES), National Livestock Breeding Center (NLBC)] for the project.

In the project, we carried out surveys, collection, classification and identification of resources. After characterization, we preserve these resources. The central-bank (NIAS) is involved with cryopreservation, mainly focusing on frozen semen. The sub-banks (NILGS and NLBC) are concerned in maintaining live animals. About 200 items including endangered native breeds and also important imported breeds have been registered. Other than the domesticated mammals, we also preserve insects such as silk worms (in NIAS), honey

bees (in NILGAS), natural enemies and insects for the assay of agricultural chemicals (in NIAES). In the project, we conserve 1908 items (from NIAS database, FY2013).

Other projects:

Some projects for animal genetic resources are listed below.

Projects for conserving native horses in Japan: Liaison Meeting for the Conservation and Utilization of Japanese Horses hosted by Japan Equine Affairs Association supports to conserve eight native horse groups.

Natural treasures (monuments): Nineteen varieties of livestock and poultry native to Japan (two horses and 17 chickens) have been designated as natural treasures, which are supported by the Ministry of Education, Culture, Sports, Science and Technology. Only Onagadori in Tosa (Kochi Prefecture) has been conserved as a special natural treasure.

The National BioResource Project: This project, supported by the Ministry of Education, Culture, Sports, Science and Technology, aims to structurally provide systematic accumulation, storage and provision of nationally recognized bioresources which are used widely in life science researches as materials (mouse, rat, xenopus, medaka fish, drosophila, zebrafish, *C.elegans*, silkworm, monkey, *C.intestinalis*, and also plants and microbes). For more details, please visit following site; <http://www.nbrp.jp/about/about.jsp>.

Utilization of animal genetic resources in Japan

These resources are now used for creating new products such as brand chicken or pork, of which values are highly-evaluated by consumers. A total of 185 brand chickens have been registered at Japan Chicken Association (<http://www.j-chicken.jp/index.html>) in 2013. Also, a total of 398 pork as “brand pork” have been introduced this year in the “Brand Pork Hand book 2014” (<http://www.shokuniku.co.jp/brandpork2014.html>). Besides meat production, pigs especially mini-pigs with the special characteristics are purchased for the biomedical studies (e.g. about 1300 heads in 2007) (Saito *et al.*, 2009). The purposes of the utilization of pigs as experimental animals are quite wide (e.g. platform for developing new medical tools, education for medical students, model pigs for human diseases, organ transplantation for regenerative medicine, and etc.). These areas are quite expanding year by year, enabling quite a big number of industrial performances in the future.

INTERNATIONAL COOPERATION FOR MANAGEMENT OF ANIMAL GENETIC RESOURCES

Activities by international organizations

The organization most active for animal genetic resources is the Food and Agriculture Organization of the United Nations (FAO). Information about animal genetic resources is available at the FAO websites (http://www.fao.org/Ag/AGAInfo/resources/en/pubs_gen.html) as a series of journal issues (Animal Genetic Resources – an international journal) and individual publications (e.g. Cryoconservation of animal genetic resources, 2012; *In vivo* conservation of Animal Genetic Resources, 2013). Country reports from each country have been available online as annexes of “The State of the World’s Animal Genetic Resources for Food and Agriculture” (2007). This information is now preparing for renewal as “The second report on the State of the World’s Animal Genetic Resources for Food and Agriculture” planning of publication in 2015. Some other organizations such as World Organisation for Animal Health (OIE), International Society for Animal Genetics (ISAG) and European Association for Animal Productions (EAAP) make their effort on the worldwide conservation of animal genetic resources.

Bilateral cooperation between countries

Many important resources have been threatened by destruction in some countries because imported modern breeds are replacing them for economic benefits. To keep rare and important resources, each country should

have their local gene bank. However, it costs much to construct facilities in some developing countries. On the other hand, as mentioned above, some developed countries have great interests to find and use model pigs for biomedical reasons. If both countries' interests meet well, international cooperation can be started. Recently, Japanese government offers some opportunities in the "Science and Technology Research Partnership for Sustainable Development (SATREPS)" program aiming at 1) international cooperation, 2) addressing global issues and advancing science, and 3) capacity development (for more details, visit: <http://www.jst.go.jp/global/english/index.html>). Our proposal between Japan and Vietnam has been provisionally selected this year (FY2014). If the plan will be approved by both governments, the project will be launched formally and work will run through five years. In the project, we will establish a cryobank system in Vietnam and conserve native pig resources there, and we will also create the system of utilizing for domestic meat industry as "brand pork" and also for biomedical purposes by establishing new animal models, which may give benefits for both countries. Sustainable utilization of porcine genetic resources will help the advanced conservation of porcine genetic resources at a low cost.

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