The Role of Pigs as a Meat Source in the Environment and Human Culture

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Portuguese sailors on their way to Japan came across an island not identified on their maps in 1542. Amazed at the forest-cloaked land, they shouted, "Ilha Formosa," meaning "Beautiful Island." The island had thus come to be known as Formosa, which was to become what we know today as Taiwan with a total land area of 36,179 km^2. The main island of Taiwan is mountainous and afforested, with fertile, cultivated, well-watered and heavily populated lowlands to the west of the central mountain range. The climate is subtropical, with hot humid summers, mild winters and heavy rainfall. There is a continuous growing season for crops and agriculture prospers, in spite of typhoons, violent summer thunderstorms, and flooding as well as prolonged winter droughts. About a quarter of the land is arable. Five percent of the land is meadow and pasture. The human population is 23.1 million and there were more than 6.8 million hogs raised by 13,054 farms in 2002.

Wild pig hunting

The pig has been a tremendously important meat source along with deer in the life of the prehistoric Taiwan inhabitants. This is based on a vast archaeological bone fossil find in Formosa (B.C. 5000 – 6000). The prehistoric inhabitants of Formosa might have had the ability to raise dogs for wild animal hunting to obtain meat sources such as pigs, deer and other mammalian animals. Several tribes inhabited Formosa before discovered by Portuguese. Presently they continue to maintain several traditional hunting skills for wild pigs hunting and pig bones collection. Such skills are used to encourage young boys into maturity. The

scientific name of the Formosa wild pig is "Porcula talvana Swinhoe" which was introduced in 1862 to European people by British Robert Swinhoe and written in his report "On the mammals of the island of Formosa". This report was published in the proceedings of the Zoology Society at London. Robert Swinhoe, an explorer of the natural resources in Formosa, conducted observations of wild animals and plants in northern Hsinchu County in 1856 and in southern Tainan County in 1858. In 2000, Taiwanese zooarchaeologist Ming-yung Chiu theorized from the differing dental criteria for domestic and wild pigs that prehistoric inhabitants raised pigs at the Shisan Hsing and Chih-shan-yen prehistoric sites.

Archaeologically, Taiwan was home to both Paleolithic and Neolithic cultures. The latter appeared at least six to seven thousand years ago. Inhabited by indigenous peoples from the Austronesian linguistic group, Taiwan was primarily a primitive society at the turn of the 17th century. Some scholars believe that Austronesian-speaking peoples first emerged in southeastern coastal China roughly five or six thousand years ago, and that Taiwan was one of their original homes. Australian archaeologist Peter Bellwood theorized that the forefathers of the Austronesian peoples crossed the sea in waves from rice-growing areas along the southeast China coast to Taiwan approximately six thousand years ago. From Taiwan these people dispersed to the Philippines and Indonesia roughly five thousand years ago. They colonized Micronesia more than two millennia ago, and arrived in Hawaii, Easter Island, New Zealand, and other Polynesian islands about a thousand years ago. Conversely, some scholars have interpreted chromosomal analysis results to imply that Southeast Asia may have been the original homeland of two groups of Austronesian immigrants. One group went to Taiwan, and the other to Polynesia. Richard Jr. Shulter and Jeffrey C. Marck relied on linguistic and archaeological data and the theories of Isidore Dyen concerning language distribution and human migration, to propose that Taiwan was the cradle of Austronesian speaking peoples.

In recent years researchers have obtained specific data concerning the genetic and blood relationship between Taiwan's Austronesian inhabitants and groups living in other regions. Taiwan's Mackay Memorial Hospital performed DNA research involving red blood cells and blood types, discovering that Taiwan's aborigines may be the world's most homogenous ethnic group – a so-called "purebred group." Haplotypes (specific gene configurations) commonly seen in Taiwan aborigines also appear in New Zealand's Maori, New Guinean highlanders, Australian aborigines, the Inuit, Mongolians, Japanese,

Manchurians, and Tlingit Indians living in Northern Canada. This suggests that the Taiwan aborigines are genetically linked to these groups. There seems to be a particularly strong relationship between Taiwan's Amis, the New Guinea highlanders and the Australian aborigines. There is also a close genetic link between the Yami of Orchid Island in Taiwan and the Ivatan of Batam Island in the Philippines. The languages of these two groups are still mutually intelligible. Several years ago the Yami initiated a series of visits between Orchid and Batam islands.

Historical records indicated that the Taiwan aborigines were classified as either “raw” or “cooked” during the early years of the Qing Dynasty, depending on whether they obeyed the government and accepted **Han**-Chinese customs. When Taiwan was a colony of Japan, the aborigines were generally termed "*takasago*". An official survey taken during the Japanese period recorded at least 19 different aboriginal groups in Taiwan. The government continued to follow the Japanese classification scheme in 1949, but substituted the term "shan-bao (mountain compatriot)" for "*takasago*". The government also classified the aboriginal population as "mountain shan-bao" and "plains shan-bao " to facilitate administration. By the year 2000, the name of each aboriginal group was recognized again. The recognized groups were the Amis, Atayal, Bunun, Paiwan, Puyuma, Rukai, Saisiyat, Thao, Tsou, and the Yami of Orchid Island. Except for the Yami, with the skill to raise pigs, the other tribes maintain a wild mountain pig hunting culture. The various aboriginal groups in Taiwan are highly diverse in terms of social organization, culture, language, religion and even body type. In pre-modern times, the lifestyle of most groups was constrained by their environment. Those living near the coast specialized in fishing and those living in the mountains specialized in hunting. The aborigines once subsisted through hunting, gathering and slash and burn mountainside land cultivation. Apart from the Amis of Eastern Taiwan and the Yami of Orchid Island, the majority of Taiwan's aboriginal groups have no seafaring traditions. The rapid socioeconomic changes that have occurred in recent decades have caused aboriginal residents to give up hunting, fishing and shifting agriculture. Instead, most make their living by fixed agriculture and other commercial activities. Despite periods of control by other colonial powers, including the Dutch and Japanese, many Taiwan aboriginal groups have assimilated into Han-Chinese culture. Some traditional cultures have disappeared completely. A few groups still preserve their cultural heritage – a heritage deriving from several millennia of

history – relatively intact. Presently, the Yami of Orchid Island in Taiwan still maintain their traditional family values, i.e., adult males should raise their own pigs. The meat from these pigs should be shared equally with all friends on special occasions.

Raising domestic pigs

Pig domestication occurred some 5000 years ago to provide a source of food protein in several civilizations. In China, pork is the meat of choice. Pork fat is used as shortening in the majority of dishes. Chinese cuisine has actually evolved around pork. Valerie Porter mentioned that domesticated pigs are marvelously diverse in shape, size, features and colors. The sway-backed, pot-bellied, wrinkle-skinned lard pigs of South East Asia are in sharp contrast to the long, lean white breeds of Western Europe. The thick, curly coat of Eastern Europe's Managalitsa defies its relationship with the hairless miniature cuino of Central America. Because of the large human population in China, pigs were confined to small households or farms much earlier than in Europe. This type of confinement led pigs to evolve into more docile, lethargic animals that were more dependent upon man for their food supply. In recent years, Chinese archaeologists have claimed that pigs have been domesticated there for 7,000 years. This is from carbon-14 evidence dating pig bones at sites spread widely over the country. It is not only by their bones that prehistoric domesticants can be recognized but also artistic representations give clues. It was only after domestication that pigs gained curly tails or lop ears. In 3486 B.C., emperor Fo-Hi of China decreed that swine should be bred and raised.

Development of the pig industry

With a monsoon climate similar to that of Southern China, and with a history of immigration, it is hardly surprising that most of the local pigs are the Southern Chinese type. The Taiwan native pigs include the Taoyuan and Taiwan Small Black. The Taoyuan is a large pig with a black or dark gray coat color; lop ears, wrinkled skin and a straight tail. The Taiwan Small Black was believed to have descended from a mixture of domestic pigs brought over from Southern China by immigrants and the local wild *Sus scrofa taivanus* that was domesticated by Taiwan's aboriginal people. The Taiwan Small Black with characteristics of long, straight snout and very small ears is also called a miniature pig since the 1970s.

Since the 1990s, it has been called the Lanyu. Both are probably the last to survive and exist only in tiny numbers. The Taoyuan is an indigenous Taiwan breed whose ancestors were brought from Ming-Ching dynasty China in the seven-teenth century. In 1897, Taiwan brought in 7 head of the exotic Berkshire boar breed to cross with local breed Taoyuan sows to produce hybrid vigor hogs. This promoted tremendous meat production in Taiwan. Modern exotics introduced from 1959 onwards, including the Duroc, Hampshire, Yorkshire and Landrace breeds. Later from 1975, it was found that a Duroc boar with Yorkshire/Landrace crossbred sows produced much better progeny for meat production. The three-way cross then became more popular in Taiwan.

Pigs are often fed in confinement on small land holdings with small exercise yards, next to the owner's household. After World War II, Taiwan's successful small-scale farm development played various critical roles and laid the foundation for an economic miracle. Feed mills began producing formulated livestock feeds using mostly imported ingredients on a large scale at the end of the 1960s. The large swine farms, with thousands of sows used modern feed, formulated on farms with modern management and housing systems. During 1986 and 1996, Taiwan became a major exporter of pork to Japan. There were five significant stages in this development:

1. **Meeting the food demand in the rehabilitation stage (1945 to 1953)**
   The government was struggling to restore agricultural irrigation facilities, increase fertilizer supplies, provide better variety and improve farming techniques to increase food production as quickly as possible. The "Rice-fertilizer Barter System", "Fertilizer Distribution Regulation", "Food Management Act", "37.5%-Rent-Reduction", "Sale-of-Public-Lands", and "Land-to-the-Tiller" were in effect. Agricultural production was restored to the pre-war period level.

2. **Fostering the industry sector through agriculture (1954 to 1967)**
   After laying foundation for basic agricultural development, the first four-year national economic development plan was carried out. The "Fostering Industry through Agriculture and Developing Agriculture by Industry" plans were announced. The government reinforced production incentive measures using the "Integrated Pig Farm Programs", "Integrated Crop and Livestock Program", "Farm Financing Project", and "Regulation for Agricultural Extension" programs. To accelerate transferring capital funds from the agricultural sector to the non-farm sector, "The Farm Land Tax in Kind" and

"Compulsory Paddy Rice Purchase" programs were promulgated in 1954 under the food price cap policy.

3. Developing industry as well as agriculture (1968 to 1983)

The development of Taiwan's economy was further advanced. Although the industrial and commercial services led the driving forces for national development, the role of agriculture in providing staple food and its contribution to the entire economy were still recognized. Agricultural production focused on the development of labor-intensive cash crops for exportation. Products such as mushrooms, asparagus and processed tomatoes were used in the early stage. In the later stage, capital-intensive production involved coastal and inshore fishing and hog and chicken commercial farming. Agricultural policy programs such as the "Accelerated Mechanical Program (1970)", "Agricultural Development Act (1973)", "Guaranteed Price for Paddy Rice Procurement (1974)", "Increasing Farmer Income and Enhancing Rural Reconstruction (1979)", and "Enhancing Basic Construction and Boosting Farmer Income (1982)" were launched.

4. Adjustment and renovation (1984 to 1990)

After thirty-years development, agriculture, then a traditional and closed-door sector, reached its development climax under limited and scarce natural resources. At the same time, upon request from trading partners, the foreign importation of agricultural products surged into the domestic market. It was unavoidable that the gap between the production and marketing structure widened due to the influx of foreign products. The "Strengthening the Agricultural Structure and Boosting Farm Income" and "The Paddy Rice Diversion" Programs were implemented. Although agricultural production increased at a 2% annual growth rate, agricultural contribution to GNP declined from 6.3% in 1984 to 4.2% in 1990. The agriculturally employed population was reduced from 17.6% to 12.9% during the same period.

5. Multi-functionality (after 1991)

To meet the challenge of trade liberalization, nature conservation and environmental protection, Taiwan launched the "Integrated Adjustment Program" in 1991, which emphasized the importance of multi-functionality through human resources, land, markets, techniques, organization, fishery, welfare and conservation. The "White Paper on Agricultural Policy" was announced in 1995. It declared a long-term policy toward commitment to integrating production, living and conservation. In 1997, the "Cross-Century

Agricultural Development" program was enacted. The percentage of agricultural contribution to GNP continues to decline in spite of its growing magnitude. Agriculture's contribution further dropped to 2.1% in 2000. The role of agriculture has been transformed from "production-oriented" in the early stage to non-economic contributions such as "open space, greening, scenery and nature conservation".

In 2000, two native breeds were classified: the Taoyuan and Lanyu. The Taoyuan was found only in tiny numbers at research institutes. A few Lanyu remained on the outer islands. The exotic Duroc, Landrace and Yorkshire are the most popular breeds for three-way cross hog production. Young Duroc, Yorkshire and Landrace boars with registered parent(s) were performance tested at the Taiwan Livestock Research Institute, COA started from the first test group of September 1989. There were 40 contemporary groups finishing the growth performance tests at the station by August 1999. There were 3,796 boars in attendance, with 82.8% completing the tests. The starting weight was set around 30 kg during 1989 to 1995. It was then increased to 40 kg in accordance with the national hog cholera free project requirements. The end weight was set at 110 kg during all test periods. The average daily gain, feed efficiency and backfat thickness were recorded and evaluated as a contemporary group deviation form for selection index calculation purposes. All original data and evaluated results were stored in an internet-based database. The performance tested data and related information can be easily accessed from anywhere on the World Wide Web *http://www.angrin.tlri.gov.tw*. The economically important traits such as PSS genotype, lineage information such as registration information, and tested parental performance can be accessed recursively through the web. The minimum ages of the tested boars at 110 kg body weight were 128, 134 and 131 days of age in Landrace (199905 tested group), Yorkshire (199609 tested group) and Duroc (199905 tested group), respectively.

Pig for science studies

Pigs have been closely associated with humans and contributed to human well being for many centuries. They provide humans with food, leather, brushes, fertilizer and serve as companions and garbage cleaners for farm families. In 1950, scientists in a group led by Professor Winters at Minnesota University

initiated biomedical research on pigs known as the Hormel and Pitman-More research in the United States. In 1962, Gottingen University in Germany developed the Gottingen miniature pig, which was considered a new and universal miniature pig. Recently indigenous pigs have declined in Taiwan in the last century. Indigenous pigs were culled and replaced with exotic breed pigs. The miniature pigs reigned as the preferred experimental animal for medicine and/or biomedical research. These miniature pigs were crossed with the Small-eared pig, it has been called the Lanyu, that was one of the indigenous pigs in Taiwan. Today, the Small-eared pig is developed for its small size and conserved as one of the native breeds by the Livestock Research Institute (LRI), Council of Agriculture (COA) and National Taiwan University.

Contribution to biomedical science

The miniature pig was in use for medical research as experimental animals. The Hormel, Pitman-Moore from Minnesota and Gootinggen minipig from Germany were put to good use in biomedical laboratory research. Several special minipigs are used in research. The “Sinclair” is used in cancer research; the “Yucatan” for diabetes and the “von Willebrand” is used for hemoglobin types. These miniature pigs have found tremendous use in biomedical research in Taiwan. Miniature pigs are used as experimental animals because the physical constitution is more similar to that of human beings than any other experimental animals. Therefore, it is a good animal model for pre-clinical operation trial usage. In testing the toxicity of a drug on the kidneys, a metabolic cage can be used to isolate the pig’s urine and excrement. Minipigs are also used for preoperative cardiac catheter testing. The surgeon professor of National Taiwan University Hospital used a piglet with 3 kg body weight and 3 weeks of age for a fresh liver transfer into a yearling pig with 60–70 kg of body weight. This experiment simulated the transfer of a healthy liver from a new-born deformed baby into an old man to replace the malfunctioning liver. Several years ago, more than half the current number of minipigs was used to develop embryo transfer or/and transgenic techniques. Some pigs were used in parasitology, ophthalmology and food science. At present, embryo transfer, transgenic animals, parasitology, ophthalmology and food sciences are applied less than dentistry, arthropathy, immunology, otolaryngology and orthopedics uses. This might reflect the current biomedical research trend in Taiwan.

Miniature pigs moved to the experimental animal stage because of the development of organic transplant technology. The mouse, rat, and rabbit were the historical experimental or laboratory animals due to less cost in propagation and management. Although the reproductive cycle, growth, and life span of the traditional laboratory animals were favorable, the body weight and organ sizes were more far from the corresponding organs in human when compared with those of pig. Primates, monkeys or macaques, were not used because they exhibited poorer reproductive performance and had higher management costs. Pigs are omnivorous animals, like dogs, and can play an important role as experimental animals. Although the reproductive performance of pigs is less efficiency than that of mice or rats, its 114 days gestation (3 months, 3 weeks and 3 days; 3x30+3x7+3 days=114 days) are easy to manage. With 4 weeks nursing after parturition one can expect to have two parturitions within a year with 7–8 piglets per litter. Furthermore, the shape and size of heart and kidneys of pigs are similar to the corresponding human organs, which conduce to organ transplant technique development, and thus make pig being the choice of experimental animal. Finally, what remains is to make the pig easy handle on the operating table and improve feeding management. Therefore, the first consideration is reducing the pig's size to the miniature level for experimental purposes.

Small-eared pig is a miniature pig source

The Small-eared pig has served as the animal model in the Society of Research on Native Livestock reports in Japan. The Taiwan Small-eared pig has small ears and small body size. It has a black coat color, straight erect face and small ears. Because they are not production economically efficient, the small pigs disappeared from the main Taiwan Island before World War II. However, they do exist on Orchid Island, also called Lanyu in Chinese. Lanyu is a separate island off Taitung county in southeast Taiwan in the Pacific Ocean. Primordial Lanyu, called the Nude Island in former centuries, is belongs to one of the Taiwan aborigine Yami races. The Yami tribe on Lanyu raised Taiwan indigenous Small-eared pigs, it has been called the Lanyu since the 1990s, before the official conservation policy made. They kept Small-eared pigs in bunkers. With not enough for food, the pigs were fed taro skins, garbage and human excrement. Century after century natural selection has given Small-eared pig a small body size. Also, the Yami traditionally choose a nursling piglet for food after parturition, which can reduce the litter size and ensure reproduction success under poor

environmental conditions. Thus, both natural and artificial selections strategies helped the development of miniature pig.

The Guam small-eared wild pig, Vietnamese indigenous small-eared pig and Gottingen Miniature Pig of Germany were all developed under similar conditions. Taiwan Small-eared pigs are now developed as experimental animals. With economic growth and development in Taiwan, living standard of the Yami has been greatly promoted. Therefore, it can be expected that the Lanyu bunker Small-eared pigs will be replaced by exotic breeds due to efficient production performance.

Many indigenous pigs in Taiwan are not fed complete mixed feed, such as "Western feed". When indigenous pigs are fed western feed, both growth and reproduction performances are incompatible to that of exotic western breeds raised on western feed (complete mixed feed). These low efficiency indigenous pigs will eventually be culled and extinct. The indigenous Taoyuan pigs were crossed with the exotic Berkshire to produce two highly efficient hybrid breeds for meat production at the beginning of the 1900s. The Taoyuan pigs are currently conserved in the Livestock Research Institute, COA. The Small-eared pig has less economic efficiency and was lost to the main Taiwan Island and kept only by the Yami tribe on Lanyu, a solitary island. It is believed that only changing from food source to experimental animal usage will the Small-eared miniature pig be conserved.

Development of the Lee-Sung minipig

Professor T. Y. Lee and Dr. Y. Y. Sung, from Department of Animal Science, National Taiwan University in 1975, initiated the development of Small-eared pig as a laboratory animal and named as Lee-Sung minipig. In Lanyu, the usual mass selection method was carried out at three weeks of age in one male and five female bases with 3 kg weight each. The selected male is considered as precious piglet that the Yami will not sell to another village. The Yami believe that if you sell your boar, all of your hogs will run away from the village. The litter size of Small-eared pigs ranges from 5-6 head. The Yami tribe will choose slaughter male piglets day by day for food to decrease the litter stress, and thus increases the suckling opportunity for remaining piglets. Therefore, nearly all piglets are females because quite limited male piglets are allowed to survive. This is why it is difficult to acquire a Small-eared boar and has contributed to the disappearance

of Small-eared pigs on the main Taiwan Island. Six piglets chosen were then sent to the department pigsty for performance observations, including body weight measurement, and fed western feed instead. At early maturity, about four months of age with 10 kg body weight in average, the pigs show the mounting behavior and a 21-day estrous cycle, as ordinary pigs. However, boar reaches sexual maturity a little earlier than that of gilt. Although pregnancy is possible from 4 months of age due to early mature characteristics, pig is usually bred at about seven months of age. The pregnancy lasts about 114 days as ordinary pigs and gives 5 – 7 piglets per litter.

Hand feeding for miniature pigs

Small-eared pigs can be hand or trough fed. During the growth period the pigs always have a good appetite and are easy to fatten. Obesity will occur if the pigs are overfed. However, obese pigs with stubby legs are not suitable experimental animals. The cost difference in hand feeding (limited feeding) and trough feeding is substantial. Hand feeding Small-eared pig is limited to 10 minutes consumption time and accounted for 70% of trough feed quantity. The pigs were hand fed from 8 weeks of age to 52 weeks old. The difference between boar and gilt weights was significant at 52 weeks. The adult boar of exotic breeds is, in general, heavier than that of gilt and it was not the case in the Small-eared pigs. Reasons for this are as follows: (1) The artificial selection method used by the Yami tribe resulted to larger male pigs slaughtered for meat and the smallest male pig reserved as the special male piglet for replacement. (2) Early sexual behavior, such as mounting each other starting from 4 months of age, occurred in boar. Early puberty in male piglet also results appetite loss and standing at attention for females, and thus loss weight.

Agricultural by-products were used to study the digestion physiology of pigs and corresponding roughage tolerance measurements were collected. Both Lanyu miniature and TLRI Black No. 1 pigs were used to conduct pig-pasturing experiments in summer. In the Lanyu miniature pig experiment, 14 gilts (5 months old) and 14 30-day pregnant sows (3 years old) were allocated into a 30 x 80 m grazing pasture. The grazing pasture area was equipped only with a water supply and 120 cm height of grasses. After 7 weeks of pasturing, the weights of gilt and sow decreased from 22.5 ± 4.8 to 15.2 ± 3.4 kg and 65.7 ± 14.3 to 49.0 ± 11.5 kg, respectively. By giving half the amount of normal feeding for another two

weeks, weights of gilt and sow gained to 18.2 ± 3.9 and 57.0 ± 14.6 kg, respectively. Although 16 kg weight loss occurred after 7 weeks of pasture grazing, forty-three percent (6/14) of the sows maintained pregnancy to term and produced viable fetuses with 5.1 born alive litter size on average. These results confirmed that the Lanyu pig had high tolerance to forage. Similar experiment was also conducted for TLRI Black No. 1 pigs, which was comprised of 75% Duroc and 25% Taoyuan breeds. Six 5-month-old gilts and six 3-year-old weaned sows were allocated to the grazing pasture for 7 weeks too. Weights of gilt and sow decreased from 63.4 ± 9.2 to 52.5 ± 8.7 kg and 183.6 ± 31.9 to 151.1 ± 29.8 kg. After two weeks on diet feeding after pasturing, the corresponding weights gained to 55.3 ± 11.9 and 155.1 ± 31.9 kg, respectively. There were 32.4 and 17.2% of weight loss in Lanyu miniature and TLRI Black No. 1 gilts. Similar trend was also found in sows of corresponding breeds, which accounted for 25.4 and 17.7% weight loss. The 7-week grazing model in summer pasture for forage tolerance determination could serve as a fiber utilization efficiency evaluation among pig breeds.

Inbred line – Spotty Lanyu

The small pig size has a benefit for laboratory animals. It is always best to have some small variations in genetics. This will reduce the intra-variation error and increases the differences in inter effect treatments in the animals experiment. Therefore, Small-eared pigs served as laboratory animals need decreased genetic variation and thus inbreeding via full-sib mating can be used to accelerate the genetic homology. Selection for small size via full-sib mating was conducted in research institute. The litter size, birth weight, 8-week weaning weight and survival rate, 22-week body weight and yearling weight were investigated and recorded. The inbreeding coefficient in the first inbred generation was 37.5%, which was much higher than that of ordinary selection program. In general, the inbreeding coefficient of farm animals breeding herd is maintained less than 3% for economic purposes. The body size of the third generation offspring from full-sib mating was decreased and corresponding offspring revealed slightly weak body condition. However, the litter size did not decrease although the inbreeding coefficient reached 59.4%. Inbreeding usually has a depressive effect on progeny vitality. Thereby, it was not surprised a recessive lethal gene defect was observed in Small-eared pigs, such as no hind-legs white spotty offspring found in the first generation of full-sib mating. Because these pigs were incapable of

movement, they soon succumbed. To improve the vitality of the inbred pigs, line inbreeding within closed herd was conducted to characterize the uniform small body size with good vigor. The inbreeding coefficient was maintained low and increased slowly in the following generations.

The Lanyu pigs is a native breed with solid black coat color. The founder population of Lanyu pigs was formed and conserved as a closed herd at the Taitung Animal Propagation Station, LRI, COA, Chinese Taipei. There were 4 males and 16 females introduced originally from Orchid Island in 1980 and propagated via random mating since then. In 1993, thirty-seven piglets with white spots on solid black coat were observed and isolated, which may be due to unavoidable inbreeding occurred in the closed conserved population. Following up the isolation in white spots, six boars and eighteen sows were selected to form the base population (G0) of "Spotty Lanyu–inbred line". There were, in total, 37 male and 53 female piglets from 18 litters obtained in the first generation (G1) with average birth weight (mean ± standard deviation) being 0.80 ± 0.20 and 0.74 ± 0.18 kg, respectively. Based on coat color and one-generation per year selection scheme, 6 boars and 18 sows were selected as replacement breeding stocks for each following generation.

The body conformations of G1 and G2 pigs at five months of age were recorded for evaluation, which included body weight, body height, body length, ear length, ear width, chest depth, chest girth, length and girth of fore limb, girth of hind limb, rump width and length of tail. There was no significant difference observed between generations or gender ($P>0.05$). G2 boars and gilts at five months of age weighed 20.30 ± 2.67 and 17.90 ± 4.14 kg, respectively, with a body height of 38.71 ± 1.20 and 36.04 ± 3.51 cm, and body length of 63.90 ± 3.53 and 54.75 ± 12.31 cm, which indicated the potential of Spotty Lanyu being an ornamental pig for recreation. In G4 generation, 63 piglets from14 litters with 4.5 mean litter size farrowed by G3 gilts were obtained with body weights of 0.88 ± 0.21 (N=31) and 0.86 ± 0.13 kg (N=32) at birth for males and females, respectively. The corresponding average weaning weights at eight weeks of age were 6.30 ± 0.67 and 6.18 ± 0.39 kg, respectively. The preweaning survival rate of the G4 piglets was 88.9%.

Inbreeding depression was found in litter size born alive of sows in the Spotty Lanyu inbreeding selection scheme. The G0 to G4 sows had 5.18 ± 2.30, 5.00 ± 2.13, 4.68 ± 2.40, 4.50 ± 1.64 and 4.38 ± 2.09 born alive piglets per litter at first parity, respectively. There was no significant difference among the age at first

parity for the G0 to G4 sows. The range of farrowing age at the first litter was 300 – 315 days of age. The survival rates at 8 weeks of weaning age were 90.5, 84.2, 87.4, 88.9 and 86.0%, respectively. Finally, the Spotty Lanyu pigs could also serve as a animal model for biomedical research due to highly inbreeding background.

Coat color

Although the Small-eared pig is a minipig suitable as an animal model, biomedical research prefers white animals. The "Gottingen" pig in Germany has white and black strains with greater demand in white pigs. Some white spotted pigs were produced in Small-eared inbred herd. However, if the white spots become evenly expanded, the pig develops poor in health. This has thus far prevented white Small-eared pig development. The white spots are the result of inbreeding and F1, of which the white spot X white spot are evidence that the white spot gene is recessive. This recessive gene might be a modified recessive lethal gene. Fortunately, there is evidence that white coat color in pigs is dominant and mating black Small-eared pigs with white Landrace pigs produce white Small-eared pigs. Furthermore, the F1 hybrid appears white or with some small black spots and thus the black coat color in F2 is expected from the segregation of F1 with recessive black coat color of the Small-eared pig and dominant white in the Landrace breed. The white miniature pig is preferable although the body size is larger. Body size is an intermediate inheritance; therefore, the smaller Small-eared pig was used to produce a white colored miniature pig for decreased body size. A back crosses to the recessive black Small-eared pig is a backcross strategy to maintain the dominant white color in the white miniature pig. The Lee-Sung pig body size is between that of the inbred miniature pig and Landrace. Result from hybrid of the former two breeds showed much less weight at six months of age compared to that of exotic breeds, 36.9 kg on average *vs.* 90–100 kg. In addition, four Lee-Sung males at 10 months of age with 25 kg body weight were used to evaluate both semen quantity and quality. The semen quantity was less compared to that of exotic breed boars but the higher sperm concentration made the same of the total sperm number for each collection. The chromosomal karyotype was shown as 2n=38 and similar to all domestic pigs. Also, the Bgl II and Stu I endonuclease cleavage patterns on mitochondria DNA confirmed the maternal lineage between the Lee-Sung strain and the Small-eared pig strain I.

Mitsai – A miniature pig selected for ornamental and recreation purposes

A new miniature pig for ornamental purposes was developed. In 1989, two Lanyu boars were mated with six Duroc sows. Semen was collected from three Duroc boars and used to inseminate five Lanyu sows. Then the hybrid piglets were examined for coat color at eight weeks of age. All piglets exhibited longitudinal stripes from head to tail. Several brown stripes and black stripes appeared side by side on piglets from either Lanyu x Duroc crossing or Duroc x Lanyu crossing. Piglets with brown-black stripes were then selected as breeding stocks and bred using half-sibling relations to produce brown-white striped offspring. However, the brown-white stripping faded at puberty. These brown-white striped piglets were named the Mitsai pig and selection program for brown-white stripping was launched in 1992 with six male and 18 female breeding stocks each generation. The generation interval was preplanned on one year for each generation. Experimental results were as follows: The third generation (F3) of Mitsai sows produced 6.00 ± 2.10 live piglets per litter and 72.8% of the F4 piglets exhibited brown-white stripes, compared to 25.3% in F3. This was an increase of nearly three times. In F6 generation, all piglets showed brown-white stripes, which remained until the pigs reached maturity. The gene for brown-white stripping was postulated to relate to a recessive gene. For economic usage, the Mitsai line with miniature characteristics and brown-white stripping coat color could be served both as an ornamental pig for recreation and a laboratory animal for biomedical research.

The brown-white stripes of Mitsai piglets are expressed as several longitudinal stripes from head to tail with the brown stripe next to the white one. Twelve boars and 24 gilts born in 1998 were mated via full-sibling mating. Ages at first litter of gilts were 280 – 456 days of old with the average age 335 ± 48 days. The litter size at birth and born alive at first parity were 5.0 ± 1.6 and 4.7 ± 1.8 piglets, ranging from 3 to 9 and 1 to 9 piglets, respectively. Litter size at weaned and survival rate at 3 weeks of age were 3.9 ± 1.9 piglets and 83.0%, respectively, with weaned sow weight at first parity being 80.3 ± 15.7 kg. The farrowing interval between the first and second parities was 155 ± 12 days. The litter size at birth in the second parity was 5.3 ± 1.8 piglets with birth weights being 1.04 ± 0.22 kg (N=53) and 1.05 ± 0.25 kg (N=54) for males and females, respectively. The body weights at weaned and at 5 months of age were 3.63 ± 0.94 kg (N=44) and 27.8 ±

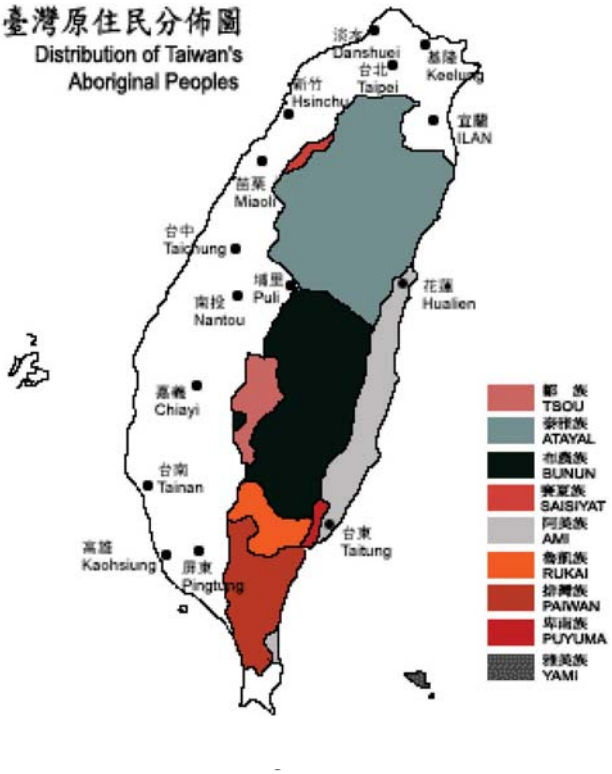
6.1 kg (N=19) for males, and 3.36 ± 0.91 kg (N=45) and 24.1 ± 6.1 kg (N=22) for females, respectively. Results showed that Mitsai sows produced more than 5 piglets per litter at birth and all piglets grew normally when full-sib mating was applied. Inbreeding depression due to full-sib mating was not observed.

Wild pig hunting

Pig skulls collection

Raising domestic pigs

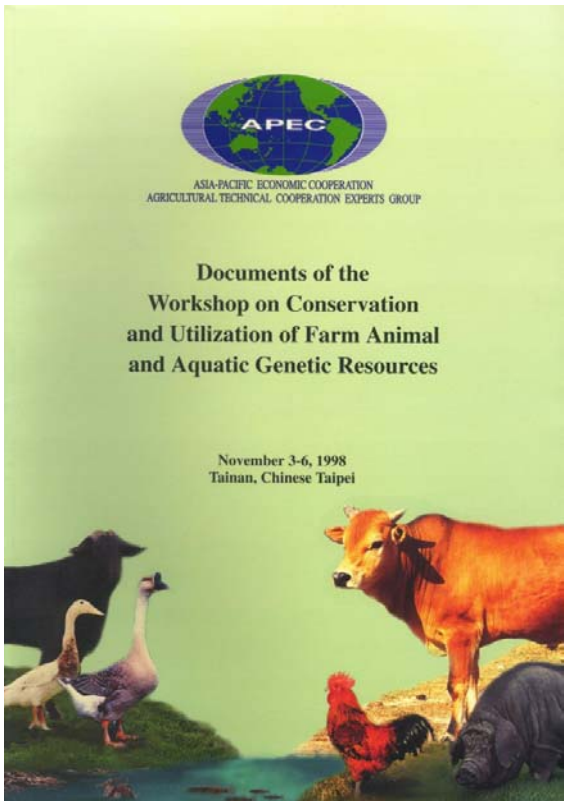
Conservation sites for domestic animals in Chinese Taipei



Distribution of Taiwan aboriginal peoples

Pig breeds in Taiwan in 2000

Pig meat



Documents from the Workshop on Conservation and Utilization of Farm Animals – 1998

New breed – Mitsai pig

郁 和 Swinhoe, Robert
1836～1877

台灣早期最偉大的博物學家

Robert Swinhoe, explorer of nature resources in Formosa

Prehistoric inhabitants in Formosa might have had the ability to raise hunting dogs for wild animal hunting to obtain meat from pigs, deer, and other mammals

Pig toe with red paper used for people's wish in temple