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Foreword

Conservation and sustainable use of Farm Animal Genetic Resources (FAnGR) are important elements for achieving variable and sustainable agricultural production systems. They also represent a very important reserve resource for economic development and food security. Livestock contributes to the national economy in terms of income, food (meat, egg, milk..), traction and manure and others such as skin, feather .. . The human need for livestock products will increase more than double in the next 25 years caused by rapidly increase in human population, rising income and rapid urbanization and changes in preferences for foods of animal origin. The importation of high performance exotic animal breeds for crossbreeding or/and breed replacement has partly met the human demand for animal products, but, at the same time a large number of local breeds with lower productivity have been endangered or are at risk of becoming extinct. The losses are continuing, when we still do not know which breeds harbor significant genetic diversity or specific genes that should be the targeted for conservation.

The assessment of the state of FAnGR is a global question that has to be addressed, in order to protect the domestic animals from the risk of disappearance. This report is a strategic document on domestic animal resources, conservation and sustainable use of FAnGR, prepared on request of FAO (Food and Agriculture Organization of the United Nations).

During the preparation process, the NIAH had received the assistance of the Ministry of Agriculture and Rural Development (MARD); the Ministry of Science and Technology (MOST), the Ministry of Environment and Resources (MOER), Vietnam Animal Husbandry Association, IUCN Vietnam, related Universities and Research Institutes with 28 contributors

A formal workshop was organized at NIAH on the 7th November 2003 with 25 delegates from MARD, MOST, MOER, Vietnam Animal Husbandry Association, related Universities and Research Institutes for comments in document and direct discussions at the workshop for the fulfillment of the country report.

This national report used data from many scientific researches over the years of Universities, Research Institutes in all regions of country especially since the Vietnam

domestic animal conservation project started in (1989). The policy documents were quoted from official documents from MARD, MOST, MOER, the International organizations (FAO, CIRAD, IUCN..). I believe this report will interesting for the audience and will result in actions that make a considerable contribution to the conservation, development and sustainable use of genetic diversity in farm animals in Vietnam. Additionally I hope this document will fulfill the requirements of the FAO.

Finally I would like take this opportunity to thank all of contributors from different organiations (Ministries, Universities, Institutes, NGOs…) for spending their valuable time and energy for helping me in the preparation of this report. Particularly I would like to thank Dr. Mrs Le Thi Thuy (Technical Secrectary-head of the animal molecular genetic lab-Animal diversity Dept-NIAH), Prof. Dr Le Viet Ly (National Coordinator of Vietnamese animal conservation program, 1989-2002), Ass.Prof. Dr Hoang Kim Giao (Deputy Director of Agriculture Dept of Ministry for Agriculture and rural Development), Prof. Dr Nguyen Van Thien (General Secrectary of Vietnamese Animal Husbandry, coordiantior of Project GCP/RAS/144/JPN), Mr. Nhu Van Thu (researcher in the animal molecular genetic lab) for providing information, data, writing relevant chapters and giving valuable suggestions. Special thanks to Prof. Dr. Anne Valle Zarate (Hohenheim University, Germany), Dr. J.C Maillard (CIRAD) for their correcting English and efficient comments. Finally I wish to thank all the researchers of Animal molecular genetic lab for their translation, typing document and all the participants of the workshops for their encouragement and support extended towards me.

Nguyen Dang Vang

Prof. Dr –Director General of the NIAH

Hanoi, April, 2003

Summary

As requested by FAO, a national report on farm animal genetic resources in Vietnam needs to be prepared in connection with the ***"State of the World's Animal Genetic Resources"*** process. The Vietnam national report wish to contribute to form a regional and global strategy on farm animal genetic resources.

This national report is a strategic policy document, starting with an inventory of animal genetic resources of the livestock sector in Vietnam. Following is an analysis of the policies regarding the utilization and conservation of animal genetic resources, animal production systems and promotion of the development of farm animal genetic resources. In the next chapters, an analysis on demands and trends on FAnGR, the capability of Vietnamese institutions and infrastructure and the national priorities and cooperation policies on Farm Animal Genetic Resources is presented. There are five parts and 17 appendices in this report, part 1 is the main component and it contains six chapters.

Part1: The state of agricultural biodiversity in the farm animal sector

Chapter 1 starts with describing the agricultural sector, including development in the animal sector. Vietnam livestock farming developed rapidly during the last 20 years and contributed a significant part to economic development, food supply for domestic market and also in poverty alleviation and food security. At the same time the animal production systems and breeding systems have been changed considerably and the domestic animal breeds have been decreased rapidly. A large number of exotic animal breeds with higher production performance have been introduced to Vietnam, some of which have adapted well and were used for crossbreeding with local breeds in order to help improve animal productivity and the diversity of animal products. This is an indispensable and necessary trend. However, this also led to extinction of several local breeds due to their low production and/or low competitive abilities and an alarming decrease in numbers of some other breeds.

Chapter 2 presents the state of food security, the human population trend in rural area and in the country. The progress in achieving the food security in the last decades in agriculture production

Chapter 3 describes the state of animal production systems, the main animal sectors and their roles in national economic and agricultural production. It is emphasized that pig production plays the most importance role in farm animal production in Vietnam. Recently, the Government policies are prioritizing pig production development for export and in some regions dairy cattle development. The local breeds still play an important role in animal production in Vietnam.

Chapter 4 includes the state of genetic diversity, the number of animal breeds and their state with high biodiversity. Vietnam is a country with more than 60 domestic animal breeds and lines but most of them have been decreasing, as there are more than 80 exotic breeds and lines have been introduced during the last 30 years, especially in recent years. Most of the native domestic animal breeds have been declining in number and the genetic diversity is being severely eroded in traditional breeds. Some of the exotic breeds have adapted very well to Vietnamese conditions and some of them were used for crossbreeding with local breeds. The hybrids play an important role in animal production due to their suitability to farming systems in rural areas and they are identified as a subject that needs to be expanded in the future.

Chapter 5 analyses the state of FAnGR utilization including the government support policies, the legal instruments, the recent state of using FAnGR, the breeding structure and its role in agriculture. Following, this chapter reveals the production state of breeds, assesses animal genetic diversity, and points out limitations in studying of breeds and the high technology for breed selection and breeding management. This part also refers to the weakness and constraints in supporting animal production that still does not meet the recent requirements, and the future trends of animal production development.

Chapter 6 describes the FAnGR conservation activities, the supporting policies and national capacity in development, management and implementation of the *in-situ* and *ex-situ* conservation program to keep endangered breeds from extinction. Among more than 60 existing breeds and lines, many are declining in number to an alarming low level; some are at risk of disappearing. The conservation program, implemented in 1987, has been securing and developing many breeds. There are 15 out of 63 known breeds which are currently restricted or limited in use due to low performance, 17

breeds are used for crossbreeding and 5 breeds were considered to be extinct or in a critical situation.

Part 2 This part analyses and evaluates the past management and breeding policies and their consequence to FAnGR, the expectations for animal production in Vietnam and opportunities and challenges of globalization relating to conservation, development and use of animal genetic resources. The solutions and measures for the development of livestock production are presented in the last section of this part.

Part 3 introduces and evaluates the capability and infrastructure of the institutions and government authorities managing FAnGR diversity, animal production and non-government organizations that support and participate in studying Vietnam biodiversity.

Part 4 reviews the national priorities for the conservation and utilization of FAnGR.

Part 5 with international cooperation and recommendations for enhanced regional and global cooperation in the field of farm animal biodiversity.

The Vietnam National report determines the following targets for the conservation and utilization of farm animal resources:

- *Coordinating closely the conservation and sustainable use of FAnGR*
- *Urgent implementing the in-situ and ex-situ conservation methods to keep and preserve the breeds at risk, priority is given to the breeds with small population.*
- *Stimulating the animal production, veterinary and service activities.*
- *Conserving the genetic resources that have a declining tendency, discovering new genetic resources, characterizing the specific genes in order to set up an effective conservation and utilization program.*
- *Increasing public awareness.*
- *Stimulating International cooperation on genetic resources and exchanging conservation experiences.*
- *Emphasizing on human resources training in conservation, especially on molecular biology techniques in order to evaluate the genetic diversity and contribute to the efficient use of FAnGR.*
- *Establishing a conservation strategy, legal documents for conservation practices and international cooperation.*

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

This part reviews the agricultural sector in general and focuses on the livestock sector. It then describes the status regarding the use, management and development of animal species, breeds and lines. The activities, efforts and capacities of Vietnamese institutions and government on conservation programs.

Chapter 1

1.1. VIETNAM AND AGRICULTURAL SECTORS – AN OVERVIEW

Vietnam is situated in Southeast Asia, with an area of 330,000 km^2 and a population of 80 million in habitants. The population growth rate is 1.5 % per year and this makes Vietnam a densely populated country with about 220 persons per km^2.

In spite of being a small country, Vietnam is one of the richest 15 countries in the world concerning genetic resources. This wealth is brought about by the natural and socio-cultural circumstances.

1.1.1. Natural conditions.

Vietnam stretches over 15 latitudes, from 8°30’ to 23°30’ N, so the climate varies and differs distinctly from the north to the south. North Vietnam is located in the tropical zone, but has cold winters due to monsoon influence; the climate, as a result, has sub-tropical feature while the high mountainous areas are of temperate character. Vietnams topography is varied and complex. Three quarters of the territory surface is covered with mountains. There are steep mountains in the north; on the Central Highland is flat and fertile plains in the north and the south. The variety in climate and geography is the main factor to the variety in agro-forestry biodiversity in Vietnam. Vietnam is situated on the Indochina peninsular, the conjunction of the Chinese and Indian continents, so it possesses many species of flora and fauna from these two great continents. Vietnam is on the conjunction of the Pacific and the Indian Oceans, thus in its development history, a great deal of flora and fauna species from other continents have immigrated to Vietnam by sea.

In Vietnam, there exist two big deltas: the Red River Delta in the North and the Mekong River Delta in the South. The average annual precipitation is considered high, from 1,700 to 2,000 mm, coupled with densely river systems, making Vietnam a country with rich water resources. From North to South, Vietnam can be divided into 7 agro-ecological zones, based on topography soil pattern and climate, three in the North (The Northern Mountain and Midlands, the Red River Delta and the North Central coast) and four in the South (the South Central Coast, the Central Highlands, the South East, and the Mekong River Delta). Currently, in the Statistical system, the North Mountain and Midland is divided in North-West and North-East zones that make up 8 agro-ecological zones. Nevertheless, with ¾ of total area is mountainous region , it is narrow from mountain to sea, the slope patent is high thus in the dry season many parts of the country are facing shortage in fresh water. (from Nov. to April)

1.1.2. Socio-cultural conditions.

Vietnam is a multi-ethnic country, with 54 different ethnic groups. The particular domestication processes of plants and animals and the habits of farming, utilizing products of different ethnicities are the important cause of the abundance in agro-forestry biodiversity. Remarkable to notice is also the diverse ethno-botanical knowledge. Vietnam is acknowledged as a country of early-developed agricultural civilization, which is another cause for the agro-forestry diversity.

1.1.3. Agriculture and livestock sectors

Vietnam is predominantly an agricultural economy country based on paddy rice production. Agriculture generates 23.6% of the Gross National Product (GNP) (2001) and 39.8% of the export income. The sector employs about 65% of the national labor force and 72% in the private sector, of those; approximately 70% are engaged in crop production and 14% in full time livestock husbandry within the agricultural sector.

Crop cultivation accounted for nearly 78% of the gross value of agricultural production, the balance of 22% coming from livestock production and service activities. Livestock production is now playing an increasingly important role in agricultural development with the growing rate at 6,9% per year. Lowland farmers as

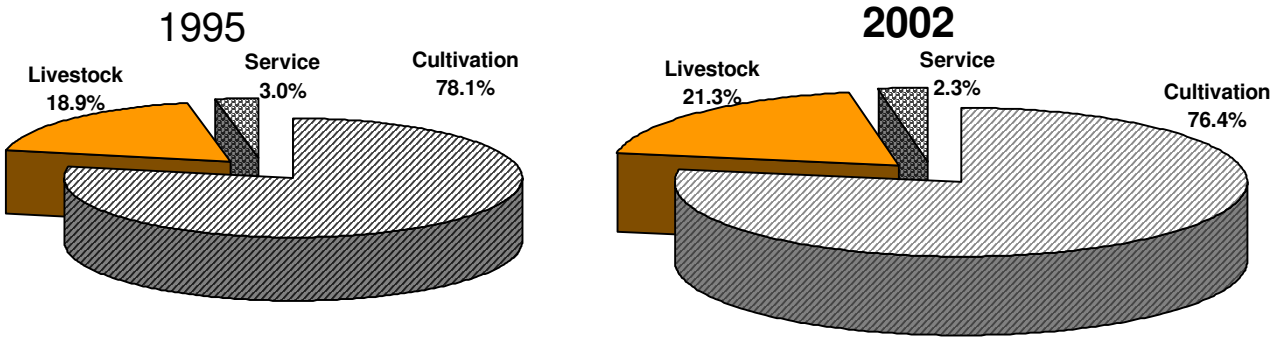
well as ethnic minorities in the mountainous areas raise the highest number of domesticated livestock. Animal husbandry in Vietnam, however, is closely integrating with rice cultivation. Animal production systems are still operating in traditional way in the rural areas, and it has a low productivity. The main objectives of animal husbandry are to satisfy the human demands for meat, milk, eggs, traction and fertilizer for cultivation. The most common local livestock species are pig, buffalo, cattle, chicken, water fowl, goat, horse ... .

Table 1. Importance of livestock to the gross domestic product in agriculture (millions of $US)

Activity	*$US (Millions)*	*Data from Year*
Livestock production (official statistics)	2060	2002
Other agricultural production (official statistics)	7635	
Best estimate of additional value of livestock	350	

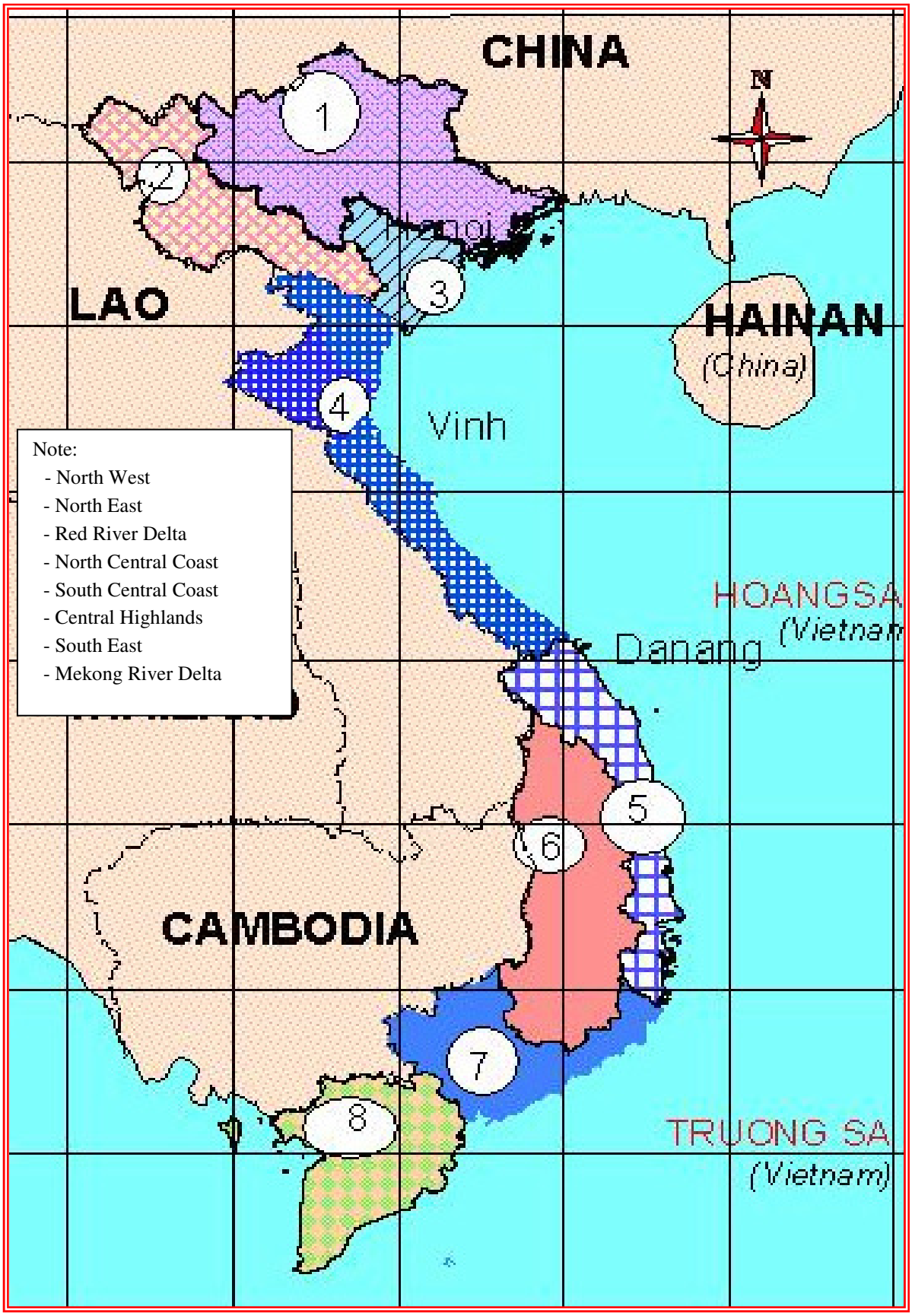
Table 2. Structure of output value of Agriculture

Year	*Total (Million $US)*	*Of which*		
		Cultivation	Livestock	Service
1991	2702.7	2151.3	483.9	67.6
1995	5516.6	4309.3	1043.1	164.2
2001	8398.6	6542.1	1645.3	211.2
2002	9695.6	7415.1	2060.4	220.1



Comparative chart of agriculture output value 1995 and 2002

Map of Vietnam and 8 Agro-ecological zones (free scale)



Chapter 2.

1.2. THE STATE OF FOOD SECURITY AND RURAL DEVELOPMENT

During the last 10 years, thanks to the government's renovation guideline started from the changes of agricultural policies in the early 1980s, our agricultural production is increasing steadily and rapidly. In the past, Vietnam had to import around 500,000 tons of food annually, however, since 1991 Vietnam ranks third among the top rice exporter and become a food security nation. Annually around three million tons of rice are exported. Nevertheless in some regions, such as the mountainous areas, where the land for cultivation and the level of cultivation are limited, productivity is low, transportation and good-exchange are restrained. People usually face food shortage at the between-crop period, and there is a need to increase good-exchange to those areas.

Table 3. Human population in the country

Year	Total (millions)	Rural or Farming (%)	Urban or Non-Farming (%)
1990	66.02	80.4	19.6
1995	71.99	79.2	20.8
2000	77.63	75.8	24.2
2002	79.75	74.9	25.1
Average annual growth rate	1.57%	1.07	3.7

In order to remain food security in a small country with a population of more than 79.7 million (2002) with a growth rate of 1.5% per year (the growth rate considerably decreases from 1,92% in 1990 to 1,33% in the year 2002), the government has set a targets production of 30 million tons of rice, 24 million pigs, 4.2 million cattle, 297 million chickens and ducks in the year 2005. Vietnam strives to bring the live weight livestock production from 22 kg/capita/annum (1999) to 30 kg/capita in 2005 and 40 kg/capita in 2010. Additional, the consumption of eggs will raise from 46 eggs/capita/annum in 1999 to 60 and 75 eggs/capita/annum in 2005 and 2010, respectively.

The rural population is 59.2 million (75.2% of total population). While the birth rate in urban areas has been reduced significantly over the past decade with the Government policies of encouraging only two children per family, there is no reduction in birth rate in rural areas. The increase in population in urban areas is mainly caused by the urbanization process in last 10 years.

Since the cropping is seasonal, a large number of people from rural areas move to the urban areas to look for a temporary job and others take part in some supplementary works such as handicraft, animal husbandry, horticulture or mushroom – cultivation. These changes deeply affect rural economy development, increases income of the rural population and in return, those activities support the agricultural activities and reduce the poverty in rural areas.

Livestock raising in Vietnam is still accurately described as subsidiary to crop cultivation but this is steadily changing and animal husbandry is getting more and more important. Farmers especially in peri-urban area are getting used to intensive husbandry with the “high input – high output” model. Nevertheless, the main animal production system remains very traditional. Its primary function is to satisfy the demands for meat, milk, eggs, draught power, transportation and organic manure supplementation for crop cultivation. In some regions, farmers use animals as a “bank” to store money. Animals are also used in other human cultural and spiritual activities. Parallel with the traditional system, there is a tendency to develop the medium and large size of livestock farms, which happens mainly in peri-urban areas where there is a big demand of animal products.

(Mong cai Pig)

Chapter 3

1.3. THE STATE OF THE PRODUCTION SYSTEM

In the years before 1980, the cooperative farms and state farms played a decisive role in the agriculture economy and most of the farm animals were local breeds with low performance characteristics but they had an adaptive capability to the harsh environment, and the ability to utilize poor quality feeds. Pigs and chicken were the main livestock production that supplied meat and sub-products. Cattle and buffalos were public property providing draught power, which raised in small households. The vast majority of cattle and buffalo were used for draught and very few animals were reared directly for meat (beef).

Since the renovation started (1986), the agricultural system and animal production structure have changed dramatically. The peoples need for animal products such as meat, milk, and eggs are continuously increasing. The demand for high production animal breeds has promoted the importation of exotic breeds of pigs (Landrace, Duroc, Yorkshire..), chicken (Leghorn, Ross, …), dairy (Holstain Friesan, Jecsey) and beef (Ongole, Charolais,..) cattle. The animal production systems have been changing significantly. There are many successful private farms including small and large sizes. Many collective state farms were bankrupt or confronted with difficulties under the pressure of the market mechanism. The big farms and research centers are now becoming main breed suppliers to the animal production network.

In Vietnam, there are two main animal production systems; there are ***"intensive production"*** with large scale production (private or state-owned) and ***" small households production"*** with small scale production system (private owned). The State Agricultural Enterprises play an important economic role in subsidiary crops, particularly industrial crops, ruminants and shrimp production. The state farms or breeding centers are responsible mainly for breeding of imported livestock, and crossbreeding. Over 90% of all dairy cattle, Redsindhi, Brahman cattle and Murrah buffalo; as well as over 80% of Large white and Landrace pigs and over 75% of the hybrid layers and broiler breeding stock are located on these state farms. It is estimated that, there are 10,7 million household farms in Vietnam. Animal husbandry in small household farms is mainly based on extensive

production with low input - low output, many animal species are kept at the same time and the animals play a very important role in the household economy. The most popular size for animal keeping in a small household is 1-2 buffaloes or cattle, 1-2 sows, 3-4 fattening pigs and dozen of hens. The scale of animal raising in the South is usually larger than that in the North. Many households tend to invest in intensive animal production such as laying hens, finishing pig, dairy cattle, goat, duck, and muscovy duck production.

Table 4. Livestock population in Vietnam from 1990-2002

Year	*Buffalo*	*Cattle*		*Pig*	*Chicken*	*Water fowl*	*Goat*
	(1000 heads)	Total (heads)	Milk (tons)	(1000 heads)	(1000 heads)	(1000 heads)	(1000 heads)
1990	2.854,1	3.116,9	11.000	12.260	80.184	23.636	372,3
1992	2.886,5	3.201,8	13.080	13.891	99.627	32.041	312,2
1994	2.977,3	3.466,8	16.500	15.587	99.627	32.041	427,8
1996	2.953,9	3.800,3	22.563	16.921	112.788	38.617	512,8
1998	2.951,4	3.987,3	26.645	18.132	126.361	41.529	514,3
1999	2.955,7	4.063,5	29.401	18.886	135.760	43.563	516,0
2000	2.897,2	4.127,9	34.982	20.194	147.050	50.996	543,9
2001	2.807,9	3.899,7	64.700	21.800	158.037	57.973	571,9
2002	2.814,4	4.062,9	78.453	23.169	159.450	73.840	621,9

National Statistical Sources 2002

The following sections describe the various animal production sectors. The pig, poultry, cattle and buffalo productions are regarded as the main farm animal production sectors in Vietnam.

1.3.1. The pig sector

In Vietnam, the pig is the most important livestock. It is estimated that 1.5 million tons (76.7% of pork in the total of meat production) were produced in the year 2001. Of which, only 2.6% is used for exporting and the remainder is for domestic consumption. The export markets are Russia, Hong Kong, Malaysia and China.

There are about 0.2 pigs per capita, in the period 1983-1993, the pig stock increased at the rate of 2,8% per annum while the total slaughter weight increased at 4.5% per annum. The sows are usually local breeds (mainly Mong cai), most slaughter pigs are commercial F1 crosses between local sows and exotic boars such as Duroc, Landrace, Yorkshire or Hampshire breeds. Most pigs are maintained in small households (90%) with the levels of quality feed supplementation depend on the breed

type and feed availability. Smallholder pig flocks are typically 1-2 sows or 2-4 fattening stock. The average annual yield is about 460 kg live weight/sow/year or 0.7 head reared to an average live weight of 70 kg at 11 months of age.

Small household systems (average 3 to 5 pigs) rely on local available feed such as by-products and intensive production systems (average 200 sows) rely on feeding of concentrate in addition to forage and by-products.

Several tens of crossbreeding formulas have been studied in the last decades. In each system and region different formulas were applied. In intensive farms the formula (Landrace x Yorkshire) x Duroc was applied, with the strategy of "leanization" according to the national pig herd program, since the Government promotes pig raising for exportation. Some regions raising "lean" pigs were established. There are many intensive farms for piglet and pork production. The AI network for pig is present in almost all areas of the lowlands and it contributes to the improvement of pig production.

The imported breeds play an important role in Vietnam's pig production. There are 56% intensive farms and only 9 % small households that are raising exotic breeds while the crossbreds are found mainly in small households and are less common in intensive farms, 58% and 28% respectively. Regarding breed supply, only 5% of the breeds in small households are provided by state intensive farms. The rest are raised or traded by small households themselves, which led to a poor quality of breeds.

Only 1.5% of the total pig herd is kept on state farms where an intensive management system prevails. These farms take part in maintaining and supplying the breeds. The development of pig production has contributed to feed mill production, veterinary practices and AI networks. Quality feed supplementation (with concentrate, minerals and vitamins) is estimate to be an average of 50% of the total feed requirement for a pig.

The major constraints affecting the pig production are limitation in capital sources, high price of feed and piglets, instability of the output market and a high risk of disease in pig husbandry. Most pigs are kept in small households, and in such

systems the profit is usually low. The farmers use indigenous or crossbred pigs and expect multiple purposes from pig raising and to get paid-off for their labor. In the intensive production system, the exotic breeds or/and crossbreds with higher production were used instead of local breeds with low performance and high proportion of fat.

1.3.2. The chicken sector

Chicken production plays the second most important role in livestock production. The local breeds have low performance but they are predominant in number and kept in extensive scavenging systems. It is estimated that there are 12 local breeds and they make up more than 80% of the chicken population in the whole country. The commercial chicken inventories are based on exotic breeds, totaled to about 30 million whereas local breeds of chicken account for 158 million. The stock of chickens has been increasing 3-4% per annum. 65% of the chicken population is in the North and 35% is in the Central and the South. Production systems involving local breeds are generally based on scavenging or foraging. Such systems are also characterized by low genetic potential for egg and meat production and high susceptibility to disease. More than 90% of the chicken is privately owned. The poultry state farms are usually breeding or broiler units with intensive fed birds managed in both cage and deep litter systems. Among the modern industrial chicken breeds only Leghorn and BE breeds are available as grandparent stock and parent stock in Vietnam. For the other breeds, parent stock is imported from overseas. There are very few entities in the private or the state sector specialized in intensive chicken egg production. There are many backyard and farmyard models for chicken keeping. Some exotic breeds such as Luongphuong and TamHoang breeds have been widely used in those systems.

Large scale egg and chicken meat production with confined feeding systems have begun to develop in peri-urban and lowland areas and it is the sub sector with the greatest development potential.

1.3.3. The water fowl sector

Duck, muscovy duck and goose are of primarily importance in poultry production and they are almost private sector. Duck raising has a long tradition in

Vietnam, as it is closely linked to paddy production. The duck population in Vietnam ranks the second in the world following China with about 37 million heads. Raising ducks is simple due to their ability to use by-product from aqua-forestry-agriculture practices. Ducts produce meat, eggs, feathers. Duck production in 1990 was 23.100 tons or 15.3% of the total poultry meat production. In the year 2000, the total poultry production was 292.911 tons, of which, 25% (73.000 tons) came from waterfowl production. The main products from ducks are meat and eggs.

Muscovy ducks are the subjects of development in small household in recent years. The muscovy duck stock is increasing dramatically since it is easy to raise ducks in all agricultural conditions. The meat of the muscovy is liked by consumers and more expensive than chicken and duck meats. The carcass percentage and the lean meat percentage of muscovy duck is higher than those of duck. The local muscovy duck breeds are De and Trau. The French muscovy ducks were introduced in 1993-1995, higher performance strains (R51, R 71) were being introduced to diversify farm animal breeds and animal products.

1.3.4. Buffalo and Cattle sector

Native swamp buffalo and indigenous yellow cattle breeds are predominant in Vietnam. There is a concentration of buffalo in the northern Mountains and Highlands (58% of the national herd), see appendix 6 and 7. The buffalo provides most important draught power, in the past, only culled animals are used for meat. Nevertheless, buffalo meat is becoming more popular for human consumption in Vietnam. The numbers of buffalo rearing for meat is growing. Besides, buffalos also supply organic manure, capital storage and take part in cultural and spiritual activities in some regions. Due to mechanization processes in agriculture, the number of buffalos in plain areas is decreasing, but the total population in whole country is lightly declining. From 1990 to 1999 the growth rate was 0.6% p.a. whereas in recent year buffalo numbers are decreasing by 1.5% p.a. The total buffalo population is 2.85 million and 2.81 million in 1990 and 2001 respectively. Buffalo and cattle management in Vietnam is mainly based on a low input/low output system that is often labor intensive, except in dairy cattle production. Dry season feeding is almost very dependent on rice straw, plantation crops

and tree leaf materials. Rarely fodder crops are grown for ruminant stock. In mountainous areas, ruminant stock grazes and browses more extensively and requires less control. Both draught and meat type buffalo rely more heavily on rice straw than on quality feed for supplementary feeding. More than 99% of buffaloes belong to the small household sector with very little dairy buffaloes.

Unlike buffalo, the number of cattle is steadily increasing about 2.8% p.a (1990 to 2000) due to the efficiency of cattle raising and the government's stimulative policies. There were 54.000 heads of dairy cattle in 2002, an increase by 13.000 heads within one year. The average milk production is 3400-3500 kg/lactation in F1 and F2 crossbred.. It is estimate that in 2010, the buffalo population will slightly decrease to 3 million heads and the cattle population will increase to 4,6 million heads of which, the dairy cattle population will be hundreds thousand.

With the "Zebuization" program since 1994, the ratio of Lai Sind (the hybrid of locals and Shindi breeds) is 28% of the total herds. The Lai Sind cattle play an important role in cattle production in Vietnam owing to its adaptation ability to hash condition in Vietnam. It is used as a base line for beef and dairy cattle in the breeding programs.

In the upland areas, each family usually own between 2-5 head of buffalo and/or cattle. The number of households raising dairy cattle is increasing, owing to the government policies.

In the year 2001, the total beef production was 153,410 tons or 7.7% of the total meat production and 64,703 tons of milk.

1.3.5. The Goat sector.

The Goat sector in Vietnam is mainly privately owned and based on extensive rearing. The goat population has nearly doubled in the last ten years. Goat raising is a component of the shifting process in animal – plant mechanisms; it contributes to the hunger eradication and poverty alleviation program, increase the household income, create more works especially in mountains and midlands areas. The goat population is

621 thousand head (2002), with 95% occupied by the 2 local breeds, Co and Bach thao. The Co breed distributes all over the country and it is raised for meat. The Bach thao is small in number (62 thousand head) and is found mainly in the Central coast and Southern regions and it is introducing to the northern region. Bach thao is raised for dual-purposes meat and milk. Some exotic breeds were introduced to Vietnam in recent years for milk and meat production such as Barbari, Jumpnapari, Beetal, Saamen, Boer and Alpine with the aim of adaptation, crossing with local breeds. The average number of goats in one household rearing goat is 5-10 head.

1.3.6. The other livestock sectors.

Other livestock production such as horse, rabbit, sheep, deer, goose, pigeon, turkey, ostrich, quail, dogs play a fairly important role in some households and systems. Nevertheless, their role in the whole agricultural production is still limited.

The Horse population is around 132 thousand animals, which are concentrated in the Northern Mountains and Midland areas, most of them are local breeds. There are several hundreds Cabadin horses were reared and studied in Vietnam for crossing . Horses play a rather important role in these provinces by providing transportation, power and meat. Besides, horses take part in culture and tourist activities, and they are used in making medical products and medicines.

Rabbit and pigeon are spontaneously raised in Vietnam, the number of rabbits and pigeons are unknown in Vietnam. There is one research center on rabbit and another on pigeon. Many other exotic animal breeds have been introduced to diversify farm animals in Vietnam, for example ostrich from Australia (African ostrich), pigeon from France, rabbit from New-zealand, bear, deer from Myanmar and so on. Some rare and wild animals are also domesticated and raised such as deer, serpent, python, porcupine, bear and crocodile.

Some breeds of dogs were reared in Vietnam for meat, there is still no statistical study for the dog meat consumption annually. There are many households rearing dog with several dozens to hundreds heads with in-cage model

Comparative studies on performance and adaptability of all domestic animal breeds are being carried out in NIAH and its subsidiary research centers.

1.3.7. The Artificial insemination.

Artificial insemination (AI) had been introduced to Vietnam in 1958 for pigs, then cattle (1960), buffalo (1961), horse (1964) and many other domestic animals (chicken, duck..). The achievements in methods of semen storage and extended media have significantly contributed to a broader development of AI. The AI network development helped to improve livestock herds. There are about 200 pig AI stations over the country and they serve for about 70% of the total pig herd. There are about 50 AI stations in dairy cattle areas or project areas. The semen for pig breeding is internally produced and the cattle semen local production serves about 60-65% of the current demand for doses of semen, the remainder is imported form French, Australia, USA, CUBA... . The Moncada center (recently assisted by JICA –Japan) produces cattle straw semen and also preserves semen of several other domestic breeds.

1.3.8. Animal feed and Nutrition

In small households, animals were kept in scavenging systems and animals browse for feed (exclude pig). Supplementary feeding is mainly based on the availability of by-products or/and crop residues from agricultural activities such as bran, rice, broken rice, straw, sugarcane tops, potatoes, batata or vegetables.... The commercial compound feeds are mainly used in intensive animal production. The total domestic production capacity of feed mills is 3.4 million tons (2001) and that meet 32-33% of the domestic demand.

The total grazing area in the whole country is about 5 million hectare with 329 thousand hectare of pasture area, of which, 58% is located in the Northern Mountains and Midlands. Rice straw is largely used in ruminant production. The rice straw production was estimated at 21 million tons, mainly in plain areas (60%). However, the number of ruminants in plain areas only makes up 20 % of the total population. The rice straw treatment with alkalis, acids or ammonia were considered to be efficient methods to improve the nutritional value of rice straw, nevertheless, those techniques are limited to apply in ruminant production.

1.3.9. Animal health situation.

The prevalence of many animal diseases in Vietnam is influenced by nutrition stress, climate, animal production system, breed, and pattern of animal transportation

and exchange. Animal diseases cause a tremendous economic loss in animal production in Vietnam.

The imported exotic breeds of livestock with high productivity are normally more susceptible to disease than indigenous animals. Many infectious diseases are found in Vietnam caused by virus, bacteria, fungi and parasites. The animal diseases, vaccines, drugs, and additives are controlled by the Animal Health department, the six regional veterinary centers, and the veterinary sub-department in each province. The veterinary network covers to community level. The majority of veterinary vaccines used in Vietnam are manufactured in the two vaccine factories, which operate as self-financing Government Enterprises and are under the control of the National Center of Veterinary drug Control – Animal Health department.

(Ho Chicken)

Chapter 4

1.4. THE STATE OF ANIMAL GENETIC DIVERSITY.

1.4.1. The state of Knowledge on FAnGR

With the agricultural and economic development, the human need for animal production and consumption of higher quality product is increasing and this requires better and more productive animals. Numerous commercial animal breeds have been introduced into Vietnam in the last few decades. These breeds enriched the farms animal genetic resources, contributed to the improvement of animal production and diversified the animal products.

Due to the lack of management in breeding there was no conservation strategy in the last decades, the importation of new exotic breeds also led to the extinction of many indigenous breeds and many others are decreasing rapidly in number because their performance, food conversion efficiency or lean meat percentage are much lower than that of imported breeds.

In the years 1950 –1957, 1964-1965 and 1976-1978 Vietnam had carried out a number of surveys on the state of indigenous farm animals. The information of those breeds is available on the DAD-IS. The statistical system in Vietnam was established from government to local levels. Every November, all data are recorded to publish a national statistical year book. The information on animal production is also collected and analyzed.

In Vietnam, the project "Conservation of Animal Genetic Resources" has established a Vietnam Domestic Animal Diversity Database based on FAO's standards (web site address http://www.vcn.vnn.vn). The state of animal genetic is changing annually so it is recommended to update information on number of breeds, population, risk levels and their development trends. Moreover, in many remote regions or villages where many animal breeds were reared and still unknown for us due to no special survey on FAnGR has been carried out.

Since 1987, the Vietnam government has decided to carry out the program on conservation of animals, plants and microorganism genetic resources. Every year, breeds at risk are reported for their status and the project coordinator board will decide the appropriate conservation methods to maintain them. Nevertheless, in remote areas,

the state of some breeds is still inappropriately evaluated. The evaluation of each breed status has not been carried out.

For livestock production, the information on product yield, product quality traits, reproduction performance and lifetime productivity are interested. The indigenous, the exotic breeds and their hybrids have been compared concerning their performance and adaptability. The results of these studies are available in annual reports of the NIAH. There are few private farms, which have individual recording systems. Studies of molecular characteristics have recently been introduced to Vietnam. The initial studies in NIAH on amplification of molecular genetic markers such as Marker Assisted Selection (MAS), Quantitative Trait Loci (QTL) have been implemented to help genetic characterization of population and selection programs for higher performance breeds and lines. Recently, the Vietnam government has put priority policies in capability building to set up research programs on molecular genetic characterization of these different animal population. For example, the government has increased the research budget in animal husbandry and veterinary and extension practices, and it invested in some development programs and upgraded the laboratory equipment on animal biotechnology.

Table 5: Breed Diversity (Number of Breeds)

	Number of breeds							
	Current Total		At risk		Widely used		Lost (last 50 yr)	
Species	L	E	L	E	L	E	L	E
Cattle	7	17	2		5	4		
Buffalo	2	1		1	2			
Sheep	1	0						
Goat	2	6			2	2		
Horse	2	1	1					
Pig	15	10	6		4	6	3	
Chicken	17	23	6		6	7	1	2
Duck	10	4	3	3	1	3		
Muscovy duck	4	2			3			
Rabbit	3	2						
Sika Deer	1	2						
Samba deer	1	1						
Pigeon	1	2						
Goose	1	3	1	1	1			
Turkey	1	1						
Quail	0	1				1		
Total	62	78						

- L = Locally Adapted or Native; E = Exotic (Recently Introduced and Continually Imported).
- Breeds at risk are those with total number of breeding females and males are less than 1,000 and 20, respectively; or if the population size is less than 1,200 and is decreasing.

1.4.2. Assessment of genetic diversity.

The Vietnamese fauna is known to have 275 species and sub-species of mammals, 1,026 species and sub-species of birds, 260 species of reptiles, 32 species of ambiphious, 500 fresh water fishes, about 2,000 sea water fishes, and dozens of thousands of non-spine fauna. The Endemic Vietnamese fauna is numerous, including dozens of mammals, 10 species of birds, 60 fish, etc. Since 1992, five more species of mammals have been discovered, namely Saola (*Pseudoryx nghetinhensis),* Mang lon *(Meganumtiacus vuquangnesis),* Bangten bull (*Pseudonovilos spiralis),* Mang nanh Truong Son (*Canimientiacus truongsonesis)* and Mang Phu hoat *(Muntiacus piliatensis).*

Asia is considered as one of the world ancient animal domestication areas. The animals domesticated here include 12 species, namely Pig (*Sus domesticus*), Cattle *(Bos indicus),* Horse (*Equis caballus*) Goat *(Carpa hircus),* Sheep*(Ous asies*), Deer *(Cervus nippon, Cevus unicolor),* Rabbit *(Oryctogalus cuniculus),* Chicken *(Gallus gallus),* Duck *(Anas platyrhynchos),* Muscovy duck *(Cairina moschata),* Goose *(Anser anser)* and Pigeon (*Columba livia).*

The indigenous breeds are distributed all over the country. The common breeds that contribute to livestock production include:

1.4.2.1 Buffalo and Cattle breeds

Buffalo are concentrated in the Northern mountain provinces of Vietnam with a proportion of 58%. Indigenous buffalos can be divided into two types, Ngo and De. The Ngo buffalo is bigger than the De buffalo. The Vietnamese indigenous buffalo meet the requirement of draught power but their meat and milk performance is low. Vietnam has imported the Murrah buffalo breed from India in 1970s with the aim to develop dairy buffalo and making crossing with the local one. Pure-bred Murrah are maintained and crossed with the Vietnamese local buffalo. But after some decades, it seems that the dairy buffalo is not fitted to our farming system and hardly to be accepted by our farmers. The productive traits of Murrah buffalo seem to be poor in local condition.

Otherwise, there is a failure in F1 for reproductive performance. It may be caused by the attribution of different chromosome numbers between the two breeds.

There are only few recording programs in place for research purposes. Records collected include: live weights at maturity; dressing percentage; milk yield and fat percentage. There is no interest in selection for dairy traits on buffalo.

There are up to 7 groups of indigenous cattle all over the country and they are considered to be one breed (Yellow cattle). The genetic phylogeny of these breeds has not been studied .Each group is popular in a certain regions depending on the interest of the people and its adaptability to local conditions. The indigenous cattle in Vietnam are small in size and have low performance in meat and milk production, but they can adapt well with harsh conditions, and have good reproduction capacity. The indigenous breeds and lines are listed in the table 5 and appendix 5.

In order to improve the productivity, draught power and milk production, Vietnam has imported many exotic animal breeds and germplast such as Red Sindhi, Sahiwal, Brahman, Charolais, Limousine, Herefore, Simental, Santa Gertrudis, Droughtmaster, Belmon Red, Red Brangus Red Brahman, Jersey and Holstein Friesians (HF). The Holstein Friesians lines are widely used for milk production improvement though creating F1, F2, F3 crossbreds (½, ¾, ⅞ HF blood component). For beef production the most popular formula of crossing are between Lai Sind and Red Brahman, Droughtmaster or Charolais. The Brahman is considered to be well adapted in central region of Vietnam.

Recording of beef performance characteristics is restricted to research studies, which are usually carried out in state farms. The data recording on dairy is carried out in state farms for milk yield, adult weight and rarely on fat and protein percentage. These analyses are mainly for research purposes. The program for management and genetic evaluation support written by NIAH (DAIRYMAN) is recently applied in some state farms and intensive private farms. The pure HF herd has increasing dramatically by local reproduction and importation from USA, Australia, Cuba. The population of

dairy cattle has been increasing in the last few years thank to the government policies with the target of increasing the domestic production of milk.

Cattle are also found in forest, natural preservation in the central and southern provinces of Vietnam. Their populations are still unknown and they are protected and regarded as wild rare precious animals. The Bangten bull have appeared in some areas but the Kouprey has not been observed for many years since the discovery of French scientists in the early XX'th century.

1.4.2.2 Pig breeds

Until the 1970s, most of the pig breeds were indigenous with low performance, then many exotic breeds have been introduced to Vietnam. The total number of pig breeds raised in Vietnam is about 25, of which 15 breeds are local and 10 breeds are imported. The list of those breeds is in the appendix 5. The indigenous pig breeds include: I, Mongcai, Baxuyen, Thuoc nhieu, Meo, Tay Nguyen Soc, Muongkhuong, Quang tri Mini, Son Vi, Ban, Lang hong, Co, H'mong pig breeds. The currently popular native pig breeds are Mongcai and Baxuyen. They are being raised in small households or in remote areas where the low input – low output system is predominant. The Mongcai breed is kept mainly in the Northern Mountains and Midlands, the Red river delta and Central Coast of Northland. The Muongkhuong, meo, co and soc pig breeds are only kept in some limited areas in the North Region and Central Region of Vietnam. The Thuoc nhieu, Baxuyen and Phu khanh breeds are distributed mainly in the South, they are crossbreds between exotic and local breeds that have existed for hundreds of years. They are now adapted well with local conditions and their body size is usually bigger than other breeds in the North. Some local breeds were used as based line for crossing with exotic breeds, lean meat percentage was increased from 33.6% in local breed to 42,6% in F1 (½) and 48-52% in F2 pig (3/4 exotic blood component)

The I breed used to be broadly used in the Northern provinces. This position was then replaced by Mongcai breed. The I breed used to face extinction due to the number of boar was critically reduced. Thank to the conservation programs, the pure I pig

numbers more than hundred animals and suffer from inbreeding but is under a conservation program.

The remarkable characteristics of the I breed are: The early puberty and the good maternal abilities, they are well adapted to the harsh conditions of the Red River Delta with poor nutritional conditions to humidity and skin parasites.

The Mongcai pig is originated from Quang Ninh province (northern Viet Nam) with the following remarkable characteristics: It is well adapted to the harsh conditions, has an early puberty, good litter size and good maternal abilities of the females.

This breed is widely kept in small households and it is used to crossbred with exotic boar breeds such as Landrace, Yorkshire.

The number of exotic pigs had been increasing in the last few years when the population of pure native breeds were decreased. Some breeds are facing extinction due to low performance, low lean meat percentage. Only Mong cai pig population has been increasing tendency and broadly raised in northern provinces. The use of exotic breeds in the breeding program of the national pig herds was referred to as “Leanization”. More than half of the national herds are crossbred (Local Vietnamese x exotic).

At present, there are about 3.5 million exotic pigs, 12 million crossbred and 6 million pure native pigs. The breeding centers play an important role in keeping pure breeds and producing hybrids. The native breeds mainly raised in small household in remote areas

Performance recording is mainly carried out on nucleus and multiplication herds. Boars are evaluated for average daily gain (ADG), feed conversion ratio (FCR) and back fat thickness (BF). Sows are evaluated for little size at birth and weaning, and piglet weight at 21 days of weaning.

Genetic evaluations are calculated in some research farms and nucleus farms. Boars and sows are selected on the basis of a selection index. There are some softwares used to help select and manage pig breeding. The PIG-BLUP and PIG-MANIA are provided by Australia and the Vietpig is designed by NIAH.

Wild boar is also found in the forest of Northern Mountainous, Central and Highlands areas. There is not yet a systematic survey on the status and its contribution to human livelihood and genetic conservation.

1.4.2.3 Poultry breeds.

Like pig breeds, native chicken breeds are mainly kept in small households, in rural and remote areas and are based on scavenging or foraging and they play a very important role in farmers livelihood through daily protein from egg, meat and goods exchanging.

There are 16 native chicken breeds and lines over the country. The most common breed is the Ri chicken. The Ri breed is found in almost all regions of Vietnam, its color is mixed and depends on people's interests in the region it is raised in. The meat and egg productivity of the Ri chicken is low but the meat quality is good and it is suitable for backyard or farmyard production.

Other breeds are kept in limited areas, for example Ho chicken in Thuan thanh-Bacninh province, Dong tao chicken in Khoai chau- Hung yen province, H'mong chicken in Northern mountain regions and so on.

There are about 23 exotic chicken breeds imported mainly for intensive farm production systems. Some breeds were used for crossbreeding with local breeds in order to improve indigenous chicken production (Rhode Island, Leghorn). The exotic breeds are mainly commercial breeds (layer or broiler), some can be used in farmyard production systems such as the Luong phuong chicken or the Tam hoang chicken. Recently many strains of chicken have been continuously introducing into Vietnam through research projects, commercial companies such as nude-naked strains from Germany, Hungary.... Some breeds and strains were widely used in certain periods in the past but now they bring less economic value thus they had reduced in number or no longer be used such as Leughorn, Plymouth rock ... *(see app. 4)*

There are about 10 exotic chicken breeding centers in Vietnam. The average flock size of these breeding enterprises is 10,000 to 20,000 hens. They keep parent and

grandparent stocks. A recording program is carried out for exotic breeds in NIAH and some other state farms. The information includes breed performance and disease resistance.

There are 8 local duck breeds and an equal number of imported breeds which are being raised in Vietnam. These breeds are: Co, Bau, Bau quy, Bau ben, Ky Lua, Moc (Binh Dinh), Nang (Lang son) and Omon duck. The Co duck occupies 70% of all local ducks but they are mixed. For improving duck production, some breeds have been introduced: Cherry Valley, CV Super M, CV2000 layer, Khakicampbell, Pekin, Anh Dao and Tiep ducks.

The indigenous breeds have been rapidly decreasing or mixed. Two breeds, Bauquy and Co ducks, are kept in the conservation program to select and purify these breeds for further utilization. Other native duck breeds statuses are less comprehensive and a survey for detailed assessment of duck the breed status must be carried out, in order to decide which breeds need to be conserved. The popular exotic breeds are : CV.Super M, CV layer2000, Khaki Campbell.

The performance characteristics are recorded in two duck breeding centers; the Daixuyen duck breeding center and the VIGOVA breeding center. These centers also keep GGP and GP flocks.

There are 3 types of native muscovy ducks raised in all regions of Vietnam. They are called according to their plumage color: Namely "Re" (white color), "Trau" (black color) and "Sen" (mixed white and black color). The French muscovy duck : R31, R51, R71, and the French weighty muscovy ducks are recently introduced in Vietnam. They are all raised for meat. It is estimated that there are 10 million adult muscovy ducks in the whole country.

Two breeds of native geese are kept in difference regions of Vietnam. Three exotic goose breeds are also present in Vietnam, they are Lion goose from China, Rheinland from Germany, Land from France. The number of exotic geese is limited.

It is estimated that 80% of the total poultry population is native and the number of poultry produced is over 100 million/annum. Thanks to the conservation program, some endangered breeds have been rescued and their population is increasing. Some of them are a good example of the success of combining conservation and utilization of FAnGR such as H'mong, Ac and Ho chicken and Bauquy duck.

In intensive systems, high performance exotic breeds have tremendous contribution to meat and egg production for domestic consumption and exportation. Leghorn and Plymouth Rock breeds have been imported for 20 years, recently, many breeds such as Rhoderi, Tamhoang, Luongphuong, Kabir chicken breeds, French muscovy duck, CV.SuperM and Khaki Campbell ducks have been introduced and brought remarkable economic efficiency. The industrial white chicken produced 14 million and 65 million colored chicken are produced annually. While the CV.Super.M duck and the muscovy duck produced 17 million and 6 million heads respectively.

There are some more poultry species raised in Vietnam and they are in a development tendency such as native and French pigeons, African ostrich, turkey and quail.

There are many jungle fowl, pheasant, partridge, peafowl breeds and their relative living in almost all forests in Vietnam. They come from the same ancestor with native Vietnamese chicken and they are considered to be potential genetic store for genetic studying and conservation.

1.4.2.4 Other livestock breeds.

There are 2 local goat breeds raised in Vietnam - Co and Bach thao breeds. The Co goat is predominant and raising for meat. It is raised in all regions of Vietnam especially in mountainous areas. The Bach thao goat is mainly raised in the Central Coast with a population of about 60.000 heads and it is raised for dual purposes meat and milk. The milk performance of the Bach thao goat is low (0.8-1,65 liter/day in 154 days of lactation). The goat number is regularly increasing and the population in 2002 was 621 thousand heads. The average herd size of a goat-raising household is 5-10 heads.

There are 3 Indian milking goat breeds which have been introduced since 1994 (Barbari, Juamnapari and Beetal). They are used for crossing with the Co or Bach thao goats to improve the productivity of the crossbreds. The Indian goats and their crossbreds are introduced and expanded in household production. Three American goat breeds have been recently imported to improve meat production supply. They are Saanen, Apil and Boer breeds.

The sheep population in Vietnam is small with an increasing tendency. Sheep are mainly raised in Phan rang – South Central coast of Vietnam, namely the Phanrang sheep. It is a meat-type sheep that may have originated from India hundred years ago. This breed adapts well to the dry and hot climate and low feed quality of this region. The Phanrang sheep was introduced to the North to study its adaptability and reproduction. Thank to the conservation and utilization, the sheep herd has increased from 1-2 thousands (1990) to 22 thousands animals in 2002 and bring considerable economic value for the sheep keeper.

The population of the Vietnamese horse is 132 thousand heads and the number of horses is stable. It is concentrated in the Northern Mountainous and Highlands provinces. Horses play an important role in socio-economic activities in highland areas such as transport or draught power. There are different phenotypes of horse in Vietnam, however, they are considered as one breed. The number of white pony is limited in Vietnam and this breed is in the genetic conservation program.

The Cabadin horse was imported long time ago (1960s) to improve the performance of native horses through crossbreds and thousands of Cabadin crossbreds are being raised.

Deer is a semi-domesticated animal and raised in many areas for velvet, meat and for tourism. The Sika deer is widely raised while the Eld deer and Samba deer are decreasing in number. The Deer farming was originated in Hatinh province and now it has been introducing to many areas with the total estimated of about 15000 heads. There are 2 breeds of deer from Myanmar (Hog deer and sika deer) which had been introduced, but are still considered as rare animals to supply for the zoo.

(Rodri breed)

Chapter 5

1.5. THE STATE OF UTILISATION OF FAnGR

1.5.1. Policy and legal Instruments.

In order to support the management and to promote the development of animal production, the Vietnam Government has issued a number of policies and decisions. The Government also determined the preferential breeds and species, which will contribute to the national economic development. These policies have had direct impact to the use and management of FAnGR

- Decision 125/ CT dated 18/4/1991 of the Chairman of the Minister Council (now it is Primer Minister) on subsidy fund for maintaining and improving the livestock and poultry breeding herds.
- The 13/CP government's decree (02/3/1993) on agricultural extension activities.
- The 14/CP government's decree (19/3/1996) on animal breeding management and MARD's circular letter to instruct the implementation of the 14-CP government's decree. In those documents, the production and management of pure breeds (GGP, GP breeds), the farm animal resources management, importing new breeds, the animal breeding policies, the list of farm animal breeds which are allowed to trade and the standard for breed quality characterization are clearly defined.
- The 15/CP government's decree (19/3/1996) on animal feed management
- The resolution No 06 of Central government (10/11/1998) on solutions for the development of agriculture and rural areas
- The Government's Decision 225/1999/QĐ-TTg (10/12/1999) on the Program on Animal breeds, crop plant, forest-plant varieties in the period 2000-2005.
- The Resolution 03/2000 NQ-CP (02/2/2000) on agricultural farms development
- The Government's decision 09/2000/NQ-CP 15/6/2000 on solutions and policies for shifting the agricultural economy structure and products consumption

- The Government's Decision No 166/2001/QĐ-TTg (26/10/2001) on solutions and policies to develop pig production for export to the year 2010, in which some measures to promote the commodity pig production in favorable regions are started. The State will support and implement vaccination and upgrade the enterprises which produce vaccines. Other measurements are on capital supporting, slaughter houses and processing plans, piglet (stud animals), technical support, AI and veterinary practices to improve meat quality for exporting. The target is 100.000 tons of pork for export in 2010.

- The Government's Decision No 167/2001/QĐ-TTg (26/10/2001) on solutions and policies to develop dairy cattle in Vietnam to year 2010 defines that the development of dairy cattle production should be closely related to the development of dairy processing plans, specialized areas, capital support, vaccine, AI, land for grass cultivation and technical services. The improvement of milk production should be based on the use of potential genetic resources of local breeds, like the Laisind breed and the high productivity of dairy cattle breeds though crossbreeding.

These documents focus on changing the mechanism of animal production, increasing the consumption of animal products, increasing the effectiveness of smallholder systems, controlling diseases. The importation of high performance breeds and maintaining the local breed resources at the same time in order to supply the appropriate breeds for different production systems. Proper attention should be paid to local breeds because they can adapt well to local environmental conditions and the farming system of Vietnam.

1.5.2. The state of use

1.4.2.5 Buffalos and Cattle.

Most of the buffalo kept in Vietnam are native breeds. The main contributions of buffalo in agriculture are draught power, meat, manure. The number of buffalo raised for meat is increasing and there are some studies on the improvement of local buffalo body size through breeding by using big sized male buffalos on the base of better diet to improve the growth performance and carcass percentage. Establishing a model on

buffalo raising for meat is also carried out in NIAH. There is neither a breeding structure nor a recording system for buffalo. There was an attempt program for improvement of both meat and milk performance by crossing the local buffalo with Murrah buffalo but the result was poor due to malfunctions in the reproduction of the hybrid.

There are two research centers doing research on buffalo breeding, the Center for Research and Development of Mountainous Animal Husbandry (the former name is the Bavan Horse and Buffalo Research Center) in Thainguyen province and the Buffalo and Pasture Research Center in Binh Duong province. Nevertheless, there are no breeding program and neither breeding structure for buffaloes.

The local breeds of cattle are mostly used for draught power and beef, even though they are small in body size. The Government has a program to improve the local cattle performance herds by crossing local cows with Red Sind or Ongole bull. The production of crossing formula is called "Zebuization" and the resulting crossbreds are called Lai-sind. The number of Lai-sind cattle is about 28% of total cattle population. The next cross depends on the breeding goals:

- To improve dairy production, the F1 then cross with Holstein Friesians bulls (or its semen)
- To improve beef production, the F1 breeds to beef cattle bulls such as Charolais, Limousine, Herefore or Brahman.
- To improve draught power, the F1 are continually upgraded to Red Sindhi.

The imported cattle breeds are kept to study their adaptation and used in pure breeds or crossbreds. In order to take full advantage of imported breeds, genetic resources on production performance and the adaptability to local conditions of native breeds, the number of crossing formulas have to be studied in order to improve meat or dairy production. At present, there are 10 dairy cattle research centers and farms. The pure HF and crossbred (Laisind x HF) are mainly used. One research center is working on Red Sindhi cattle and one AI center producing semen of Red Sindhi, Shahival, Brahman, Holstein Friesian. Nevertheless, large amount of pellet semen was imported from USA, Canada, Australia, France and Cuba. The AI networks for cattle insemination is present in dairy cattle or/and project areas. There are about 30 AI stations all over the country.

With the Government's policies to promote dairy cattle development and the requirement of domestic consumption as well as export of milk and dairy products, the number of Laisind cattle and dairy crossbred cattle will be continually increasing. The stock of dairy cattle is 54.000 heads, an increase of 13.000 heads in one year and it will be hundreds thousand in 2010. This is a heavy task needs to make joint effort between farmers and different level of authorities.

In cattle and buffalo production, the private sector does not take part in breeding and breeding management but it does in commercial animal raising and consumption activities. The modern supportive techniques have been recently studied in order to apply them in animal breeding practices such as Embryo Transfer, Embryo sex determination, QTL techniques, determining the genes that contribute to quality and quantity of milk and beef production and genes relating to disease resistance. Those techniques will bring about tremendous changes in cattle production. The NIAH has been applying a dairy cattle management program (Dairy-man) but only in intensive farms or breeding centers. The breeding structure is only carried out in breeding farms. In household, there is unstructured breeding due to free grazing and the population per each farm is too small.

1.4.2.6 Pig breeds

The native breeds are mostly founded in rural/remote areas and far from large consumption market. Nevertheless, the hybrids are predominant and the population of native breeds decreased. The total population of pig was about 23 million heads (2002) of which, the native breeds was about 6 million heads and mainly distributed in uplands, rural and remote areas.

High productivity exotic breeds will be used to meet the requirements of urban consumption and exporting market. In domestic consumption and in rural areas, the hybrid will be predominant, the dame line is a local breed and the sire line is a high performance exotic breed such as Duroc, Yorkshire or Pietrain.

The local breeds and crossbreds are widely raised in households since they can utilize by-products, natural vegetables, broken rice, maize, rice bran or fish meal. Based

on low-input systems, they require simple management and conditions, and they withstand the hardships. In rural and mountainous areas, pigs are raised for multi-purposes such as capital storage, use in cultural activities as wedding ceremony, funerals, religious celebrations, gifts and of course they supply manure for plant cultivation.

With efforts to introduce pig breeds with higher productivity to rural and remote areas in extension and poverty-alleviation programs, some local or/and crossbred pigs have been gradually introduced to low-input systems to help improve the productivity of these systems. In the intensive systems or in the households where high productivity breeds such as Landrace, Yorshire, Duroc and their crossbreds were raised in adequate conditions (feeds, health care and hygiene), the efficiency of this system is much more than that of a low input system.

Systematic breeding is carried out only in nucleus herds and breeding farms. Straight breeding is used for pure breed keeping in GGP and GP herds and it is employed mainly for exotic breeds. Unstructured breeding is commonly used in the household and in the extensive systems. The breeding objective in that system is referred to as “Leanization” to improve the product. In both production systems, the breeding objective is similar: to increase the productivity of lean meat yield per pig. The quality and quantity traits are interesting in all breeding systems, while disease resistance, lifetime productivity traits are not yet considered. There are 10 breeding center with nucleus herds, mainly exotic herds. The breeding programs are implemented by using AI. There are 100 breeding farms which serve as multiplication herd with the average size of 200 sows and 10 breeding boars. 10% of exotic sows are for pure breeding and 90% are used for crossing. There are 4 boar-testing stations, two in the North and two in the South. However, only 30% of the current testing capacity is used. The majority of the boars used on small farms, for either AI or natural service, are purebred indigenous or exotic breeds. Up to 60% of the national pig herd is using AI. In each province there is one to several AI station.

Crossing pig is fairly important in commercial pig production. The crossbreeding with the aim to use the heterosis and introduce the high performance genes of imported breeds into the pig herd.

In the main breeding and selection system, the main indices of pig performance are evaluated. Some new techniques for evaluating pig performance such as back fat thickness by using ultrasonic probe, Pig – BLUP and a Vietnamese management software - Vietpig are recently used in some pig breeding farms. The molecular tools that assist the selection and breeding programs are being studied in NIAH.

With the market driving forces for meat quality and productivity, together with trends in economic development, only one breed that give high quality products and good reproductive performance such as the Mongcai, Baxuyen pigs can maintain and develop because they can be used as base lines for crossing. The other breeds will be declining and if we don't have strategies to keep them and exploit their good potential, they will soon be extinct.

Some exotic breeds due to degradation of genetic breeding over many years importation and/or not meet the target of leanization have been decreased in number such as Larger white, Hampshire, Berkshire and DE. (*See appendix 5*)

1.4.2.7 Poultry breeds

Apart from supplying meat and eggs, the local breeds also take part in cultural and social activities in Vietnam, for example Ho and Choi (fighting) chicken are for entertainment in religious celebrations; Ac and Tre chicken are used for medical purposes, Tre chicken are raised as pet birds. In the human livelihood, they supply daily food and protein and also bring extra income when necessary. The native breeds are mostly kept in small households. The performance of imported breeds is much higher than native breeds. In imported breeds the feed consumed per 1 kg of weight gain is lower, the live weight at slaughtering is higher and the age at slaughtering is shorter the local ones. Nevertheless, raising imported breeds requires higher investment and depends largely on the market demand. Therefore, not all households can raise chicken in intensive system patterns. The local chicken, which raised in scavenging systems is always sold 1.5 to 2 times more expensive than normal broiler.

The recording system is only carried out in some state breeding centers. The straight breeding is used for GGP and GP keeping in state breeding farms and run by the government. For multiplication production systems, crossbreeding is used. Many exotic breeds are used in pure lines as layer or broiler. There are a number of crossing formulas between local and exotic breeds. Of which, the crossing combination of (Luongphuong x Mia) x Kabir chicken or Luongphuong x Ri chicken are good formulas used in farm yard raising. For layers, the traits lifetime productivity, production yield, feed efficiency and adaptability are of the main interest. For the broilers, the breeder interested in feed efficiency and product quality traits. The imported breeds are being adaptively raised and selected in 10 poultry breeding centers all over the country. The average flock size is 10.000 to 20.000 hens and kept in GP and PS flocks. About 18% of the farmers buy chicken breeds from state-breeding farms, the remainder gets them from other private farms or by self-supply. Apart from state breeding centers, some private farms and joint ventures companies such as CP-group take part in producing and supplying poultry breeds. Up to now, there is no research and application activity of molecular tools for breeding selection.

Duck is raised and developed in aquatic regions, especially in rivers, streams, and paddy fields. The Duck production is largely private own and are closely linked to paddy production. The distribution of duck is mainly in two main deltas (*58% in Mekong river delta, see appendix 6 and appendix 11*) and coastal trip of Central region. The breeding objectives vary from North to South. In the South, ducks are used primarily for meat production, while in the North, the main purpose of duck raising is egg production. Ducks are raised mainly along the costal areas and in river deltas, particularly the Mekong river delta where 58% of the country's total duck production. Records are kept by two state breeding centers - the Dai xuyen Duck Research center in the North and the Livestock Technology Transfer Center in the South. These Centers keep parent and grandparent stocks.

Duck meat production is highly seasonal as it relies on rice harvests time from April/May and September/October. Duck egg production is less seasonal. The exotic breeds are used in both pure breeds and crossbreds. The crossbreeding system is used to improve the production of local breeds. The pyramid breeding structure is only applied in the 2 duck breeding centers. The GP flocks are kept in these centers. In local breeding farms, the PS flocks are maintained and crossbred ducks are produced for large scale meat

or egg production. Some private farms or enterprises also take part in producing crossbreds but the breeding systems are poorly maintained or mating is unstructured so their performances are unstable.

1.4.2.8 Summary of the other main points.

In order to meet the increasing requirement of livestock products, the government seek to increase productivity per animal by two methodologies of breeding

- *Improving the indigenous animal breeds by selecting the pure breeds (pure breeding)*
- *Changing the genotype of traditional farm animals' type by either breed substitution or crossbreeding.*

Straight breeding is applied for imported and local breeds in breeding farms and breeding research centers and also in the conservation programs under the supervision and support of the Department of Agriculture – MARD, Ministry of Science and Technology. This is the fundamental genetic resource for the development of sustainable agriculture. For improving the animal production in crossing, all indigenous breeds can be used as maternal line and the exotic breeds as paternal.

In animal production development, the National Institute of Animal Husbandry plays a very important role in animal breeding, pure breeding, crossbreds, studying on the animal nutrition and feeding. NIAH also contributed significantly to technology transfer to farmers. The NIAH has two poultry research centers, one cattle and pasture research center, two duck breeding center, one goat and rabbit research center, one pig research center with one GGP farm and a number of research divisions, extension center carry out the animal production over the country. In addition, the Vietnam Livestock Corporation takes part in management and operate the livestock breeds, animal products.

Others exotic breeds such as goat breeds(dairy goat from India, meat-goat from USA), muscovy duck, pigeon strains (several type of muscovy duck and pigeon from French); rabbit from New-zeland, Hungary to diversify the domestic products

Currently, there are two Government programs that promote the animal production for domestic consumption and export: "lean meat" pig production and dairy cattle development programs.

1.5.3. Future trends in utilization and development

The animal production in Vietnam is characterized by inadequate feed resources, poor breeding management system, low genetic selection pressure and low livestock productivity. This leads to the erosion of genetic resources and creates low quality progeny meanwhile many of high quality breed are used as commercial production. The breed recording and performance systems for management and improve genetic of breeds are only carried out in some state-owned breeding centers. In additions, the modern techniques for evaluating and have been recently introduced in Vietnam, their contribution to breeding and selection programs is still not significant.

The requirements on environment protection, sanitary, food security, products quality and market driven will contribute to livestock production system and farm animal structure when Vietnam take part in regional and global economic organizations in order to increase the competitiveness of animal products in domestic consumption and export. The breeds that do not meet the requirement of large scale production will be lessen and introduced to conservation program and instead of those, the high quality and productivity breeds will be used.

The breeds which will essentially contribute to animal production in the near future will be dairy cattle (local breeds x Red Sindhi x HF) for milk production, the Laisind cattle crossed with beef cattle for meat production, high performance of pig breeds for pork production, and high productivity of chicken and duck breeds. If the imported breeds are raised and managed in intensive systems, they will perform high productivity and the breeder will get more profit. Nevertheless, with the conditions of small household, it is more suitable to use the native and/or crossbreed animals.

The main targets of livestock production development, in short term and long term , in Viet Nam are mainly to satisfy the domestic consumption. The quantity of exporting livestock productions is not worth mentioning due to a number of disadvantageous factors in competition such as low productivity (cased by local breeds, high price of feeds, hot and moisture condition), low quality and strict veterinary barrel. Hence, the introduction of higher performance exotic breeds to increase the competitive ability for exporting may get little success.

Animal husbandry branch in Vietnam should take advantage and exploit the human consumption need of high quality of product from native animal such as scavenging chicken, Ri chicken's eggs, native pig meat (the meat with toughness and softness in balance and its quality is the same from wild boar).

The government has already an hunger alleviation and poverty eradication program, the policies to support the poorest villages and methods to increase social demand. With densely population and the increasing living standard, the demand for domestic consumption will be increased and the domestic market will develop steadily.

Farm animals development:

Buffalo: we should strive for increasing buffalo-meat for the market demand and keep the buffalo population not decreasing. Buffalo rearing is very popular and it is one of the advantages of the households in the Northern mountainous areas and in the North Central Coast. The appropriate ecological condition of those regions for buffalo rearing and high-price of buffalo-meat are bring certain benefit for the farmers.

Cattle: beef cattle development need paying special attention since the draught power for crop cultivation is mainly solved by machines, furthermore, cattle beef is remain a valuable food sources in the market and is steadily increasing during last tens years. However, the beef ratio in Vietnamese's people daily meals is still small.

Dairy cattle: It is necessary to develop dairy cattle in order to provide milk – products, to diversify the farm animals, to create more jobs in the rural areas and to replace a portion of imported-milk(about 30%). However, we should pay much attention to the competition of milk when integrate policies take effect and appropriate measures for the small household raising dairy cattle should be put in to practice.

Pig: Pig production is the top range of development and eating habit of Vietnamese people. Besides developing lean meat for urban consumption, crossing of local and exotic breeds and also local breeds will be accepted since a large number of consumers living in rural and mountainous areas. Moreover, pig manure will still very necessary for crop cultivation. Nevertheless, the trends of pig heads increasing will slow down and development trends will focus on productivity and production quality.

Poultry: With the increasing demands, the commercial broiler will continuing develop. Scavenging chicken which is the choice of the gastronomers, and high income people will steadily increasing . Duck, a well known water fowl of Vietnam will developing and closely link to deltas, Red river delta and Mekong River delta. The native duck with delicious meat characters will be conserved.

Goat: Goat will be certainly developed in mountainous regions with semi-scavenging model.

Others livestock breeds will not have suddenly changes since their contributions to national economic are limited.

In summary, due to the small scale of animal rearing in small household will commonly exist in next 10-20 years so the farmers will chose the advance of using wisely the native and crossing breeds to take full advantage of locally available feeds (especially the agro-industries by-products) for livestock production. The large herbivorous livestock will have a considerable development in number and production.

1.5.4. The constrain factors to the use and development of AnGR.

- The breeding system and the organization of producing animal breeds are inappropriate. The animal raising activities are mainly carried out in small farm scale; it is difficult to apply the advance approaches in genetic and breeding to improve animal production.
- The main sources of animal feed are in short supply, such as, corn, soybeans oil meal, fish meal, premix, amino acids. The domestic sources satisfy only 70% of the national need. The feed mill price is still high; the cost for feed makes up 70% of the product cost. The feed quality of 136 feed mills over the country is different and most of the small feed mill has poor feed quality.
- The shortage in budget in order to establish an adequate farm animal genetic conservation system for guaranteeing breeds supply for mass production.
- The prevalence of diseases is a latent threat to livestock production. The effectiveness of veterinary documents, decrees and laws is limited. The conditions in slaughterhouse and processing plant are poor.

Local chasing pig in Sonla province

Chapter 6

1.6. THE STATE OF FAnGR CONSERVATION

The genetic diversity of FAnGR can be conserved in a variety of manners: Conservation by development and use, *in-situ* and *ex-situ* conservation. The farm animal conservation program started in Vietnam in 1987 with the NIAH's initiative, when the number of native breeds was rapidly decreasing and the genetic diversity of local breeds was eroded. Factors that cause threat to indigenous animal genetic resources include: crossbreds by AI, replacement by exotic breeds; neglect (bottle neck) arising from shifts in social setting and market demand; the uncontrollable breeding in extensive production systems and no strategy for keeping purely native breeds. The objectives of a conservation strategy are:

- To protect the endangered breeds, to identify and to maintain a gene pool of environment adaptation in order to supply the future needs on animal biodiversity
- To provide genetic material for breeding programs
- To maintain the biodiversity in sustainable agriculture for further used in economic, cultural, education, ecology…

At present, the Ministry of Environment and Resources is the focal point together with relevant ministries in charge of management, implementing all activities relating to biodiversity including farm animal conservation programs, plant genetic resources and micro-organism resources. The implementation units are Research Institutes, Universities, Agricultural Extension organization, the Department of Agriculture and Rural development and other social organizations such as Gardening Association, Women Association, Elderly Association.. Genetic conservation is now considered as a national regular task and is annually budgeted. Many breeds have been rescued from the risk of extinction, some breeds such as Ac chickens, Bauquy ducks, H'mong chickens are being developed thanks to appropriate measures in market development and the exploitation of the special characteristics of those breeds.

In 1985, the biodiversity action plant had been approved and it is the policy document in order to conduct, study, and conserve the biodiversity genetic resources. The major elements of the action plan include:

- To satisfy the basic material, spiritual and cultural needs of the Vietnamese people, both for now and in the future, through the wise management of natural resources, and
- To define and establish policies, organizations and actions where sustainable use of natural resources will be fully integrated into all aspects of Vietnam's social and economic development.

From 1993 to 1997, with the support of the Japanese government, Vietnam and 11 other Asia countries have carried out the project GCP/RAS/144/JPN – "Conservation and utilization of farm animal genetic resources in Asia –Pacific" aimed at identifying animal characteristics and conserving the genetic resources for maintaining the biodiversity in sustainable agriculture.

In 1997, the Ministry of Science, Technology and Environment issued the ***"Regulations for management and conservation of plant, animal and micro-organism genetic resources".*** The regulation has defined the contents of management, conservation activities, the breeds needed to be conserved, organizing the conservation implementation, budget and other relating items.

Accordingly, the country has promulgated several laws and regulations, policy documents governing biodiversity conservation and protection. These include: the Biodiversity Action Plan (1995), Law of Management and Protection of Rare and Precious Animals (1993), and the Environment Protection Law (1994). In 1994, Vietnam approved the International Convention of Biological Diversity.

Vietnam has a strict law on import and export and quarantine control on genetic resources. The conservation and development of farm animal genetic resources is going on with a national development strategy on animal production.

The activities in the domestic animal conservation program include:

- Identifying the objects of conservation, conducting survey and evaluating the security level of farm animal. Investigating the informative data on physiology, genetic and economic related traits for characterization of native breeds. Developing alternative stocks with characteristics of native breeds for meeting a wide variety of market production condition.
- Assisting farmers in *in-situ* conservation, establishing small farms for conservation of the species that are really at risk.

- Establishing a systematic *ex-situ* conservation for genetic materials: semen, embryos, somatic cells and DNA samples.
- Using the molecular tools to step by step analyze the farm animal genetic resources for identifying:
  - *The genetic relations among breeds for animal classification (phylogenetics)*
  - *Economic important traits and unique traits for current and future use.*
- When native breed in the conservation program need to be keep at pure herd. Crossing with other breeds should be supervised. Due to many breeds need to be conserved, it is necessary to bring in to play the participating of all constitution in the society such as social organizations, clubs, community, village... The conservation should be closely link to the development and utilization..

Table 6. number of breeds in the conservation program

Species	Local breeds at risk			
	Total	*In-situ* conservation	*Ex-situ* conservation	Both (in and *ex- situ*)
Cattle	5	2	3	2
Buffalo	1	1		
Sheep	1	1		
Goat	2	2	1	1
Horse (*)	2	2	1	1
Pig	10	4	7	4
Chicken	9	7	7	7
Muscovy	2	2		
Duck	4	3	1	1
Goose	1	1		
Deer	1	1	2	
Rabbit	1			

*: include white horse subspecies

1.6.1. Conservation by development and use.

The best guarantee for conserving and maintaining genetic resources is to use them. Development and use may also be regarded as a form of *in-situ* conservation; In such a manner, the animal is conserved, utilized and also developed. The Mongcai pig, Phanrang sheep, Ac chicken, Bauquy duck and H'mong chicken are breeds that are being conserved in this manner.

1.6.2. *In-situ* and *Ex-situ* conservation.

The benefit of *In-situ* conservation is that the genetic resources can be maintained in their natural environment where is the home place of the breed. Only *in-*

situ conservation can truly preserve the ecological system. Promoting *in-situ* conservation is the primary measure towards reestablishment of the lost biodiversity. The measure is to conserve them in household scale. Conservation units are in villages and communities.

The table below summarizes the indigenous breeds and their state. The terms "critical", "endangered" and "vulnerable" are according to FAO definitions. See appendix 5 for more details on all rare breeds.

Table 7. Number of native breeds and their status.

	Cattle	*Buffalo*	*Horse*	*Pig*	*goat*	*chicken*	*duck*	*Goose*	*Sheep*	*Turkeys*	*Deer*	*Muscovy*	*rabbit*	*pigeon*
Critical, declining				4							1			
Endangered, declining			1	2										
Vulnerable, declining	5	1	1	4		5	2	1					1	
Normal, stable	1	1			2	2				1	2		1	1
Growing, Development	1			1		4	2		1			2		
Extinction				3		1	1							
Total	7	**2**	**2**	**14**	**2**	**12**	**5**	**1**	**1**	**1**	**3**	**2**	**2**	**1**

Inbreeding is a latent problem in rare breed under *in-situ* conservation due to their small population. This leads to the reduction in performance and vitality of their progenies. *In-situ* conservation requires regular expenditure. The competition under the pressure of market is a hindering factor for the conservation and the subjects of conservation are sensitively influenced by natural calamities such as flood, typhoons or diseases.

The Rare Domestic Animal Conservation program in Vietnam has successfully applied the *in-situ* conservation to rescue breeds at risk such as the Ho chicken, the Mia chicken, the Dong tao chicken, the Ri chicken, the I pig, the Mongcai pig, the Meo pig, the Co duck, the Bauquy duck and the Phanrang sheep. Some breeds have increased in

number and shifted to conservation by development and use, for example, the Ac chicken, Bauquy duck and Mongcai pig.

For the breeds at risk or races in small numbers, a special raising or preservation condition is needed. *Ex-situ* conservation includes the conservation of genetic material within living animals but out of the environment in which it developed (*Ex situ in vivo)*, and external to the living animal in a cryogenic environment (*Ex situ in vitro)*. Both are applied for these breeds.

The *ex-situ* in vivo has been applied in Vietnam to preserve the endangered breeds as I pig, Dongtao chicken, H'mong chicken, OKe chicken, Bauben duck, Bauquy duck and Kylua duck. The conservation sites are in research institutions, intensive state farms and private farms.

Ex-situ conservation using cryogenic conservation of genetic material such as somatic cells, sperm, embryo, egg or DNA. The advantages of this method are that it is less risky, especially under the natural factors and able to avoid degenerative inbreeding. Nevertheless, this method requires modernly equipped laboratories with high technology and more expense. Due to a number of reasons, the *ex-situ* cryogenic conservation mainly contains animal tissue, DNA and cattle sperm, and in contrary, very few embryos. The table 8 summaries the genetic materials conserved *ex-situ*. Actually, in Vietnam, the conservation activities are implemented for threatened breeds due to the shortage of financial support .

Table 8. The *ex-situ invitro* conservation results

Species	*Semen*	*ADN*	*Embryo*	*Tissue*
Pig		572		300
Chicken		401		
Cattle	220.000 pellets	350	70	200
Horse		40		
Sheep		6		
Sika Deer		44		
Goat		53		
Samba Deer		40		
Co duck		108		
Bau quy duck		50		

1.6.3. Strategy for Farm Animal genetic conservation.

- Conserving while developing and utilizing the conserved breeds, bringing the native breeds into commodities, supplying the initial materials for breeding and genetic research activities
- Establishing a national strategy on conservation of plant, animal and microorganism genetic resources.
- Considering the establishment of a National Center of Conservation and Development of farm animal genetic resources in different locations and duplications for safety.
- Bringing all rare breeds to secure levels
- Applying biotechnology and bioinformatics to characterize the genetic traits, preserve the biological potentiality of FAnGRs. Strengthening the management, development and utilization activities in research, economic development, education, tourism and culture. Restoring endangered genetic resources, selecting and supplementing new breeds which need to be conserved.
- Completing the regulation document systems for management, conservation, and exploitation of genetic exchange activities in order to meet the national needs in economic development and enable integration into regional and international economy.

- Strengthening the human resource training including short term and long-term training, paying more attention on biotechnology fields in characterization of genetic potential for effective utilization of FAnGRs.

In-farm Sika deer

Part 2-
Changing demands on livestock production

This part analyses and evaluates the past management and breeding policies and their consequence to FAnGR, the expectations for animal production in Vietnam and opportunities and challenges of globalization relating to conservation, development and use of animal genetic resources. The solutions and measures for the development of livestock production are presented in the last section of this part.

2.1. LESSONS FROM THE PAST.

1.6.4. Animal production systems.

In the 60s and 70s of last century, agriculture, including animal production system in Vietnam, was organized in cooperative formation, most of the ruminants and pigs were cooperative owned. The livestock were kept in cooperative farms, in small households and in state-managed farms. The national economy was weak and shortcoming, which was the consequence of long wars. The livestock production based mainly on native breeds with low productivity performance and ineffective management mechanisms. Thanks to the renovation process in the mid of 1980s, started in agricultural sectors, the household's economy has improved and the animal production has changed. Animal production systems were gradually changed the cooperative system has been replaced by private household production, which connected benefits of farmers and production effectiveness and efficiency. The animals then have their owners and the owners take care of their animal with all their heart. This led to increasing animal numbers in the last decades. The animal production systems had been changing and to some instant developing. However, because of inappropriate measures and the affect of the market driven economy, mass importation and development of high productivity exotic breeds took in order to catch up with high target on profit and productivity, the native breeds are getting less in number and their role in animal production is declining. Some of them became extinct, other are at risk. Thus, it is necessary to establish strategies focusing on stimulating farmers to develop animal production, provide sufficient services and ensure their benefit in order to develop a sustainable animal production and to conserve precious genetic resources. This is a heavy

task, and it requires well-organized programs and should be based on the efforts of all people .

1.6.5. The breeding systems.

The animal breeding systems in Vietnam have not been well implemented because the population of animals per farm is small and there are little or no recording systems. There has not been much attention paid on maintenance of GGP or/and GP stock. This leads to uncontrollable crossing of native breeds with imported breed, the erosion of genetic biodiversity of native breeds and the wasteful utilization of valuable exotic breeds when they are used as commercial breeds. The breeding systems are being gradually reorganized and obtained successful results in duck production, pig production and cattle production.

The pyramid breeding structure has successfully brought tremendous effectiveness in duck production, breeding centers and duck breeding management as a whole. This is the successful breeding management model that can be applied to other livestock breeding systems.

The main points that need more attention in animal breeding activities are:

- Improve the accuracy of genetic selection by using modern techniques such as back fat thickness measuring, genetic index, individual productiveness testing and genes relating to quantitative traits.
- Establish an effective and efficient breeding program to conserve native breeds that correspond to different production systems.

1.6.6. Genetic resources conservation.

The animal genetic conservation activities have been implemented since 1987 and the program has obtained many important achievements in *in-situ, ex-situ* animal conservation. Those achievements were significant thanks to the concrete guidance of the Ministry of Science Technology and Environment and now it belong to the Ministry of Environment and Resources, the policies and guidelines of the Government, the active management of the program steering committee and the effective coordination of the research and local organizations in implementing the program. Nevertheless, because the late in implementing of conservation program, 5 breeds had disappeared, 4 breeds are in a critical condition and 8 breeds are at risk. Due to the insufficient budget, the *ex-situ*

conservation is not that systematic and many breeds at risk or endangered are not in a good condition to be conserved. There is not yet a gene bank for animal genetic resources in Vietnam and there are few well-trained and specialized personnel in the genetic conservation field in Vietnam.

1.6.7. The Veterinary and Agricultural Extension activities.

Vietnam is located in a subtropical area with hot and humid climatic conditions, the livestock production is mainly based on intensive production and it is gradually changing. Many diseases are prevalent and cause a tremendous economic loss in animal production. Thanks to the vaccination program, some infectious diseases have been partly controlled and eradicated. Nevertheless, the inadequate veterinary policies and regulations, the ineffective implementation of those regulations, together with the limited knowledge of the farmer in disease prevention and control, lead to the reduction of the effectiveness of veterinary practices, especially in remote or rural areas.

Diseases detection and control has to face many difficulties. In some places, farmers don't want to make report the disease when their animals have disease symptoms. The slaughter control and inspection is undisciplined and nearly out of control. The disease quarantine usually takes time due to the inadequate equipment for this task. The proportion of vaccinated animal is low and the quality of vaccines needs to be improved. The veterinary network in local levels is weak and poor in activities. The excess development of alien invaders such as the golden snail, some predator pet fishes are the costly lessons for the lack of discipline in introduction of exotic creature to new environment. The golden snail has caused a significant loss in rice production in southern provinces over the years, a same situation could have happened with Nutria *(Myocastor coypus)* if the responsible organisms had not banned the importation and keeping such animals in the year 2000.

The uncontrollable and animal and animal product at the border gates of importing and exporting lead to the spreading of many contagious disease from neighbor countries

The agricultural extension system has a low investment and effectiveness. The agricultural extension services provide mainly technique, rather than market information, regulations and policies or credit conditions.

2.1. FUTURE DEMANDS AND TRENDS

This part will focus on the needs and trends in the future including the issues on the regional and global economics integration of any nation and worldwide

1.6.8. Global development trend.

The general trend probably will be the increase of human consumption of animal products due to the rapidly growth of the human population, the increase of income and the fast urbanization. The economic development of Southeast Asia countries is considered to be the fastest. Consumers not only require more in quantity but also high quality products, diversification, safety and processing methods are also required. The commercial liberalization in the ASEAN region and worldwide will be the indispensable trend and the products must have enough competitive capacity on both price and quality. It is emphasis that In Vietnam, the consumer taste tends to be in favour of local breeds such as indigenous pigs, scavenging chickens and people accept a higher price. This is a good reason to promote the conservation and use of farm animal biodiversity.

1.6.9. Changes in policy, strategy on conservation, utilization and development of FAnGR.

In order to meet the current requirements and to have adequate policies to gradually change the livestock production mechanism, the government should focus on production and consumption, increase the effectiveness for small-scale households, control animal diseases, maintain the genetic resources of native and import a limited number of exotic breeds in order to supply genetic materials for different production systems including mountainous and remote areas. Some policies encourage the use of native breeds should be applied because these breeds can adapt well to hard conditions in Vietnam.

The capability of an artificial insemination system must be strengthened and increased in quality, the productivity and the efficiency of compound feed, grain feed and agricultural by-product and others source for livestock feed must be improved;

prodding the implementation of labels and product quality; enhancing the research and development activities and agricultural extension should be focused on. Considering the consumption capacity of the domestic market with 80 million inhabitants, the domestic consumption will be very high.

1.6.10. The concrete measures requested:

1.4.2.9 Policies relating to breeding programs.

- Importing, selecting and creating new breeds or lines with high performance, introducing them to mass production to meet the recent requirement. Selecting and crossing to improve the product quality performance. Reorganizing the breeding system in order to supply native, exotic, or hybrid breeds for different production systems.
- Checking, rebuilding and issuing the national breeding index for dairy cattle, pigs, and poultry. Establishing the National Breeding Improvement Council for some important species (cattle, pig, poultry)
- Privatizing the breeding centers to promote the breed improvement, create new breeds/ lines, and enhance the competitive capability.
- Breeding farms which keeping pure lines of GGP or GP and provide commercial animal producers should be supported by the Government.

1.4.2.10 Policies relating to producing and manufacturing of animal feed stuff.

- Intensifying the feed quality control and inspection. Strengthening the capability of animal feed analysis laboratories to evaluate animal feed quality. Issuing a national standard for animal feed; ensuring the accuracy of feed quality in registered labels.
- Creating the material sources for animal feed with low price such as hybrid corn or Soya been. Reducing the importing tax for animal feed ingredients when the local production cannot meet the demands.
- Supporting animal nutrition in research and extension.
- More attention will be needed to processing and post harvest technology in order to improve product quality and safety.

1.4.2.11 Policies relating to veterinary hygiene and animal processing

- Strengthening vaccination, upgrading the equipment and training of personnel for regional veterinary centers. Consolidating the veterinary network at commune level to increase the effectiveness of veterinary services.
- Encouraging and giving priority for loan and credit to develop slaughterhouses and animal-processing systems. Regular and strict inspection the slaughter and animal processing houses.

1.4.2.12 Policies relating to market stimulation

- Establishing some clue markets to collect more goods. Having credit policies to help the slaughter and meat processing enterprises at the clue markets to reduce the transport cost and loss in animal transportation.

- Broadcasting the economic, commerce and market information to all producers, slaughterers, animal product processors and consumers. Ensuring the benefit of all components taking part in animal production.

1.4.2.13 The management policies

- Establishing the Department of Livestock Production in order to quickly set up strategies, policies, and management of the state administration in animal production.

1.4.2.14 The Investment policies

- It is necessary to have stimulating policies to encourage the intensive production systems or large-scale production with specialized zones. This model will reduce the service cost on animal feed, veterinary and hygiene inspection.
- This system requires certain amount of investment. Government should create good conditions for farmers to borrow with low interest and the timelines corresponding to the biological cycle of livestock and capital in construction investment turnover and buying animal breed for this model of the intensive livestock production investment.

1.4.2.15 Policies related to research and extension activities.

- Strengthening the research capability of the Research Institutes including laboratories upgrade.
- Training research and extension personnel
- Giving priorities for researches in main point projects, with a high-tech direction and that correspond to Vietnam's condition such as: studying high productivity breeds; studying breeding facilities, micro-environment in the houses; studying animal nutritional requirements with the direction of balancing the amino acids, vitamins, minerals and energy in the diet.
- Studying and applying the Informatics Technology to manage breeding and selection of dairy cattle, pure line of beef cattle and GGP stock of pig breeds.
- Studying animal product processing and ensure food security, based on the development of an organic agriculture.
- Doing research on the efficiency of different production systems and market demands for animal products.

Part 3
State of National capacities

This part describes the institutional involvement in research, education and extension and rural development, showing which organizations are active and whether the current capacity is sufficient to organize, set up and develop a policy for better conservation, development and use of animal genetic resources.

3.1. ECONOMIC CAPACITY

Vietnam is one of the early places where the animals were domesticated and existing the abundant animal biodiversity include a number of breeds and lines. Thought, Vietnam is still a poor country, limited in conservation capacity, the living standard is low, especially in rural and remote area – where the human livelihood still rely on the natural resources exploitation, moreover, there are a number of breeds need to be conserved and mainly kept in those areas. Consequently, the farm animal conservation task is not easy. The unmanageable of animal hunting and rare and precious animal trading, the unconscious destruction of the surrounding environment are existing. Every year, the budget for farm animal conservation activities is too small (about 35.000 USD) for many breeds and conservation forms (*in-situ, ex-situ*). For those reasons, the mobilization of all resources from government, community and foreign aids is necessary.

3.2. RESOURCES CAPACITY

1.6.11. National Government

On behalf of the Vietnamese government, the Ministry of Environment and Resources together with others ministries are responsible for implementing and managing of the Convention on Biodiversity (Rio de Janeiro, 1992) and the general Government policies regarding animal genetic resources.

The Department of Agriculture and Department of Extension of MARD is responsible for sector policy and planning. These departments are also responsible for directing and coordinating technology transfer, production and marketing. The Agriculture-

Forestry Extension network is expanded to commune level and this network has a significant contribution to livestock production.

The Department of Animal Health is responsible for management, implementing and supervision of all veterinary activities such as veterinary quarantine; inspection; and diseases, drug and vaccine control.

1.6.12. Research organizations

The National Institute of Animal Husbandry (NIAH) and the National Institute of Veterinary Research (NIVR) carry out more than 80% research activities on animal science and veterinary all over the country. The remainder is carried out at the Institute of Agricultural Science (IAS) in the south of Vietnam and the other six Agricultural Universities.

The NIAH is responsible for research in all aspects of livestock production and for the implementation of research results to the production. The main subjects of study in NIAH are: Biochemistry, Biophysiology, Genetics, Nutrition, Reproduction and Artificial Insemination, Embryo transfer, Rare Animals and Biodiversity, poultry, cattle, and pig production. Researches are carried out in 12 research departments, 10 animal research centers from north to south and also in small households and state farms. Most of the farm animal conservation activities are carried out by NIAH's researchers. According to the statistic of MARD in December 2000, the NIAH has 633 staff members, of which 41 are doctors, 64 are MSc's and 213 are engineer or bachelor, and the remainder are technicians and workers. The NIVR conducts all researches related to animal health including Bacteriology, Mycology and hygiene, Virology, Parasitology, Immunology, Epidemology and Disease Prevention (drugs and vaccines). The NIVR employs 215 staff members, of which 26 have a doctoral degree, 58 MSc and 80 have post graduate degrees.

With the investment of the Vietnam government and international support through international research projects, the current research facilities of these institutions is classified as on an average level in the ASEAN region. Nevertheless, to meet the current and future needs in development and utilization of FAnGR, these institutes need more investments in research facilities and human training. The human resources in these

institutes are inadequate. The constrains in the attraction of well educated personnel in research activities are the low salary and the reorganization in permanent staff mechanism.

Most of the Agricultural Institutions with national mandates are located in the North and concentrate their attention on Northern agriculture, whereas Central Vietnam is served by only one major institution- the Agricultural University of Hue and University of Taynguyen. The South of Vietnam is served by the Institute of Agricultural Science, the University of Agro-forestry Thuduc and the University of Cantho. The budget for Agriculture research is small (1% national budget was contributed to research in 1994-1995), recently, the funds for research have improved.

1.6.13. Training Institutions.

The formation and training system in Vietnam consist of 6 Agricultural Universities (two in the North: Hanoi and Bacthai; two in the Central: Hue and Taynguyen and two in the South: Thuduc and Cantho). The Universities are under the direction of the Ministry of Education and Training. The MARD is also responsible for training of farmers, staff and it operates some Secondary Schools of Agricultural Technology.

The Universities offer training at the BSc, MSc and PhD. Levels. Training in BSc levels is completed in 4-5 years. Training focuses on theory and there are fewer chances for practical. Postgraduate training is also offered at some institutes (NIAH, NIVR, IAS). The current opportunities to study abroad are broad and depend on international project and funding support from both Vietnamese government and bilateral cooperation.

1.6.14. Joint venture, private sectors.

Join ventures and the private sector do not take part in research and education activities related to livestock production yet. They participate in trading and manufacturing of animal feed, veterinary medicine, animal breeds, transportation and slaughtering.

There are about 138 feed mills all over the country that manufacture 3.4 million tons of compound feed.

For the domestic market, most of the animal slaughter is done by small farmers and private butchers with poor facilities. Larger scale processing of livestock product is limited. There are three major slaughter plan in Vietnam: VISSAN with a capacity of 40.000 tons in two slaughter houses in the South; ANIMEX, with a combined-capacity of 10 regional slaughter houses of 17.000 tons; Thaibinh with a combined capacity of 6.000 tons through 6 slaughterhouses in Thaibinh province in the North.

There are 4 dairy processing plants in Vietnam with the capacity of 600.000-650.000 tons.

1.6.15. Genetic conservation.

The Government is now paying more attention to the matter of Genetic conservation, therefore the budget for genetic conservation is regularly increasing. There are 6 Ministries concerning to genetic conservation under the regulation of Ministry of Science and Technology. For conservation of agricultural genetic resources, there are 9 focal institutions and a network of genetic conservation include Universities, department of Agricultural and rural development and some Association conduct this work.

The genetic conservation activities have been conducting in Vietnam since 1987, the number of well-trained personnel working in this field is limited but they have obtained much experience from conservation activities in the least decades. A number of young scientists have been training in oversea and they will contribute to the conservation and sustainable use of animal genetic resources.

1.6.16. The nongovernmental organizations

Special importance should be attached for the contribution of NGO's National and International such as Women Union, Elderly club. in collection and conservation of farm animal breeds. The native breeds are conserving more successfully if they are kept closely link to cultural activities (Ho, ac chicken, I pig, Phanrang sheep cases study).

The NGOs and International organizations are taking part in Agriculture activities, Environment and natural resources protection especially the forest, marine, salt-marsh forest ecological systems. Those organizations take part in the consultative activities and technical assistance to the activities concerning to exploitation, conservation of natural resources especially to the biodiversity. Those organisations are UNDP, FAO, IUCN, WWF, Birdlife international, Fauna and Flora International, CIRAD. The CIRAD has cooperated with NIAH since 1999 on studying the farming deer biodiversity and will have further projects on biodiversity conservations and animal characterization.

(I pig)

Part 4
National Priorities
Priority and action plan in AnGR

Vietnam government has stressed several policies and strategies for the development, utilization and conservation of genetic and natural resources. The prioritized policies are a strategy for genetic resources conservation programs and research orientation to year 2010, pointed out by the MARD, the MONRE and the MOST including

Priority actions identified through the consultation process include: survey, classification and documentation of all farm animal breeds, including their production environments, economic traits and estimates of genetic diversity; development of breeding and utilization approaches that can facilitate in situ conservation; and genetic characterization of adaptive traits.

Strategies for conservation and sustainable use need to answer the following questions:

1. Which breeds/strains of domesticated animals and populations of wild relatives need to be conserved as a matter of priority;
2. How can limited conservation resources be allocated amongst the populations that need to be conserved
3. How the contribution of FAnGR to human livelihood can be incorporated into decisions on conservation programmes;
4. How agricultural programmes may be designed to minimize potential negative impacts on genetic diversity
5. How existing policy and market environments can be made more supportive of the conservation and sustainable use of FAnGR.

   Expected outcomes of AnGR program

*. Enhance awareness in the action of the long-term benefits of FAnGR conservation.

* initiate preliminary capacity building for FAnGR conservation at national levels.

* facilitate participatory consensus on the objectives and design of the project through:.

Determine :

* Existing status, trends, utilisation and performance of some priority of poultry breeds, reviewed in assessment of potential species/breeds and specific locations

* Molecular genetic data generated on selected breeds to form a basis for the development and testing of a conservation priority-setting tool due to many Vietnam native animal breeds were created many years ago by indiscriminate crossbreeding under natural selection only or crossed with imported breeds. The evaluation of genetic resources is needed to determine of genetic distance, identify the genetic relations within and between breed as well as economic important traits for today and future use (performance, lactation and disease resistance, unique traits.)

* Identification and assessment of the principal policy and market factors determining trends in indigenous breed numbers and uses of selected species.

* Assessment of capacity building needs at local and national levels: FAnGR management, evaluation of their impacts and existing capacities, training programmes for stakeholders…

2. Learning from experiences
   - Technical solution
   - Implementation and organization
   - Policies
3. Proposal suitable policies for conservation of FAnGR
4. Enhancing knowledge, responsibility of stakeholders between livestock development and conservation of FAnGR and environmental protection.
5. Increase public health and income for farmers

Particular Approaches

Highly respects approaches of conservation through use so to ensure sustainable exploitation of FAnGR.

- To remind every one to put more attention to the sustainable development of agriculture, to keep a balance between livestock, land and environment.

- Training program relevant technology, special concentration for molecular genetic research in identification of genetic variation between and within breeds having

different locations as well as economic important traits for strategic priorities of conservation and sustainable use FAnGR

- should not neglect the development of traditional feeding system.

- Transforming market potential breeds in to production by political supports for long-term breeding programs.

- Publishing Domestic Animal Diversity Information System (DADIS).

- Do not put the sustainable development and industrialization and modernization in contradiction. The sustainable development with support of speed of industrialization in right way.

The development of livestock production closely linked with crop production in a sustainable farming system.

The study on the integration between Livestock, crop and environment protection in Vietnam has been run systematically ⇒ urgent need exchange experiences with other countries and receiving supported from other International Organization.

Part 5
International cooperation

About 70% of global farm animal breeds existing today are in developing countries where the risk of loss is highest and the research facilities, knowledge, technology and budget resources for conservation are limited. Animal genetic diversity plays a very important role in food security and environment al protection. The diversity is the result of thousands of year of evolution and it is the property of not only a specific nation but also of the global community. Therefore, the genetic resources conservation is not only for a specific nation's prosperity but also for the global community to benefit. International cooperation in genetic resources conservation will ensure the successful conservation activities and guarantee the sustainable agricultural development all over the world.

As described in part 4, the Vietnamese government highly appreciates the international cooperation in genetic diversity conservation. Vietnam is a country with rich biodiversity resources including farm animals and their wild relatives. More than 70 indigenous breeds are existing and they have many precious characteristics such as disease resistance, adaptation to harsh environments, including heat tolerance and ability to utilize poor quality feeds, early puberty, good litter size and the good maternal abilities. The meat quality of native breeds is said to be better than the commercial ones. Due to a number of reasons, many breeds are in danger and need to be saved while the budget and facilities for conservation are limited, the task is onerous.

Vietnam wants to strengthen the multilateral relation with International Organizations on Agriculture and Animal development ... such as FAO, ILRI… bilateral and international cooperation with other countries and regions all over the world with respect of getting necessary assistance in order to:

- Establish a system for researching, characterizing, and identifying the traits of farm animal resources. That information is necessary to exploit the potential biodiversity of breeds and long-term conservation and sustainable used of FAnGR in the diverse agriculture.
- Exchange knowledge on In-situ, *ex-situ* conservation and training personnel in this field. Exchanging the genetic resources with other countries to diversify the genetic resources in agriculture.
- Establish the Information Data System, set up a gene bank for animal genetic resources in Vietnam.

Appendices and References

Appendix 1. How this report was prepared.

In 2001, the Vietnam government was invited to submit a national report. The Ministry of Agriculture and Rural development and the Ministry of Science and Technology, which are responsible for management, conservation and utilization of animal genetic resources, requested the NIAH and the national coordinator for animal genetic resources at NIAH to prepare a proposal for a project organization. Dr Nguyen Dang Vang, the national coordinator was appointed in the role of project leader.

The report was prepared following the guideline of FAO through regional training, and training preparation kits by a writing group. The report content is based on the FAO's defined frameworks. The reference documents include scientific reports on animal sciences, veterinary medicine, genetic conservation of Vietnamese scientist over the years; the speeches of scientist, manager on management, utilization and conservation of FAnGR; and the suggestions on policies and measures for the development of livestock production.

The draft was prepared and discussed among the writing group members and a workshop was organized in Feb. 2003 for a large and diverse group of scientists and managers from different fields of animal science, veterinary, and genetic conservation in Institutions and Ministries.

The composition of the writing group is listed bellow, together with participants of the contributor

Project leader

Nguyen Dang Vang
National Coordinator for Animal Genetic Resources
National Institute of Animal Husbandry

Writing group.

Le Thi Thuy. Dr. NIAH, Secrectary
Le Viet Ly. Dr. Prof. NIAH
Nhu Van Thu. NIAH

Workshops on animal genetic resources..

- Genetics and Breeding
- Cattle and Buffalo production.
- Poultry Science.
- Animal genetic Resources Conservation.
- Ministry of Agriculture Rural and Development (Department of Agriculture, Department of Scientic and product quality)
- Animal Husbandry Association.
- Ministry of Environment and Resources
- Ministry of Science and Technology
- IUCN
- FAO, Vietnam
- CIRAD
- Dept. Scientic and technology Dept., Son La provinces
- National Institute of Animal Husbandry
- Hanoi Agriculture University N.1
- Thai Nguyen Agricutural and Forestry University
- Hue Agricutural and Forestry University
- National Institute of Veterinary research
- Natural Resources & Ecological Institute

List of contributors to “Vietnam national report on animal genetic resources" is in the Appendix 24 and 25

Appendix 2. List of abbreviations

ADG	Average daily gain
FAnGR	Animal Genetic Resources
DAD-IS	Domestic Animal Diversity Information System
FAO	Food and Agricultural Organization of the United Nations
FCR	Feed conversion ratio
HF	Holstein Frisian cattle
MAS	Marker Assisted Selection
NGOs	Non Governmental Organization
NIAH	National Institute of Animal Husbandry
NVIR	National Institute of Veterinary research
ILRI	International of Livestock Research Institute
QTL	Quantitative trait loci
SoW-FAnGR	State of the World's Animal Genetic Resources
AI	Artificial Insemination
IAS	Institute of Agriculture Science
MARD	Ministry of Agriculture and Rural Development
MOST	Ministry of Science and Technology
GGP	Great grandparent
GP	Grandparent
p.a.	Per annum

Appendix 3. The endangered breeds

Currently, there are a number of livestock breeds which are insignificantly contributing to livestock production due to low production performance and that are at risk of extinction, they include:

Species	*Breeds*	*Trends*	*Causes*
Pig	I	Decreasing, critical	Low performance, inbreeding
	Co	Critical	Low performance
	Langhong	Critical	Low performance
Horse	White	Endangered	Poor reproduction
Duck	Co	Normal	Mixed
	Bauben	Endangered	Mixed, low performance
	Kylua	Endangered	Mixed, low performance
	Nang (Langson)	Endangered	Mixed
Chicken	Mia	Endangered, small population	Mixed, low performance
	Dongtao	Endangered, small population	Mixed, low performance
	Ho	Endangered	low performance and reproduction
	Vanphu	Critical, extinction	Mixed, low performance
Buffalo	Murrah	decreasing	inappropriate

Appendix 4. Imported breeds

	Breed	Origin	Aim of utilisation	Levels of use	Trends
	Pig breeds				
1	Large White	Russia	BP,Leanisation	Normal	decreasing
2	Duroc	USA	BP, Leanisation	Normal	Increasing
3	Landrace	USA, Japan, French, Russia	BP, Leanisation	Wide	Increasing
4	Yorkshire		BP, Leanisation	Wide	increasing
5	Hampshire	USA	BP, Leanisation	narrow	decreasing
6	Berkshire	Russia	BP, Leanisation	Normal	decreasing
7	Pietrain	Belgium	BP, Leanisation	wide	increasing
8	DE	Germany		limited	decreasing
9	Cornwal			Limited	limited
10	Meishan	China		New imported	
	Cattle, buffalo breeds				
11	Hostain Friesian	Cuba, USA, Australia	Dairy, crossing	Wide	Increasing
12	Sindhi	Pakistan	BP, crossing	Wide	Increasing
13	Brahman	Cuba	Crossing, Meat	Normal	Increasing
14	Zebu		Crossing, Meat	Normal	
15	Charolais		Crossing, Meat	narrow	
16	Brownswiss		Crossing, Meat	Studying	
17	Limosine		Crossing, Meat	studying	
18	Simental		Crossing, Meat	studying	
19	Shahiwal		Crossing, Meat	studying	
20	Herefore		Crossing, Meat	studying	
21	Santa Gertrudis		Crossing, Meat	studying	
22	Droughtmaster		Crossing, Meat	studying	
23	Belmon Red		Crossing, Meat	studying	
24	Red Brangus		Crossing, Meat	studying	
25	Red brahman				
26	Ongole				
27	Jersey	USA	Milk	Studying, RI	increasing
28	Murah Buffalo	India	MP		decreasing
Goat, Deer breeds					
29	Barbari	India	Dairy		Increasing
30	Jumnapari	India	Dairy		Increasing
31	Beetal	India	Dairy		Increasing
32	Sannen	USA	Meat	RI	
33	Boer	USA	Meat	RI	
34	Alpine	USA	Meat	RI	
35	Eld deer	Myanmar		studying	Increasing
36	Hog deer	Myanmar		studying	Increasing
37	Samba Deer	Myanmar		studying	Increasing
38	Cabadin horse	Russia	Crossing	Narrow	normal
39	California rabbit	USA	Meat	Narrow	decreasing
40	New Zeland rabbit	Hungary	Crossing, meat	RI	Increasing

	Breed	Origin	Aim of utilisation	Levels of use/year of introduced	Trends
	Chicken				
41	Leughorn	Cuba	Egg production	Limited	decreasing
42	Plymouth Rock	Cuba	hybrid production	Limited	decreasing
43	Rod Ri	Cuba	hybrid, meat production	normal	decreasing
44	Kabir	Israel	crossing, MP	RI	increasing
45	Goldline	England	Egg production	Normal (1989)	
46	Sasso	French	MP	1992	
47	Hybro	Cuba	meat	1985	decreasing
48	Ross208	Hungary	Meat	1993	decreasing
49	BE	Cuba	Meat	1988	decreasing
50	Tamhoang	China	MP	Wide	Increasing
51	Luongphuong	China	MP	Wide	Increasing
52	Thai hoa	China	Meat	Wide	normal
53	Egypt	Egypt	Meat	RI	normal
54	ISA	French	MP	1999	Normal
55	COB	England	Meat	1996	Decreasing
56	Brownick	French	Egg	1995	N-A
57	707	England	Meat	1992	Increasing
58	AA	England	meat	1990	Limited
59	Hyline	England	Egg	1992	Increasing
60	Lohman	Germany	Meat	1990	Increasing
61	Hurbard	French	Meat	RI	normal
62	Sao	Hungary	Meat	RI	increasing
63	Golden	Hungary	MP	RI	limited
64	French Turkey	French	Meat	1995	N-A
Duck, Muscovy, pigeon, Goose, …					
65	Peikin duck	China	Meat	Narrow	Decreasing
66	CV duck (Hungary strain)	Hungary	Meat	Narrow	Decreasing
67	CV duck (Czech strain)	Czech	MP	Narrow	Decreasing
68	CV- Super M duck	England	Meat	Wide	Increasing
69	Khakicambell duck	England	egg	Wide	Increasing
70	CV Super M1	England	meat	Wide	Increasing
71	CV-Layer2000	England	egg	Wide in the South	increasing
72	Muscovery	France	Meat	Wide	Increasing
73	Rheinland goose	Gemanny	Meat	Narrow	Decreasing
74	Land goose	France	Meat	Narrow, RI	Increasing
75	Lion goose	China	Meat	Narrow	normal
76	French pigeon Titan	France	Meat, pet	Wide	Increasing
77	French pigeon Mimas	France	Meat, pet	Wide	Increasing
78	Ostrich	Australia	Meat	Normal	Increasing
79	Turkey	French	Meat	Narrow	Decreasing
80	Quail	Japan	Meat, egg	Normal	stable

BP. Breed improvement, MP: multi purpose, RI: Recently Introduced, N-A: not available

Appendix 5. Level of using native breeds, their trends and safety .

	Breed	Origin/ conservation site	Aim of utilization	Levels of use	Trends
	Pig breeds				
1	I	Namdinh,Thanhhoa	Meat, crossing	Critical	Decreasing
2	Mong cai	Quangninh	Meat, crossing	not at risk	Decreasing /mixing
3	Lang hong	Bacgiang	Meat, crossing	Critical	Decreasing
4	Ba xuy^{a}n	MRD	Meat, crossing	Vulnerable	Decreasing
5	Thuoc nhieu	Thuocnhieu	Narrow	Vulnerable	Decreasing/ few boar
6	Phukhanh	Khanhhoa		Extinction?	Mixing
7	Muongkhuong	Hagiang	Wide	Normal	Decreasing
8	Meo	Nghean	Wide	Normal	Decreasing
9	Soc	Daclac	Wide	Normal	Decreasing
10	Co	Nghean		Extinction	Without boar
11	Sonvi	Phutho		Extinction	
12	Mini	Quang tri	Meat	Vulnerable	decreasing
13	Ban	North-West	Meat, crossing	Vulnerable	decreasing
14	H.mong	North-West	Meat, crossing	Vulnerable	decreasing
	Cattle, buffalo breeds				
15	Thanhhoa group	Thanhhoa	draught, meat, crossing	Normal	Decreasing (Zebuization)
16	Nghean group	Thanhhoa	draught, meat, crossing	Normal	Decreasing (Zebuization)
17	Langson group	Langson	draught, meat, crossing	Normal	Decreasing (Zebuization)
18	Phuyen group	Phuyen	draught, meat, crossing	Unknown	Decreasing (Zebuization)
19	Baria group	Vungtau	draught, meat, crossing	Unknown	Decreasing (Zebuization)
20	H'mong	Hagiang	draught, meat	Normal	
21	Uriu	Nghean	draught, meat	Vulnerable	Decreasing (Zebuization)
22	Ngo Buffalo	Highland	MP	Normal	Increasing
23	De Buffalo	Lowland	MP	Normal	decreasing
Goat, Sheep, horse, rabbit..					
24	Co goat	Northen	Meat	Normal	Stable
25	Bachthao goat	Ninhthuan	MP	Normal	Increasing
26	Phanrang sheep	Ninhthuan	Meat	Normal	Increasing
27	Sika deer	Nghean	velvet, meat	Normal	Stable
28	Samba deer	Central Highland	Meat	Normal	Increasing
29	White horse	North mountainous	Fancy, medical	Vulnerable	Decreasing
30	Color horse	Thainguyen	draught, meat..	Normal	Stable
31	Rabbit black	Northern	Meat	Normal	Increasing
32	Rabbit white	Northern	Meat	Normal	Increasing
33	Rabbit grey	Northern	Meat	Normal	Increasing
	Chicken				
34	Ri	Northern	MP	Normal	Decreasing/mixing
35	Ho	Bac ninh	Fancy, meat	Normal	Increasing
36	Mia	Sontay	Meat	Normal	Increasing
37	Dongtao	Hungyen	Meat	Insecure	Decreasing/mixing

38	Ac White	Vinhlong	Meat, medicine	Normal	Increasing
39	Ac Black	Vinhlong	Meat, medicine	Normal	Increasing
40	Oke	Hagiang	Meat, medicine	Vulnerable	Decreasing
41	Te	Hagiang	Meat, medicine	Vulnerable	Decreasing
42	Tauvang	Southern		Normal	Decreasing
43	H'mong black	Sonla, Northwest	Meat, medicine	Vulnerable	Decreasing
44	H'mong white	Sonla, Northwest	Meat, medicine	Vulnerable	Decreasing
45	H'mong brown	Sonla, Northwest	Meat, medicine	Vulnerable	Decreasing
46	Vanphu	Yen bai	Meat, egg	Extinction	
47	Tre		Fancy, fighting	Vulnerable	decreasing
48	Choi (fighting)	All region	fighting	Normal	Normal
49	Phu lu Te	Hatay	Meat	Vulnerable	decreasing
50	Turkey	Hungyen	Meat	Vulnerable	Normal
Duck, muscovy, goose, pigeon					
51	Co duck	Hatay	Meat, egg	Normal	Decreasing/mixing
52	Bauben duck	Hoabinh	Meat, egg	Critical	
53	Bauquy duck	Nghean	Meat	Critical	
54	Kylua duck		Meat	Vulnerable	Decreasing/mixing
55	Omon duck		Meat		
56	Nang duck	Langson	Meat, egg	Vulnerable	Decreasing/mixing
57	Moc duck	Binh dinh	Meat, egg	Vulnerable	Decreasing/mixing
58	Trau Muscovy	All region	Meat	Normal	Decreasing/mixing
59	De Muscovy	All region	Meat	Normal	Decreasing/mixing
60	Sen Muscovy	All region	Meat	Normal	Decreasing/mixing
61	Co goose	Red River Delta	Meat	Normal	Decreasing/mixing
62	Native pigeon	All country	Meat, fancy	Normal	Stable

Appendix 6. Livestock population by province
(data from year 2001- Thousand heads)

Region, province	Buffalo	Cattle	Pig	Chicken	Waterfowl	Goat
Whole country	**2807.9**	**3899.7**	**21800.1**	**147050.0**	**49138.0**	**547.5**
Red river delta	***149.6***	***381.4***	***5489.0***	***39425***	***8134***	***46.9***
Ha Noi	13.8	39.2	341.3	2616	322	0.8
Hai Phong	15.4	10.7	518.2	3469	778	7.8
Ha Tay	31.1	95.0	1030.7	6214	1529	5.8
Hai Duong	30.1	40.6	709.4	5949	1054	1.2
Bac Ninh	12.7	42.0	417.5	2373	665	0.0
Hung Yen	5.5	29.8	432.8	4505	1038	0.9
Ha Nam	4.2	26.4	308.2	2026	547	10.4
Nam DInh	9.7	27.0	629.1	3991	855	1.3
Thai Binh	8.0	40.2	778.3	5679	936	0.3
Ninh Binh	19.1	30.5	323.5	2603	410	18.3
NorthEast	***1251.0***	***625.6***	***4300.8***	***31764***	***4856***	***180.4***
Ha Giang	130.2	60.5	271.2	898	325	84.8
Cao Bang	106.2	110.1	262.9	1282	267	4.0
Lao Cai	117.0	17.9	316.7	1231	145	19.8
Bac Kan	80.1	32.0	152.7	1034	193	9.6
Lang Son	185.2	45.3	304.4	2555	407	11.0
Tuyen Quang	136.7	20.1	276.4	2217	215	11.2
Yen Bai	87.6	28.1	296.1	2175	236	19.8
Thai Nguyen	122.1	25.6	430.4	2316	305	7.8
Phu Tho	90.7	96.9	471.2	5707	852	3.6
Vinh Phuc	32.6	101.5	432.8	4148	870	1.6
Bac Giang	100.8	75.1	781.0	6405	672	1.4
Quang Ninh	61.8	12.5	305.0	1796	369	5.7
NorthWest	***381.2***	***173.7***	***1026.9***	***4481***	***596***	***70.2***
Lai Chau	134.6	26.9	268.1	612	126	28.4
Son La	128.7	96.1	419.7	1761	255	30.0
Hoa Binh	117.9	50.7	339.1	2108	215	11.8
North Central coast	***685.4***	***849.4***	***3351.9***	***18110***	***4394***	***104.6***
Thanh Hoa	215.4	233.6	1114.9	6561	1619	28.9
Nghe An	271.7	286.9	1093.8	5451	1263	51.5
Ha Tinh	100.0	148.0	406.3	2686	348	11.4
Quang Binh	33.6	105.1	281.0	1462	250	5.1
Quang Tri	37.1	57.8	211.5	1000	450	6.7
Thua Thien- Hue	27.6	18.0	244.4	950	464	1.0

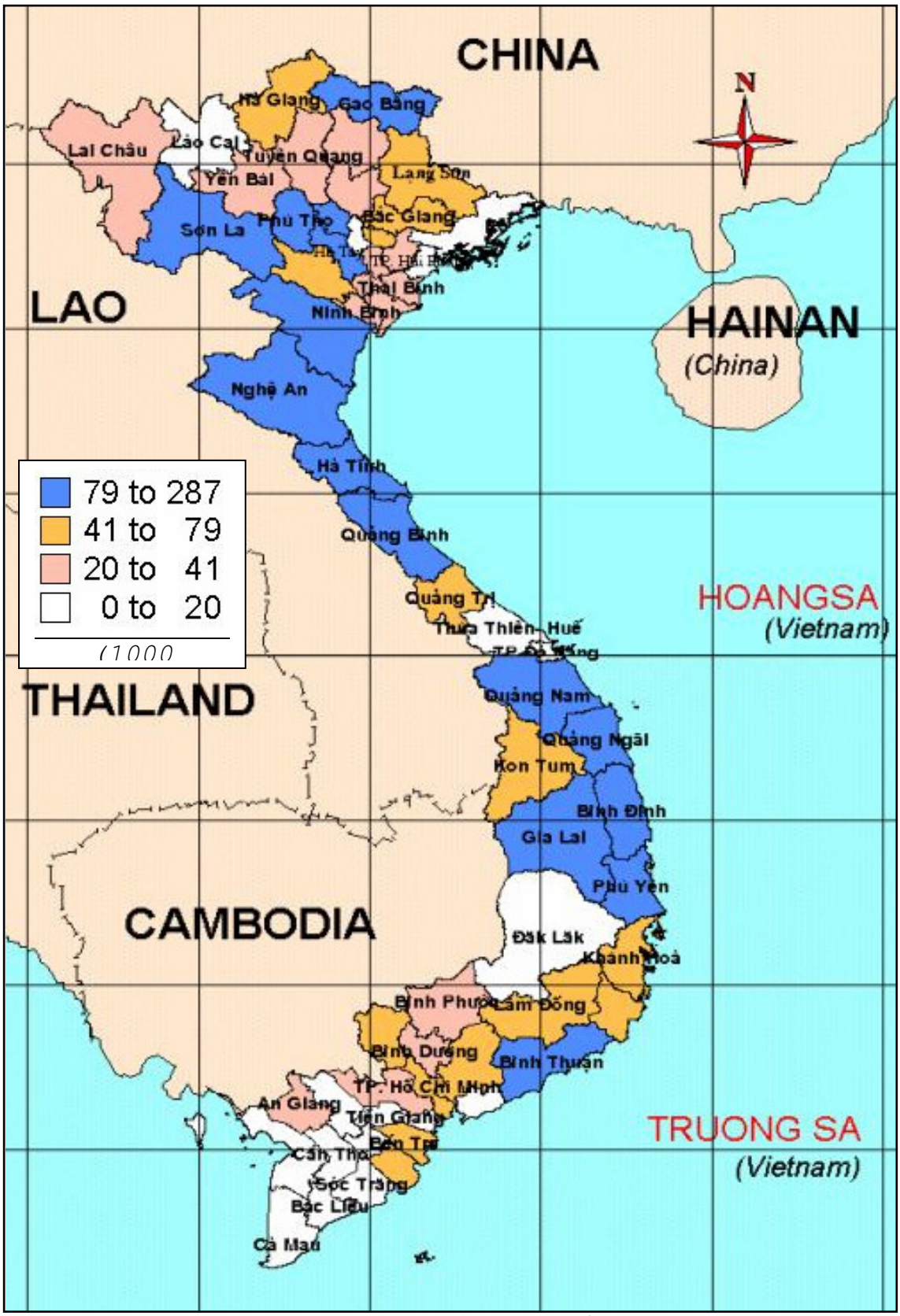
Region, Province	Buffalo	Cattle	Pig	Chicken	Waterfowl	Goat
SouthCentral Coast	***127.9***	***772.4***	***1922.0***	***9021***	***4661***	***28.1***
Da Nang	2.6	16.6	106.6	636	213	0.4
Quang Nam	53.8	195.5	501.7	3098	719	7.7
Quang Ngai	43.1	184.2	482.5	1640	700	2.9
Binh Dinh	20.7	192.5	545.2	1817	1645	5.3
Phu Yen	2.4	136.8	164.6	1021	716	2.4
Khanh Hoa	5.3	46.8	121.4	809	668	9.5
Central Highlands	***47.4***	***397.9***	***913.0***	***3997.0***	***536.0***	***31.5***
Kon Tum	11.6	61.7	125.1	523	71	5.5
Gia Lai	14.7	248.4	280.2	981	52	23.0
Dac Lac	21.1	87.8	507.7	2493	413	3.0
South-East	***125.2***	***479.3***	***1850.4***	***17680***	***4522***	***65.1***
Ho Chi Minh City	8.1	45.9	194.1	2268	746	1.1
Lam Dong	14.2	41.5	198.6	1483	86	4.5
Ninh Thuan	5.4	78.7	65.1	267	418	36.7
Binh Phuoc	16.7	27.0	127.3	927	72	1.1
Tay Ninh	48.3	56.2	118.0	1915	737	0.7
Binh Duong	15.8	27.1	222.8	2084	141	2.4
Dong Nai	7.7	55.6	575.5	5550	551	5.2
Binh Thuan	7.8	120.8	212.2	2041	1473	11.0
Vung Tau	1.2	26.5	136.8	1145	298	2.3
Mekong R.Delta	***40.2***	***220.0***	***2946.1***	***22572***	***21439***	***20.7***
Long An	11.6	25.6	212.1	2313	1476	0.0
Dong Thap	1.7	5.3	214.3	2077	1955	1.9
An Giang	3.1	39.8	164.9	1342	1150	1.2
Tien Giang	0.8	15.7	437.6	3258	1573	4.7
Vinh Long	0.3	14.6	256.9	2850	2083	0.0
Ben Tre	4.1	52.0	272.6	2960	2085	8.2
Kien Giang	7.6	8.6	265.2	1292	1879	0.0
Can Tho	1.0	1.6	289.2	1219	2037	0.1
Tra Vinh	4.2	53.1	232.0	1946	1476	4.4
Soc Trang	2.0	3.5	226.4	932	1920	0.0
Bac Lieu	3.1	0.2	187.1	908	2401	0.2
Ca Mau	0.7	0.0	187.8	1475	1404	0.0

Appendix 7. Distribution of buffalo population by province

(data from year 2001- Thousand heads)

Appendix 8. Distribution of cattle population by province

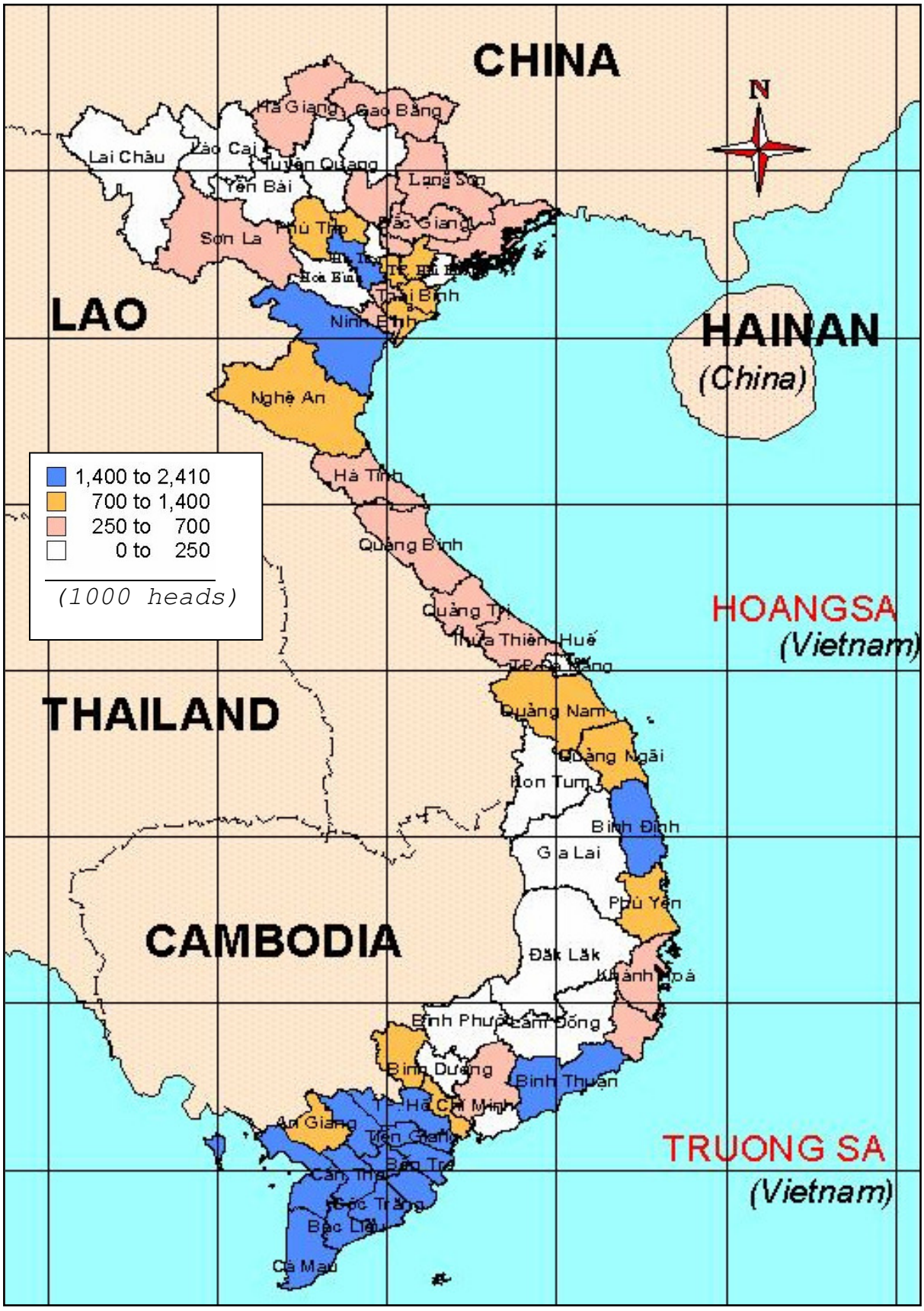
(data from year 2001- Thousand heads)



Appendix 9. Distribution of pig population by province

Appendix 10. Distribution of goat population by province
(data from year 2001- heads)

Appendix 11. waterfowl population by province
(data from year 2001- Thousand heads)



Appendix 12. Chicken population by province
(data from year 2001- Thousand heads)

Appendix 13. Plan index for livestock population 2000 – 2005 and 2010

Index	*Unit*	*2000*	*2001*	*2005*	*2010*
Pig	1000 heads	19.500	20.000	24.000	30.000
Poultry	1000 heads	197.000	220.000	297.000	350.000
Cattle	1000 heads	4.146	4.220	4.200	4.600
of which dairy cattle	1000 heads	32	33	100	200
Buffalo	1000 heads	2.950	2.960	3.000	3.000
Goat	1000 heads	500	530	650	800

Source: Agriculture Extension department

Appendix 14. Live weigh yield of livestock, egg, milk (1990–2002)

TT	*Years Items*	*Unit*	*1990*	*1995*	*2000*	*2001*	*2002*	*Average increasing rate 1990-2002*
1	All live weight	Thousand tons	1.007,9	1.332,1	1.835,9	1.989,3	2146,3	6,4%
	Of which							
	- pig	Thousand tons	729,0	1.006,9	1.408,9	1513,3	1653,6	7,5%
	(percent %)		72,3	76,1			77	
	- poultry	Thousand tons	167,9	197,1	286,5	322,6	338,4	6,7%
	(percent %)		16,6	15,0			15,8	
	- cattle and buffalo	Thousand tons	111,9	118,0	140,4	153,4	154,2	2,9%
	(percent %)		111,1	8,9			7,2	
2	Eggs	Billion unit	1,90	2,82	3,71	4,16	4,53	8,0%
3	Fresh milk	Thousand tons	9,30	20,9	52,2	64,7	78,4	24%

Appendix 15.Total pork yield export (Thousand tons)

1991	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*	*2001*	*2002*
25,1	12,2	19,7	12,6	6,4	4,6	10,0	10,0	7,0	12,2	30,0	19,0

Appendix 16: Milk production and domestic consumption needs

Index	*1990*	*1995*	*1997*	*1998*	*1999*	*2000*	*estimated 2001*
Total population of dairy cattle (head)	11.000	18.700	25.000	27.000	29.000	35.000	38.000 - 40.000
Annual increasing rate (%)	-	11,6	16,2	8,0	7,4	10,3	18,6
Total production of domestic fresh milk yield (ton)	12.000	17.000	31.000	36.800	39.000	54.000	65.000 - 70.000
Increasing rate (%)	7,2	6,9	16,4	18,7	19,5	22,7	20,3
Self producing of fresh milk kg/capita/annum	0,170	0,230	0,420	0,450	0,530	0,690	0,81
Requirement of fresh milk kg/capita/annum	0,470	2,050	3,700	5,000	6,000	6,500	7,00
Propotion of self producing/requirement (%)	36,1	11,2	11,3	9,0	8,3	10,6	11,4

Appendix 17. Development trends of dairy cattle in the last 10 years

Year	*All country (head)*	*Crossing HF (Head)*	*Average milk yield/animal /lactation (kg)*	*HF(head)*	*Average milk yield(HF)/animal/lactation (kg)*
1990	11.000	9.000	2.100	2.000	2.800
1991	12.100	9.300	2.200	1.800	3.000
1992	13.100	11.500	2.200	1.600	3.200
1993	15.100	13.600	2.250	1.500	3.200
1994	16.500	15.000	2.300	1.500	3.300
1995	18.700	17.200	2.330	1.500	3.300
1996	22.000	20.500	2.500	1.500	3.400
1997	24.500	23.050	2.700	1.450	3.500
1998	27.000	25.650	2.800	1.450	3.600
1999	29.500	27.800	3.000	1.700	3.700
2000	35.000	33.000	3.300	1.750	3.850
estimated2001	38.000 - 40.000	36.000 - 38.000	3.600	2.000	4.100

Appendix 18. Land suitable for crops, and pasture purposes by physiographic zone

Regions	*Thousand hectares*		
	Cultivated land	Grassland	Percent
North West	560.6	113.0	1.14
North East	1436.1	188	1.89
Red River Delta	764.2	4.3	.04
North Central Coast	1,008.9	80.3	0.81
South Central Coast	708.2	52.5	0.53
Central Highland	997.4	58.3	0.60
North East South	1,171.4	36.6	0.37
Mekong River Delta	2,823.6	1.1	0.1
Total	***9,470.4***	***534.1***	

Appendix 19. Performance of pig breeds and their hybrids

Breeds / Indexes	*Carcass percentage (%)*	*ADG (g/day)*	*FCR*	*Back fat thickness (mm)*	*P Slaughter (kg)*	*Age of Slaughter (month)*	*Litter size*	*Litter size at 60 days*	*Age of puberty (month)*
I	62,7-64,1	200 –250	5,9-7,7	36,6-37,6	50	8-10	8.8-11.3		4-5
MC	68,0 – 71,1	327	4,5-5,5	29,89-34,10	50-55	8-10	11.2	7.3-7.8	3-4
Land	71,4-75,2	642	2,90-3,1	25,72-26,44	95- 100	10	9.12		7
York	72,7-75,7	635	2,7-2,9	24,85-25,54	95-100	10	9.08	7.3-7.8	6.5
Mc x Land	78	477	4-4.94	45	110	10	10.8		
Mc x York	80	408	3.5	50	100-110	10	10.84		

(Mc : Mong cai; Land: Landrace; York: Yorkshire)

Sources: Scientific report on Animal science and Veterinary Medicine 1999-2000 – NIAH
Selected scientific work on Animal Husbandry – NIAH- 1969-1984.

Appendix 20. Performance characteristics of Goat breeds and their hybrids

Index	*Co*		*Bach thao*		*Babari*		*Jumnapari*		*Bach thao x Co*	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Weigh at birth (kg)	1.85	1.64	2.86	2.39	2.32	2.1	3.86	3.2	2.45	2.10
Weigh at mature (kg)	35-40	25-30	60-65	40-45	44.6	33.5	59.5	44.9	45-50	35-40
Age at mature (month)	4-6	4-6	6	6-7			18	18	4-6	4-7
little/year		1,64		1.7		1.47		1.27		1.55
Little size		1,51		2.1		1.45		1.37		1.64
%Live at 6 weak of age		75.6		85.9		88.4		86.9		88.2
Milk yield (lit/animal/day)		0.35		1.65		1.14		1.55		0.72
Lactation(Day)		91		154		146		176		149

Sources: Scientific reports of Sontay Goat and Rabbit Research Center 1982-2002.

Appendix 21. Performance characteristics of the Duck and Muscovy breeds.

	Co	*Bau ben*	*Bau Quy*	*Super M*	*Khakhicambell*	*Native muscovy duck*	*French muscovy duck*
Weight at 8 weeks (kg)	0.95-1.1	1.59-1.75	-	1.9-2.2	1.15-1.2	1.2-1.8	2.3-2.5 (1.4-1.6)
Number of egg/year	200-240	100-110	80-90	180-200	265	69-70	170-200
Egg weight (g)	63.6-65.4	70-75	70-72	82-84	65.46	64.7-68.8	69.1-76.9
Age at first egg (week)	140-150	190-200	190-200	168-182	142-146	210-235	156-165
P. at laying (kg)	1.46-1.54	1.8-2.3	1.6-1.9	2.6-3.1	1.7-1.8	2.1	2.6
Feed consumption for 10 eggs (kg)	2.8-3.0	-	-	4.9-5.2	2.25	-	3.54
Carcass percentage	-	66,3 (65,1)	-	73-74	-	62-64	67
% live at 6 weeks	96	-	93-96	93-98	96-98	-	92-97

Data in bracket belong to female birds.

Sources: Scientific reports on duck and muscovy duck breeding and raising 1982-2002. NIAH.

Appendix 22. Comparative performance characteristics of some chicken breeds

	Ri	*Mia*	*Dong Tao*	*Ho*	*Ac*	*Ross 208*	*Broiler*	*Hybro HV 85*
Age at first egg(week)	113	137	157	240	113 – 121	168		169
Weigh at mature (g)	1058	1320	1993.75	2215.6	565	3402		2200
% fertilized egg (%)	92.6	93 -94	89.54	70	94.6	90 - 92		93.8 - 94.02
% hatchability	78	80 - 87	77.27	50	80 – 90	75 - 77		80 - 81
Egg weight (g)	43.95	58	45.23	51	29 – 30	55.78 - 56.91		56.78
Feed consumption/10 eggs (kg)	3.06	3.92	4.14		2.5	4.5 - 5.5		2.5 - 2.6
% Live at 6 weeks	92.11	92.33	95.33		88	94 - 96		90 - 92

Sources: Scientific reports on poultry research and FAnGR conservation – NIAH

Appendix 23. Some biological characters of cattle and buffalo breeds.

	HF	*Thanhhoa YC*	*Lai sind*	*F1(laisind+HF)*	*F1 (Lai sind + Charolais)*	*F2 (3/4 HF)*	*Ngo Buffalo*	*De Buffalo*	*Murrha Buffalo*	*Hybrid(De x x Murrha)*
Weight at mature	510	60 - 200	250	350		400	400 - 450	300 - 350	400 - 450	501
		(250 – 300)*					(450 – 500)	(350 – 400)	(617)	
Carcass percentage	40 - 44	38 - 42	40 - 45	42 - 45	40 – 44	40 - 44	38 - 40	38 - 40	50-55	50
Milk yield (lit)	4245	400 - 500	1500 - 2000	2949.4		3175.7	300	300	1300 - 1400	1114
Milk fat percentage	3.8 - 4.1	>5%	5.2	4.32		3.98	10.44	10	6.7	7.31
Lactation (day)	300	150 - 180	300	300		300	300	400	270	299
Age of mature (month)		24	14 - 20	14 - 18		14 - 18	30 - 36	30 - 36	45.21	49

* Data in bracket represent for bulls.

Sources: Scientific reports on buffalo and cattle breeding. NIAH

Appendix 24. Contributors for the preparation of the 1st Report on the State of the World Animal Genetic Resources

(Vietnam AnGR status Report)

	Name	Designation & Official Address	Telephone, Fax & Email address
1.	Prof. Dr. Nguyen Dang Vang	Director National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi Chaiman	844.8389267 / 04.8385022 Fax: 04.8389775 Email:vang.niah@netnam.vn
2.	Prof. Dr. Le Viet Ly	National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4 9389770/8223397 Fax: 84.4 8389775 Email: ly.niah@netnam.vn
3.	Dr. Tran Trong Them	Vice Director National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4.8389267 / 84.4.8385022 Fax: 84.4.8389775. Email: niah@netnam.vn
4.	Dr. Le Thi Thuy	Senior researcher National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi Tecnical Secrectary	84.4.8389165 / 0912171688 Fax: 84.4.8389775 thuy-niah@netnam.org.vn
5.	Mr. Nhu Van Thu	Animal diversity and conservation National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4.8389165 / 0912357860 Fax: 84.4.8389775 nhuwx@hn.vnn.vn
6.	Dr. Nguyen Van Tai	Specialist Department of Environment - Ministry of Resources & Environment 83 Nguyen Chi Thanh – Ha Noi	84.47734245 / 0913031783 Email: nvtai@yahoo.com
7.	Ass. Prof. Dr. Le Minh Sat	Deputy Director of Agriculture Management Department Ministry of Science and Technology 39 Tran Hung Dao – Ha Noi	84.4.9439663 / 0913364297 Fax: 84.4.9439733 Email:lmsat@most.gov.vn
8.	Dr. Truong Van Dung	Director National Institute of Veterinary Vietnam Giai Phong street – Ha Noi	84.4.8693921 / 0913202752 Fax:84.4. 8697687 truongvandung@netnam.vn
9.	Ass. Prof. Dr. Hoang Kim Giao	Deputy Director. Department of Agriculture-Ministry of Agriculture and Rural Development, Vietnam 2 Ngoc Ha, Ba Dinh, Hanoi	84.4.7341228 / 0913248452 Fax: 84.4.8236403 Email:hkimgiao@netnam.vn
10.	Prof. Dr. Dang Vu Binh	Director Hanoi Agricultural university Trau quy- Gia lam- Hanoi	84.44.8767864/ 0913304531 Fax:84.4.8276554 Email:dvubinh@hn.vnn.vn
11.	Ass.Prof. Dr. Dinh Van Chinh	Head of animal genetic and breeding Dept. Hanoi Agricultural university Trau quy- Gia lam- Hanoi	84.4.8276650 / 0912070964 Fax:84.4.8276554 Email:dvchinh@hn.vnn.vn
12.	Mr. Dang Tat Nhiem	Specialist Deputy of Science & product quality-Ministry of Agriculture and Rural Development	84.4.8232751/8237534 Fax: 84.4.8433637 Email:khcnkythuat@hn.vnn.vn

13.	Prof. Dr. Nguyen Van Thien	Secretary General. Association of Husbandry in Vietnam, Phuong Mai, Dong Da, Hanoi, Vietnam	84.48691511/8386032
14.	Mr. Nguyen Minh Thong	Representative IUCN 13A Tran Hung Dao Stress, Hoan Kiem, Hanoi	84.49330012/3. 0913219892 Fax:84.4.8258 794 Email:thong@iucn.org.vn
15.	Dr. Warwick Brown	Specialist in Diversity of IUCN 13A Tran Hung Dao Stress, Hoan Kiem, Hanoi	84.4.93330012/3 Fax:84.4.8258 794 **Email**: minh@iucn.org.vn
16.	Mr. Nguyen Cong Minh	Specialist in Diversity of IUCN 13A Tran Hung Dao Stress, Hoan Kiem, Hanoi	84.4.93330012/3 Fax:84.4.8258 794 Email:minh@iucn.org.vn
17.	Mr. Vu Ngoc Tien	Specialist FAO Programme Assistant FAO Representation in Vietnam 3, Nguyen Gia Thieu street Hanoi,Vietnam	Tel: 84 4 9424208 ext. 19 Fax: 84 4 9423257 Email: tien@fao.org.vn
18.	Dr. Jean C. Maillard	Biodiversity Specialist CIRAD,Thuy Phuong – Tu Liem -Ha Noi	84.4.8388068 Fax: 04.7570521 email:maillard@fpt.vn
19.	Mr. Nguyen Trong Tuan	Vice Director Department of Science & Technology Son La	Tel:84.22854751 Fax: 84.22853485 Email:duand2@hotmail.com
20.	Ass. Prof. Dr. Cao Van	Vice Head of Husbandry & Veterinary Department Thai Nguyen Forest Agricultural University	84.280.855564/ 0912003452 Fax: 84.280.852921 Email:tuaf@hn.vnn.vn
21.	Dr. Tran Hue Vien	Head of Husbandry & Veterinary Department Thai Nguyen Forest Agricultural University	84.280.855564/ Fax: 84.280852921 Email:tuaf@hn.vnn.vn
22.	Prof. Dr. Vu Quang Con	Director Natural Resources & Ecological Institute Hoang Quov Viet, Ba Dinh district, Hanoi	84.48361441 Fax: 84.4.8361196 Email:vucon@ncst.ac.vn
23.	Dr. Le Duc Ngoan	Dean of Animal and veterinary Dept. University of Agriculture and forestry 102 Phung Hung, Hue	84.54.525 39/0914126048 Email:fas@dng.vnn.vn
24.	Dr. Pham Khanh Tu	Head of Animal genetic and breeding Dept. University of Agriculture and forestry 102 Phung Hung, Hue	84.54.525439/0905100399 Email:vpduan@dng.vnn.vn
25.	Dr. Phung Duc Tien	Director Poultry Research Centers	84.4.8389773 Fax: 84.4 8385084

		Chem – Thuy Phuong – Tu Liem -Ha Noi	
26.	MSc. Hoang Van Loc	Head of Technical Department Poultry Research Centers Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4.8389773 Fax: 84.4 8385084
27.	Ass Prof.Dr. Dinh Van Binh	Director Goat & Rabbit Research Center, Son Tay – Ha Tay.	84.34 881094 84.34.81094/0913322320 Email: binhbavi@netnam.org.vn
28.	MSc. Tang Xuan Luu	Vice Director Cattle and Forage Research Center Bavi Bavi – Ha Tay.	84. 0912053429 Fax: 84.34.881404 Email:ttbobv@netnam.vn
29.	Dr. Nguyen Duc Trong	Director Dai Xuyen Duck Research Center Dai Xuyen – Ha Tay.	84.34.854931 0913288746 Fax: 84.34854250

Appendix 25. participantf of the workshops "Vietnam national report on animal genetic resources"

	Name	Designation & Official Address	Telephone, Fax & Email address
1.	Prof. Dr. Nguyen Dang Vang	Director National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi Chaiman	844.8389267 / 04.8385022 Fax: 04.8389775 Email:vang.niah@netnam.vn
2.	Prof. Dr. Le Viet Ly	National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4 9389770/8223397 Fax: 84.4 8389775 Email: ly.niah@netnam.vn
3	Dr. Le Thi Thuy	Senior researcher National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi Tecnical Secrectary	84.4.8389165 / 0912171688 Fax: 84.4.8389775 thuy-niah@netnam.org.vn
4	Mr. Nhu Van Thu	Animal diversity and conservation National Institute of Animal Husbandry Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4.8389165 / 0912357860 Fax: 84.4.8389775 nhuwx@hn.vnn.vn
5.	Mr. Nguyen Hoang Duc	Specialist Department of Environment - Ministry of Resources & Environment 83 Nguyen Chi Thanh – Ha Noi	84.47734245 / 0913031783 Email: nvtai@yahoo.com
6.	Mr. Nguyen Trung Thang	Specialist Department of Environment - Ministry of Resources & Environment 83 Nguyen Chi Thanh – Ha Noi	84.47734245 / 0913031783 Email: nvtai@yahoo.com
7.	Dr. Truong Van Dung	Director National Institute of Veterinary Vietnam Giai Phong street – Ha Noi	84.4.8693921 / 0913202752 Fax:84.4. 8697687 truongvandung@netnam.vn
8.	Ass. Prof. Dr. Hoang Kim Giao	Deputy Director. Department of Agriculture-Ministry of Agriculture and Rural Development, Vietnam 2 Ngoc Ha, Ba Dinh, Hanoi	84.4.7341228 / 0913248452 Fax: 84.4.8236403 Email:hkimgiao@netnam.vn
9.	Ass.Prof. Dr. Dinh Van Chinh	Hanoi Agricultural university Trau quy- Gia lam- Hanoi	84.4.8276650 / 0912070964 Fax:84.4.8276554 Email:dvchinh@hn.vnn.vn
10.	Prof. Dr. Nguyen Van Thien	Secretary General. Association of Husbandry in Vietnam, Phuong Mai, Dong Da, Hanoi, Vietnam	84.48691511/8386032
11	Dr. Warwick Brown	Specialist in Diversity of IUCN 13A Tran Hung Dao Stress, Hoan Kiem, Hanoi	84.4.93330012/3 Fax:84.4.8258 794 **Email**: minh@iucn.org.vn
12.	Mr. Nguyen Cong Minh	Specialist in Diversity of IUCN 13A Tran Hung Dao Stress, Hoan Kiem, Hanoi	84.4.93330012/3 Fax:84.4.8258 794 Email:minh@iucn.org.vn
13.	Dr. Jean C. Maillard	Biodiversity Specialist CIRAD,Thuy Phuong – Tu Liem -Ha Noi	84.4.8388068 Fax: 04.7570521 email:maillard@fpt.vn

14.	Dr. Pham Sy Tiep	Head of International and Scientific planing Dept. National Institute of Animal Husbandy Thuy Phuong, Tu Liem, Hanoi	84.4.8389165 / 0912357860 Fax: 84.4.8389775 Email: niah@netnam.vn
15.	Ass. Prof. Dr. Cao Van	Head of animal genetics and breeding Department Thai Nguyen Forest Agricultural University	84.280.855564/ 0912003452 Fax: 84.280.852921 Email:tuaf@hn.vnn.vn
16.	Dr. Tran Hue Vien	Dean of animal husbandry & Veterinary Department Thai Nguyen Forest Agricultural University	84.280.855564/ Fax: 84.280852921 Email:tuaf@hn.vnn.vn
17.	Prof. Dr. Vu Quang Con	Director Natural Resources & Ecological Institute Hoang Quov Viet, Ba Dinh district, Hanoi	84.48361441 Fax: 84.4.8361196 Email:vucon@ncst.ac.vn
18.	MSc. Hoang Van Loc	Head of Technical Department Poultry Research Center Chem – Thuy Phuong – Tu Liem -Ha Noi	84.4.8389773 Fax: 84.4 8385084
19.	MSc. Tang Xuan Luu	Vice Director Cattle and Forage Research Center Bavi Bavi – Ha Tay.	84. 0912053429 Fax: 84.34.881404 Email:ttbobv@netnam.vn
20.	Dr. Nguyen Duc Trong	Director Dai Xuyen Duck Research Center Dai Xuyen – Ha Tay.	84.34.854931 0913288746 Fax: 84.34854250
21.	Dr. Nguyen Van Duc	Head of Animal Genetic and breeding Dept. National Institute of Animal Husbandy Thuy Phuong, Tu Liem, Hanoi	84.4.8389165 / 0912357860 Fax: 84.4.8389775 Email: ditruyen@hn.vnn.vn
22.	Dr. Vo Van Su	Head of Animal Diversity Dept. National Institute of Animal Husbandy Thuy Phuong, Tu Liem, Hanoi	84.4.8389165 / 0912357860 Fax: 84.4.8389775 Email: vovansu@hn.vnn.vn

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