Advances in the Brazilian animal genetic resources conservation programme

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Summary

Brazil has various species of domestic animals which developed from breeds brought by the Portuguese settlers soon after the discovery. Over the last five centuries, these breeds have been submitted to natural selection in particular environments and therefore today, they present characteristics adapted to the specific environmental conditions. From the beginning of this century, some exotic breeds, selected in temperate regions, have begun to be imported. Although more productive, these breeds lack adaptation traits, such as resistance to disease and parasites found in breeds considered to be "native", but even so, little by little, they have substituted the native breeds to such an extent that the latter are, today, in danger of extinction. To avoid the loss of this important genetic material, Brazil created an Animal Genetics Resource Conservation Programme, coordinated by the National Research Centre for Genetic Resources and Biotechnology (Cenargen) of the Brazilian Agricultural Research Corporation (EMPRAPA). The conservation has been carried out by various Research Centres of EMPRAPA, Universities, State Research Corporations, as well as by private farmers, with a single coordinator at national level, Cenargen. The conservation is being carried out through Conservation Nuclei, situated in the habitats where the animals have been subjected to natural selection (*in situ*), and by the storage of semen and embryos (*ex situ*). The recently created Animal Genetics Laboratory of Cenargen allowed genetic characterisation studies on cattle and horse breeds to begin, and, in the near future, work with asses, buffalo and sheep will be conducted.. From the results of this research it will be possible to compare the native breeds and estimate genetic distances between them. The harmonisation of chosen micro-satellites with those which have been used in other Latin America and Iberian Peninsula countries will be extremely useful for comparative studies and will allow future exchange of germplasm between countries.

Resumen

Los colonizadores portugueses, cuando vinieron al Brasil, trajeron consigo, animales domésticos. Estos se multiplicaron, y han sido sometidos a un amplio proceso de selección natural, adquiriendo características adaptativas y/o de producción para las diversas situaciones ecológicas del país y se han transformado en lo que conocemos como razas "locales" o "criollas". Cerca de tres siglos después del descubrimiento, muchos criadores comenzaron a importar animales de razas nuevas, buscando mayor productividad. El establecimiento de políticas que promovieron la dilución de germoplasma autóctono a través de programas extensivos de cruzamiento con esas razas importadas resultó en rápida substitución de las razas locales. Aunque éstas presenten productividad más baja que las exóticas, están extremamente bien adaptadas a las condiciones ambientales, a los que estuvieron sometidos bajo selección natural. En este trabajo discutimos la situación actual de la

conservación de las razas todavía existentes en Brasil. La investigación sobre evaluación, conservación y utilización de reservas genéticas de razas con características únicas, debe proveer la fundación para la utilización efectiva del germoplasma a nivel global. Complementariamente al uso tradicional de recursos genéticos animales, están los avances significativos en genética animal alcanzados en las dos últimas décadas, usando técnicas de biología molecular, tales como el mapeamento y la identificación de genes. Toda esta preocupación con la diversidad de los animales domésticos ha llamado la atención de los investigadores a la rápida desaparición de las razas locales, y, consecuentemente con la dilución del germoplasma autóctono a través del uso extensivo de programas de hibridación. La conservación de recursos genéticos animales en Brasil viene realizada en diversos Centros de Investigación de EMPRAPA (Empresa Brasileira de Pesquisa Agropecuária), Universidades, Empresas de Investigación de distintos Estados, bien como por productores privados, involucrando todo el país, bajo la coordinación del Cenargen (Centro Nacional de Investigación de Recursos Genéticos y Biotecnologia). La conservación se realiza por medio de núcleos de conservación, mantenidos en el habitat donde los animales están adaptados (*in situ*) y por el almacenamiento de semen y embriones (*ex situ*), incluyendo 7 especies animales: bovinos, bubalinos, cerdos, ovejas, cabras, caballos y asnos. Una importante tarea del Programa es aumentar la conscientización sobre la importancia de la conservación de recursos genéticos animales.

Introduction

Brazil has various species of domestic animals (Figure 1 to 4), which developed from breeds brought by the Portuguese settlers soon after the discovery. For almost five centuries, these breeds have been submitted to natural selection in determined environments so that, today, they present characteristics adapted to the specific environmental conditions.

From the beginning of this century, some exotic breeds, selected in temperate regions, have begun to be imported. Although more productive, these breeds lack adaptation traits, such as resistance to disease and parasites found in breeds considered to be "native", but even so, little by little, they have substituted the native breeds, to such an extent that the latter are, today, in danger of extinction. To avoid the loss of this important genetic material, Brazil created an Animal Genetic Resources Conservation Programme, coordinated by the National Research Centre for Genetic Resources and Biotechnology (Cenargen) of the Brazilian Agricultural Research Corporation (EMPRAPA).
The conservation has been carried out by various Research Centres of EMPRAPA, Universities, State Research Companies, as well as by private farmers, with a single coordinator at national level, Cenargen. This programme includes the following stages:

1. identification of populations in an advanced stage of genetic dilution;
2. phenotypic and genetic characterisation of germplasm; and
3. evaluation of productive potential. The conservation is being carried out by Conservation Nuclei, situated in the habitats where the animals have been subjected to natural selection (*in situ*), and by the storage of semen and embryos (*ex situ*). An important challenge for this programme is to increase awareness among the different segments of society for the importance of the conservation of animal genetic resources.

Objectives of The Brazilian Conservation Programme

The objectives of the Brazilian Animal Genetic Resource Conservation Programme are:

1. Identifying and characterising phenotypically conservation nuclei, establishing centres of originand assessing genetic diversity and variability for the groups of animals in danger of extinction;

Figure 1. Lavradeiro horse (Northern region).

2. Monitoring existing animal conservation nuclei;
3. Starting new conservation nuclei of breeds, which are identified as being in danger of extinction;
4. Conserving *ex situ* genetic material by cryopreservation of semen and embryos;
5. Genetically characterising the breeds involved in the Programme; and
6. Increasing the awareness of the diverse segments of society about the importance of the conservation of animal genetic resources.

Brazilian Animal Genetic Resources

Native breeds

The first cattle arrived in the American continent with the settlers in 1493, when some animals were left on the *Hispaniola* Island, which today is the Dominican Republic and Haiti. Cattle arrived in Brazil for the first time in 1532, introduced by the Portuguese. New introductions were made from the Archipelago of Cape Verde, where the Portuguese had been since 1460.

With its continental dimensions, Brazil has a huge variety of ecosystems where the different species of domestic animals brought by the first settlers began to establish themselves. Through centuries of natural selection, these animals attained special adaptation features specific to the ecological niche where they developed. Little by little, these animals dispersed over the whole Brazilian territory, and adapted to the very diverse environmental conditions with special characteristics such as in the Mato Grosso Pantanal, the North Eastern Agreste, the southern Brazilian Plateau and the Pampas of Rio Grande do Sul.

Due to the increasing demand for food of animal origin, farmers from many developing countries followed a course which, inevitably, led to the dilution of the "local" germplasm

by the use of intensive crossbreeding with animals of exotic breeds. Many of these programmes failed, since the introduced animals had lower productive indices than the "local" breeds. This meant that a considerable number of farmers, in establishing their production systems, started to give a deserved importance to the "local" breeds, because of their adaptation to the environment which is usually hostile especially in the tropical region.

Zebu breeds

At the end of the last century, the introduction of animals, which until then had been considered extremely exotic – the zebu, began. Today these breeds are responsible for almost the total meat production in the country, as purebred or crossbred animals, from the latitude of São Paulo State northwards.

The zebu was first introduced into Brazil at the end of the 19th century. These animals, which originated in India, were originally crossed with the local breeds. Little by little the local breeds were absorbed. As a result, Brazil has today the largest zebu population in the world, while in their country of origin, where they are considered sacred, they are raised freely and protected by the community until they die a natural death.

Before the first importation of zebu cattle to the Southeast region of Brazil, the Southern region, of temperate climate, had already imported British cattle breeds which were highly productive. The latter did not have the same adaptation problems as animals of the same breeds in the tropical regions of the country. As in central Brazil, the British breeds introduced in the south of the country were used in crossbreeding schemes, leading again to a drastic reduction in the effective population size of the local breeds.

The expansion of the zebu breeds in Brazil is an undisputed reality. Today about 80% of the Brazilian cattle population is made up of zebu cattle or their crosses with Creole and European cattle. Although, up to this time, the conservation Programme is only involved with the native breeds, as they are threatened with extinction, there is already a demand from the zebu breeders that these breeds also be included. This is due to the almost total domination of the Nellore breed in Central Brazil. Of the six principal zebu breeds that exist in Brazil, approximately 85% of the total number of animals registered are Nellore.

Another aspect, which should be highlighted, is the fact that the use of new technologies and more efficient methods in genetic improvement programmes have led to profound changes in the procedures used by the breeders in the selection and reproductive management of their herds. Since 1984, when the first Bull Summary was published (Mariante *et al*., 1984), the breeders began to have more precise information about the genetic merit of each individual selection candidate. This, together with techniques which allowed the increase in reproductive capacity of the genotypes of interest (artificial insemination, embryo transfer and in vitro fertilization), have made the decision taking process more objective, especially when referring to the choice of animals for reproduction and mating schemes.

From the beginning of the publication of the Bull Summaries a large number of breeders started to put greater emphasis on the productive traits (taken from the Classification Table of the Summary), leaving behind the qualitative traits, such as breed characteristics and type. Bulls which up to then may have been left aside because of one or another external trait, which did not please the more conservative breeders, sired offspring with exceptional weight gains, proving that they imprinted production traits which were more important at slaughter. These bulls then became highly demanded by the Artificial Insemination Centres and their semen was sold at very high prices.

This situation resulted in the use of a small number of bulls, especially those classified as Elite, which, certainly led to the reduction in genetic variability. Ironically, this bull classification due to merit, together with more modern practices in animal reproduction

Figure 2. Pantaneiro horse (Northern region).

already mentioned, are partially responsible for the reduction in genetic variation (Mariante, 1990).

These preocupations of breeders led to the demand for the creation of a Germplasm Bank where semen and oocytes of zebu breeds would be stored, and would be monitored by EMPRAPA-Cenargen, although it would be situated at the headquarters of the Brazilian Association of Zebu Breeders in Uberaba, Minas Gerais State. The choice of animals which would be selected to donate semen and oocytes could be based on the Family Catalogue, which to date has been published for the Nellore breed (Magnabosco *et al*., 1997). The catalogues for the other zebu breeds should be published in the near future.

Information is presented about the zebu breeds originally introduced and selected in Brazil (Gir, Guzerat, Nellore and Sindi), and those formed there (Indubrasil and Tabapuã). Some animals of the Kangaian breed were also imported, but today their effective population size is greatly reduced.

Gir

The first animals of the Gir breed were probably imported around 1906. The greater portion of the importation, which resulted in creation of nuclei which exist today, dates from 1920.

Guzerat

The main importations of the Guzerat breed were to the Curvelo region, Minas Gerais State. Later, farmers in the Uberaba district, of the same state, became interested in raising this breed. The breed continued to expand to the north of São Paulo State and from there to other regions of the country. In the region known as the Minas Triangle, Minas Gerais State, it was used in crossing programmes with the Gir and Nellore breeds, creating the Indubrasil breed.

Nellore

The Nellore breed belongs to the second Indian group (cattle with white or grey hair and short horns), by the classification of Joshi and Phillips, referred to by SANTIAGO (1987). The Brazilian Nellore population is originated from importations made in 1930 and notably those in 1960 and 1962. At the present time the Brazilian Nellore is tending to the type of the Indian Ongole. Of all the zebu cattle found in Brazil the Nellore stands out because of its production qualities and it is becoming more prized by the breeders. Although for some time it had been left aside because of its short ears, similar to those of European cattle, today it is in first place in terms of Genealogical Registration, as well as its overwhelming use as bulls in herds of other breeds. The animals are highly fertile, resistant to parasites and to tropical disorders, precocious and have extraordinary maternal ability. In Brazil, the Nellore is essentially a meat producer, which has been subjected to highly intensive selection to obtain males for slaughter.

Sindi

The Sindi breed is very similar to the Gir from the west of India,to Sahiwal, from Punjab and the red cattle of Afghanistan. Due to the movement of nomad tribes in its home track, it had been crossed with Gir in some regions. The Sindi, which arrived in Brazil in about 1906 and 1930, had the Baixada Fluminense region, in the state of Rio de Janeiro, as their destination as well as the Novo Horizonte and Jardinópolis townships, in the São Paulo State. In general, these animals were small, good looking and useful in areas where there was a lack of forage, where it would be more difficult to maintain larger animals.

Table 1. Species and breeds included in research projects in the Brazilian Programme of Animal Genetic Resources Conservation - 1999.

Species	Breed	Region of the country
Cattle	Mocho Nacional (National Polled)	Southeast
	Pantaneiro	Centrewest (Pantanal)
	Curraleiro or Pé-duro	North east
	Criollo Lageano	South
Buffaloes	Baio	North
	Carabao	North
Asses	Jumento Nordestino (North-eastern Ass) or Jegue	Northeast
	Jumento Brasileiro (Brazilian Ass)	Southeast
Horses	Pantaneiro	Centrewest (Pantanal)
	Lavradeiro	North
Goats	Canindé, Gurguéia, Moxotó, Marota, Repartida	Northeast
Sheep	Criollo Lanado	Northeast
Diverse species	Animal Gene Bank (AGB)	Centrewest

Table 2. Number of semen doses and embryos stored in the Animal Germplasm Bank (AGB) of Cenargen, in 1999.

Species/Breed	No. of semen doses	No. of embryos
Cattle		
Criollo Lageano	6 159	9
Mocho Nacional	6 533	54
Caracu	3 950	47
Curraleiro	5 300	17
Criollo Argentino	288	-
Pantaneiro	4 277	20
Junqueira	2 143	4
Patuá	250	-
Goats		
Moxotó	546	-
Canindé	109	-
Sheep		
Criolo Lanado	500	56
Horses		
Pantaneiro	-	1
Asses		
J. Nordestino	150	-
Total	30 205	208

Indubrasil

The Indubrasil, according to Santiago (1984), was the first zebu breed formed by Brazilian breeders, based on cattle imported from India. Initially, its pioneers in the Minas Triangle gave it the name of Induberaba, but only in 1936 was it officially recognised as the Indubrasil, a name that it keeps today. Its origin, although basically founded from the Gir, Nellore and Guzerat breeds, is obscure as to the exact genetic contribution of each of the breeds or zebu types used.

Tabapuã

According to Santiago (1984), the first polled zebu, object of selection in Brazil, was the Tabapuã, named after the township where it was formed in São Paulo State. Phenotypically, these cattle resemble the American Zebu (Brahman), which means that several Brahman cows, when dehorned, are confused with Tabapuã animals. Despite this, its racial composition is mainly Nellore with some Guzerat and Gir.

Formation of Conservation Nuclei

The Conservation Nuclei, organised in the form of research projects, can be found all over the country. The elaboration of research projects, usually based in research centres near the habitats where the animals were naturally selected over the last few centuries, was the solution adopted to try and rescue the small effective populations of the breeds in danger of extinction.

The articulation of Cenargen with these Conservation Nuclei (Germplasm Banks) is made by Germplasm Curator (based in Cenargen), in collaboration with the Curators of the Germplasm Banks (normally the research project leaders). In the present collaborative programme, there are 3 Germplasm Curators for animals at Cenargen: one for large species (cattle, buffaloes, horses and asses), one for small species (sheep, goats and pigs) and one for wildlife.

The Animal Germplasm Curators are researchers of Cenargen, attributed with giving advice to the Technical Head in relation to germplasm considered relevant to national agriculture and animal production. They work at national and international level, with subjects related to the enrichment of knowledge and conservation of product germplasm, being supported by technical areas for these activities. Among other functions, the animal Germplasm Curator has to promote, start and follow activities related to conservation, multiplication and/or regeneration of germplasm of products under their responsibility. The Curators of the Germplasm Banks have the responsibility to

Table 3. Recent Scientific Events which included Conservation of Animal Genetic Resources in their programmes.

	Date	Event
Tampico, Mexico	November, 1998	4th Ibero American Congress for Criollo Breeds
Kathmandu, Nepal	August 1998	4th World Conference on Conservation – RBI
Colina, SP, Brazil	July 1998	National Equine Forum
Soeul, Korea	July 1998	8th World Congress of Animal Production
Valdivia, Chile	May 1998	X Chilean Veterinary Medicine Congress
Armidale, Australia	January 1998	5th World Congress on Genetics Applied An. Production
Niterói, RJ, Brazil	December 1997	Workshop of the Rio de Janeiro Research Corporation
Amsterdam, Holland	November, 1997	CEDLA Workshop
Brasilia, DF, Brazil	July 1997	Workshop on Conservation of Animal Genetic Recourses
B.Horizonte, MG, Brazil	May 1997	Brazilian Animal Production Congress – Zootec'97
Ottawa, Canada	February 1997	Symposium organised by Ag-Canada
Guadeloupe, F.W.I.	December 1996	Caribbean Meeting, INRA
Bogota, Colombia	November 1996	3rd Ibero American Congress for Creole Breeds
C.Grande, MS, Brazil	October 1996	XV Pan American Veterinary Congress (PANVET)
R. Preto, SP, Brazil	May 1996	33rd Brazilian Animal Breeding Society Congress
Brasília, DF, Brazil	November 1995	Workshop for curators of Conservation Nuclei
Orlando, USA	July 1995	87th Annual Meeting American Society of An. Science
San José, Costa Rica	July 1995	Towards an Inter American System for An. Genet. Res.
Circello, Italy	June 1995	Expert Consultation of FAO
Guelph, Canada	August 1994	4th World Congress on Genetics Applied An. Production
Kingston, Canada	August 1994	3rd World Conference on Conservation – RBI
Buenos Aires, Argentina	July 1994	Argentinean Association of Animal Production Congress
Rio de Janeiro, RJ, Brazil	July 1993	Annual Meeting of the Brazilian Na. Production Society
Santiago, Chile	July 1993	Conservation Symposium (ALPA Meeting)
Zafra, Spain	September 1992	1st Ibero American Congress for Creole Breeds
Córdoba, Spain	September 1992	World Meeting on Domestic Animal Breeds
Turrialba, Costa Rica	July 1992	Conservation & Development of An. Genet. Res. in L.A.
Rio de Janeiro, RJ, Brazil	June 1992	Science Forum (Earth Summit)
Nanjing, China	January 1992	FAO International Course on Regional Gene Banks

maintain the Conservation Nuclei as well as to multiply, regenerate and distribute the germplasm.

At the present time the Programme of Conservation of Animal Genetic Resources has 13 ongoing research projects (Table 1).

As already mentioned, the Conservation Nuclei are being kept where the animals were naturally selected over centuries. In a huge country such as Brazil, with several different climates, there is no reason to conserve animals in environments different from those to which they are adapted. Trips for the identification of new nuclei, in order to maintain endangered breeds considered to be native, means that new populations are continually being identified. Some are very similar to breeds officially included in the *in situ* conservation programme and others have totally distinct characters. In general, these populations, which have been identified in the last few years, have extremely reduced effective population sizes. The strategy used has been to include them initially in the cryopreservation programme, so as to assure the storage of genetic material in the BGA in Cenargen. At the same time, their blood is collected to be used for genetic characterisation.

The results of genetic characterisation could reduce existing doubts about breed groupings. As an example, we can cite the case of the Criollo Lageano, Franqueiro and Junqueira cattle. All have huge horns and some breeders insist that they are the same breed, while others treat them as separate breeds. With genetic characterisation, strategies could be developed based on facts and not on suppositions.

Cryopreservation

To avoid the disappearance of local breeds, FAO began contacts in 1987 to install regional Animal Gene Banks (RAGBs) for developing

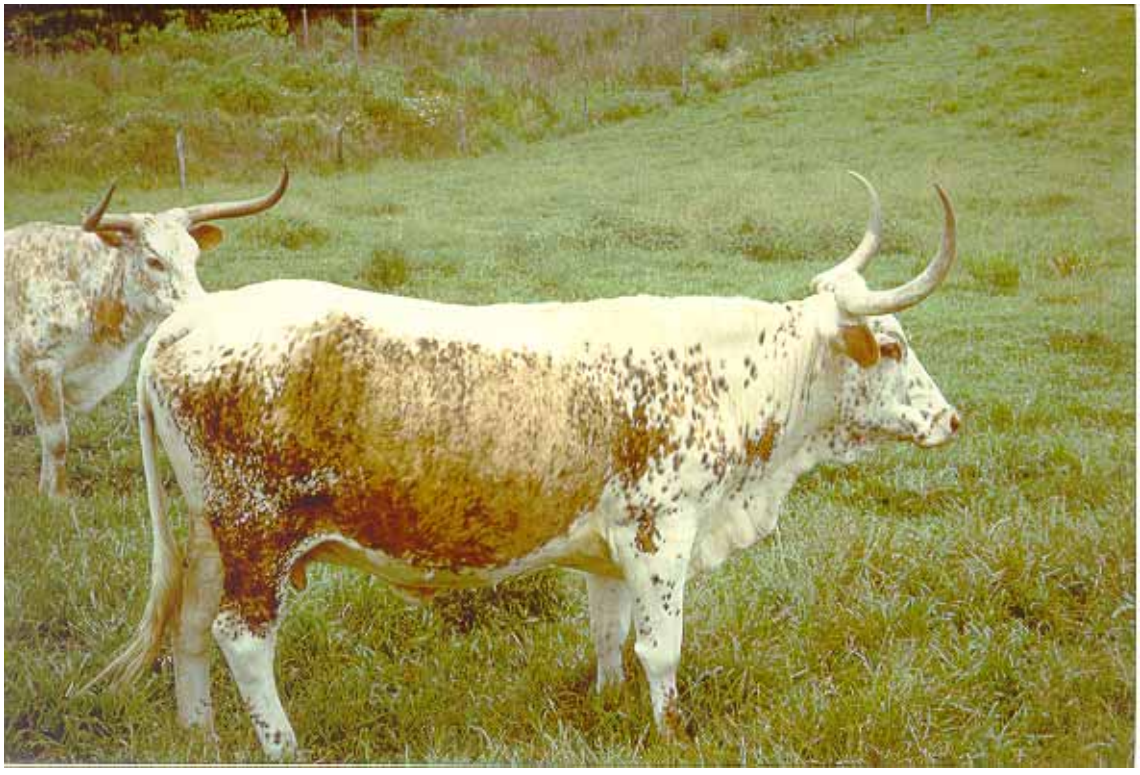

Figure 3. Criollo Lageano cow (Southern region).

Table 4. Number of animals of various breeds threatened with extinction on Cenargen's Experimental Farm in 1999.

Species/Breed	Number of males	Number of females
Cattle		
Caracu	1	1
Criollo Lageano	1	5
Curraleiro	7	10
Junqueira	2	3
Mocho Nacional	1	1
Pantaneiro	6	18
Patuá	1	2
Puganu	1	1
Goats		
Azul	1	4
Canindé	2	`3
Marota	3	6
Moxotó	3	8
Nambi	2	2
Repartida	1	4
Horses		
Campeiro	2	6
Pantaneiro	4	5
Asses		
Casco de Mula	1	1
Inhata	1	2
Monteiro	1	2
Moura	1	1
Nilo	1	2
Piau	1	1
Rabo de Peixe	1	2
Total	51	104

countries. At that time Cenargen/EMPRAPA had been chosen to host the Bank that would be responsible for the storage of semen and embryos of the breeds of domestic animals in danger of extinction in South America. A copy of the material would be stored in the Instituto Nacional de Tecnologia Agropecuaria, Argentina, for security reasons. Because of health legislation differences, regulating the entry and exit of genetic material between countries, none of these RAGBs was established. There is a need to reach a common denominator, so that the future exchange of germplasm is facilitated, as the RAGBs have no commercial purpose, just storage for future use. RAGBs were also proposed for Asia and Africa. Seeing that, at that time, this goal would be difficult to achieve, FAO decided to stimulate these countries to create their own Animal Germplam Banks or to strengthen those that already existed. At the same time it gave priority to the Domestic Animal Diversity – Information System - DAD-IS (FAO, 1998a). The erosion of domestic animal diversity is very clear as is evident from the number of breeds threatened with extinction world-wide (Hammond, 1993). With the help of many countries and organisations, particularly the European Association for Animal Production (EAAP), in 1991 FAO started a world-wide programme, with the collection of population data for seven main species of domestic animals. To date, two editions of the *World Watch List for Domestic Animal Diversity* have been published (FAO, 1993 and FAO, 1995).

In Brazil, the conservation of animal genetic resources was not jeopardised, since when FAO proposed the creation of the RAGBs, Brazil had already created its own Animal Germplasm Bank (AGB). The Brazilian AGB is kept at Cenargen, which is responsible for the storage of semen and embryos of various breeds of domestic animals threatened with extinction in Brazil. It has existed since 1983 and it is because of its existence that Cenargen was chosen to host the South American RAGB, as mentioned above. Table 2, shows the present state of the Brazilian AGB.

Conservation Nuclei must exist for semen, embryos and oocytes of the species/breeds in danger of extinction to be collected. For some breeds included in the Brazilian programme, there are less donor bulls than the number recommended by Smith (1984), which are 25 donors per breed with 100 doses/bull. Unfortunately, when the *ex situ* conservation began, some of the breeds did not have this number of males. Therefore, although more than the recommended 100 doses/bull has been collected, the number of bulls was reduced. In other cases, as the Argentine

Creole, as it is not a Brazilian Breed and its use in Brazil is not common (although some bulls were used on the Criollo Lageano of the Fazenda Canoas, Santa Catarina State) it was decided to stop the collection, and the semen already collected was kept by the AGB.

As the Conservation Nuclei are increased in size and number, or new herds are identified, the intention is to collect genetic material from the greatest possible number of animals, thereby increasing the genetic representation in the AGB.

Another National research programme of EMPRAPA, is that of Biotechnology Applied to Agriculture and Animal Production. This contemplates a project which intends to develop animal reproduction techniques that may be used in Conservation work. Among the techniques being studied are embryo bisection, *in vitro* fertilisation, cloning and the formation of transgenic animals.

Genetic Characterisation

For a long time the characterisation of different breeds of domestic animals in Brazil was based, almost exclusively, on phenotypic data (morphology and production), which sometimes is insufficient to distinguish between pure breeds and those heavily influenced by environmental factors (Panepucci, 1986). With reference to genetic characterisation, the few papers published on Brazilian native breeds include only cytogenetic studies, blood groups and protein polymorphisms.

In the bovine species, structural differences of the Y chromosome observed in different karyotypes of animals of European origin (*Bos taurus*) show that this chromosome is submetacentric, while Afro-Asian breeds (*B. indicus*) are acrocentric. While studying the Curraleiro breed, Brito (1995) verified the occurrence of polymorphism of this chromosome at a cytogenetic level. About 68% of the animals had an acrocentric Y chromosome, which indicates that, at some time during the formation of this breed, zebu type animals were introduced. This dimorphism of the Y chromosome had been observed by Tambasco (1985) in four native bovine breeds (Caracu, Mocho Nacional, Curraleiro and Criollo Lageano), which indicates that both bovine subspecies were involved in the formation of native breeds. Although the Criollo Lageano has a lower acrocentric Y chromosome frequency, this could be due to the geographical location of this breed (found in the South of the country where the zebu influence is much smaller). Crossing the two species may have been favourable for these breeds, because it associated certain qualities of the taurines, such as precocity and productivity, with hardiness and disease resistance of the zebus.

Another study with native cattle breeds was carried out by Dr. Mário Poli (personal communication), of INTA, Argentina, consultant to Cenargen, in 1985. Poli cites that from phylogenetic trees, based on data obtained from the study of thirty blood factors and genetic frequencies, only three systems were determined (F, J and L), since the lack of genealogical registers made it impossible to estimate the frequency of more complete phenogroups.

In the Caracu breed, Bicalho (1985) carried out a population study of different breeding nuclei based on blood groups and protein polymorphisms. It was concluded that this breed originated from the Portuguese breeds Alentejana and Mertolenga, although there are no registers of the latter breed entering Brazil. The author concluded that the Caracu has low genetic variability and was subdivided into four genetically distinct subpopulations. From the analyses, it was suggested that animals should be exchanged between nuclei to prevent greater loss of genetic variability.

The genetic characterisation of several cattle breeds was the subject of a doctorate thesis using protein polymorphisms. The study included three native Brazilian breeds (Caracu, Pantaneiro and Mantiqueira), one native Argentinean (Argentine Creole) and two zebu breeds (Nellore and Gir). The genetic distances between pairs of populations were calculated using NEI method (1972 and 1978), from gene

frequencies of eight protein systems, using the DISPAN programme. The highest values were obtained between pairs where one of the breeds was of *Bos taurus* origin and the other of *Bos indicus.* The average distance between the native Brazilian and the Nellore and Gir breeds was 0.1083 and 0.0964, respectively (LARA, 1998). The small values obtained for genetic distances between the Caracu, Mantiqueira and Pantaneiro with the Argentine Creole, suggest a great similarity between them and support the hypothesis that these breeds were founded by Iberian cattle, probably sharing the same ancestry.

The small number of projects in this area, up to the present time, helped establish the Animal Genetics Laboratory of Cenargen as a priority. The laboratory started to function in February 1998 and will work primarily with DNA polymorphisms for the genetic characterisation of the populations of animals of the conservation programme. At the same time, a DNA Bank is being set up, which already has samples from several species of animals (60 heads of cattle, 18 horses, 113 asses, 154 goats and 89 buffaloes). The intention is that, in the short term, cells and tissues of several species, including wild animals, should be stored.

For the first stage, the intention is to verify the degree of diversity within the breeds/native populations, to gain a global idea of genetic distances using similarity indices. Following an FAO recommendation, 50 animals of each breed will be used. Since the sampling process is vital for the success of the proposed plan, an investigation will be made into the Conservation Nuclei and/or Breed Societies, when they exist, of the geographical distribution of each breed, so that the samples are representative of the whole population known to exist. The DNA may be collected from blood or semen.

For comparative studies, two methods for the evaluation of DNA polymorphisms will be used. Since there is not sufficient data in the literature to evaluate, from molecular information, what constitutes a distinct breed, it is necessary to compare different markers (Grattapaglia, personal communication).

A priori, the RAPD will be used as it is relatively cheap and fast, as well as relevant to the study (Egito, 1995). Micro-satellites will also be used, as they are well developed in cattle studies. This technique differentiates the heterozygotes which are co-dominant thus generating more information to discriminate the variability within populations, helping in the choice of individuals for conservation. In the Animal Genetic Laboratory, work has already begun on cattle and horses and will soon include asses, buffaloes, goats and sheep species.

The primers for the micro-satellites on cattle were selected from thirty identified by the International Society of Animal Genetics (ISAG), after a meeting in 1996. These primers are the same recommended by MoDAD-FAO (FAO, 1998b) and are being used for genetic characterisation of the Iberian breeds in a project being carried out by the University of Porto, Portugal, and financed by the European Community. This fact will make the comparison of the breeds studied in both projects easier and facilitate the exchange of germplasm between the countries.

Public Awareness of the Importance of Conservation of Animal Genetic Resources

Another objective of the programme is to make the various sectors of society aware of the importance of conservation of animal genetic resources. Presenting the programme on various opportunities has helped significantly. The creation of a *Farm Park,* as has occurred in several European countries will be another strategy to bring this theme to the public attention.

Presentation of the Brazilian Animal Genetic Resources Conservation Programme

The presentation of the Brazilian Programme has stimulated the creation of Conservation Nuclei in Brazil, as well as of other National

Animal Germplasm Banks in other Latin American countries. The creation of these other banks may allow, in the medium term, the collection of all the material in one place - the RAGB (with a duplicate in a second country) as proposed by FAO in 1987. In this way, the Programme has been presented in different events in Brazil and abroad. In Brazil the intention is to bring the philosophy of the work with animal conservation to society, as well as the actual state of development of the programme (often stimulating the creation of new Conservation Nuclei); abroad the intention is to

1) show the state of animal genetics resources conservation in Brazil, stimulating the creation of new National Banks and
2) present the actual conservation situation on the continent as a whole. It is hoped that the awareness level of society on the importance of conservation of animal genetic resources is being raised at both the national and international level.

Since the conservation of animal genetic resources is a relatively new topic, it has only recently been included in the programmes of congresses and symposia. Until recently, the researchers who dared to breach this topic were labelled as philosophers. It was said that the so-called "native" breeds should be conserved in Zoological Gardens. Fortunately, this point of view is changing rapidly, and the most important congresses in the animal area are including sessions or symposia on this topic. At last, traits such as adaptation, hardiness and disease and parasite resistance, which many of these local breeds have, are being recognised and valued. Table 3 presents some of the places and sessions where the Brazilian Animal Genetic

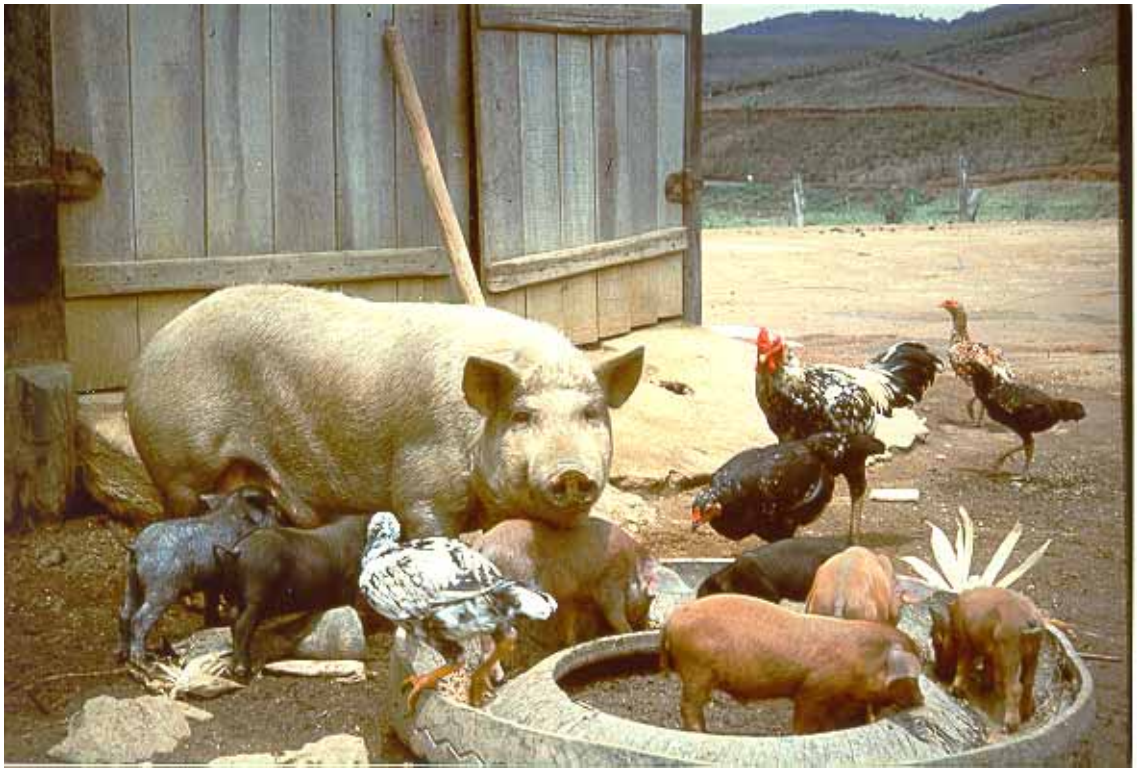

Figure 4. Tatu pig (South-Eastern region).

Resources Conservation Programme has been presented over the last seven years, so that the increasing status of conservation can be evaluated.

Brazilian farm park

In 1993, the Animal Germplasm Bank (AGB) of Cenargen was recognised by the Brazilian Ministry of Agriculture, who donated an area of 900 ha for the installation of a *Farm Park*, which will be called Farm Park for the Animal Diversity in Brazil. The main objective of this park will be to bring together, in Brasilia, living examples of domestic animal breeds of different species (cattle, buffaloes, horses, asses, sheep, goats, pigs and poultry) which are in danger of extinction. This Farm Park will be open to the public and is already being built on Cenargen's Experimental Farm. Up to the present time, a large part of the animals that will be shown on the Farm Park have already been brought to Brasilia, and are being used for semen and embryo collection stored in the AGB. Table 4 shows the number of animals of the various species/breeds that can be found in Brasilia and which will be part of the Farm Park.

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