EXPERIENCE WITH *IN SITU* PRESERVATION OF POULTRY BREEDS

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1. Introduction

Conservation of poultry breeds continues to receive minor attention in the growing world literature on conservation of animal genetic resources. There are several technical publications pertaining directly to poultry, a few inventories have been prepared, and some genetic stocks are currently held in conserve. But much more activity is needed to protect rapidly dwindling poultry genetic resources throughout the world. Industrialization of the poultry industry is advancing; there is a near monopoly of industrial stocks in developed countries, and these same stocks are rapidly replacing indigenous poultry in developing countries. Meanwhile, consumption of poultry products continues to increase; chicken consumption has surpassed beef in the United States; Yamada (1988) estimates that poultry meat currently accounts for 25% of the total world meat supply. Because of industrial monopoly, and because the genetic base for industrial poultry appears to be very narrow, it has been argued that the need for conservation is greater in poultry species than it is in domestic mammals (Crawford, 1984a, 1984b, 1990).

There are scattered notations in the technical literature to indicate that some poultry stocks are actively being conserved in a few countries - Poland, Romania, Hungary, Russia, Sweden, Iceland, Spain, France and Canada. The international registry published at three-year intervals by Somes (1988) includes some stocks being conserved purposely. Unfortunately, these conserves do not all have much long-term security. For instance, the very large and important collection of chicken stocks held at Parafield Poultry Research Centre in Australia has now been dispersed (personal communication). There appears never to have been direct poultry conservation action in developing countries (Mukherjee, 1990).

Except for the report by Wezyk and Kasznica (1982), there is almost nothing in the technical literature describing procedures utilized and results obtained during purposeful conservation of poultry stocks. The intent in this report is to describe the procedures which have been used by the author during the past 25 years at the University of Saskatchewan in maintaining a collection of poultry genetic resources, and to estimate the effects of these procedures. Three conservation protocols will be described:

1. Non-pedigreed natural mating in floor flocks.
2. Pedigreed random mating in caged flocks.
3. Storage of tissue cultures and DNA.

The University of Saskatchewan collection of poultry genetic resources was begun in 1965 and it continues to the present. It emphasizes lines of middle-level production poultry and synthetic lines holding single gene mutations. Stocks have been added to the collection when opportune. The collection currently comprises 17 middle-level lines (11 chicken, 1 turkey, 1guinea fowl, 1 domestic duck, 1 muscovy duck and 2 goose), and 13 mutant lines. In addition to its conservation role, it is utilized extensively in teaching and in research which provide financial support.

2. Conservation protocols

2.1 Non-pedigreed natural mating in floor flocks

Eleven pure lines of middle-level production chickens have been maintained successfully for many years (Table 1). The oldest in the collection have been kept for 24 generations; two recent additions have been kept for nine and four generations. The 'Araucana' line is a synthetic established in 1966. All of the others had been held as closed flocks prior to collection, but flock size and selection history are poorly known. Number of founders (Table 1) refers to actual numbers of males and females used to generate the first conservation generation. They reflect stock availability and housing facilities at time of collection, and purpose of acquisition; most were obtained for research purposes initially, and only the last three listed were acquired primarily for conservation. Nearly all of them are one-of-a-kind lines that are not kept anywhere else.

Table 1: Middle-level production chicken lines maintained at University of Saskatchewan.

Breed	Acquisition [1]	Founders	
Barred Plymouth Rock	1965 U	4 m +	39 f
Fayoumi	1965 U	15 m +	35 f
Brown Leghorn	1965 C	12 m +	16 f
'Araucana'	1966 C	1 m +	6 f
Light Sussex	1967 C	10 m +	21 f
White Jersey Giant	1967 C	5 m +	10 f
Hungarian Yellow	1971 U	7m +	9f
White Wyandotte	1972 C	6m +	10 f
White Leghorn	1974 U	20 m +	60 f
New Hampshire	1980 C	20 m +	60 f
Rhode Island Red	1985 U	20 m +	50 f

[1] C = commercial origin; U = university/research origin

These eleven lines have been maintained for all or most of their conservation history using non-pedigreed natural mating in floor flocks. The intent has been to approximate random breeding and to avoid all selection pressures.

About 200 chicks per line are hatched each yearly generation. They are brooded and reared under routine procedures. To reduce costs, half of the males are discarded at random at 15 weeks of age; it has not been possible to arrange for vent-sexing at day-old. Breeding stock is placed in adult quarters at 21 weeks of age. Females are chosen at random, rejecting only those with very gross defects. Numbers retained have been 50-60 females in one pen per breed, which has necessarily been a function of available pen space. About 25 males per breed are also chosen at random; 5-6 are kept with the female flock and the others are held in a bachelor flock in a separate pen. The adults are given routine care and management. Expected mortality is 1% per month, so that when reproduction begins at 11 months of age there should be 45-55 females alive per breed and there will still be an excess of needed males.

Hatching eggs are obtained beginning when the adult flock is 11 months of age. A major objective is to ensure that many males are used as sires. From those available, 15-18 males are randomly chosen and identified with colored leg bands as three groups of 5-6. Beginning several weeks before the breeding season and continuing throughout, these three groups of males are placed with the females each week in rotation; that is, red band males enter the female flock on Monday, white band males replace them on Wednesday, blue band males replace the white bands on Friday, red band males rejoin the female flock on Monday, etc. Hatching eggs are accumulated for one week and then placed in artificial incubators. A setting of eggs is made each week until sufficient progeny have been generated. It is important to ensure that the maximum numbers of sires and dams provide progeny for the next generation. Two hundred chicks are needed. Hence, about 100 are retained from the first hatch, and about 100 from the second. Additional weekly hatching is needed for lines having poor reproductive performance; in some cases a series of six consecutive weekly hatches has been required to generate the needed 200 chicks. Chicks for retention are taken at random from the hatching trays, avoiding only those with gross defects; they are identified individually although their pedigree is not known. The entire cycle is then repeated.

Valiant attempts have been made throughout to ensure uniformity of environment and husbandry procedures, but with only a modicum of success. Housing conditions have changed many times, from derelict buildings and free range to modern confinement facilities; brooding and rearing are now conducted in a new building with elaborate environmental controls, but adults are kept in a renovated swine farrowing barn that is only moderately adequate. There have been many changes in technical and husbandry personnel. And there have been occasional major problems with disease.

At no time in the history of these lines has it been feasible to measure production performance adequately because of chronic shortages of funds, staff, and facilities. It would have been desirable to include an established random-bred control strain (Gowe and Fairfull, 1990) in the collection to monitor genetic and environmental trends, but that has not been feasible either.

However, information and data on yearly reproduction of stocks have been maintained throughout, wherein technical procedures have remained constant, incubation facilities have been excellent, and there has been continuity of personnel. Yearly measures of fertility and hatchability of fertile eggs permit an assessment of reproductive fitness of the conservation stocks. They also provide an indirect measure of egg production performance, since it is generally recognized that rate of egg production and hatching success are positively correlated. Fertility and hatchability of four of the conservation lines are shown graphically in Figures 1 and 2.

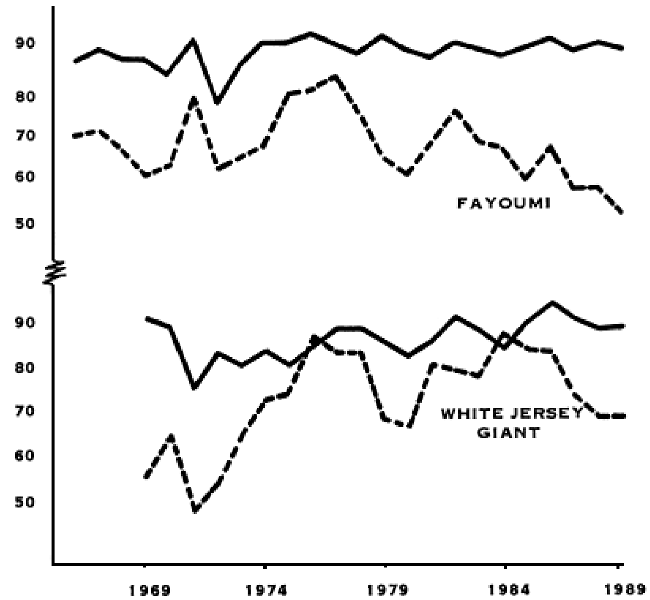

Figure 1: Fertility and hatchability of Fayoumi and White Jersey Giant conservation flocks. Solid line = per cent fertility; broken line = per cent hatch of fertile eggs.

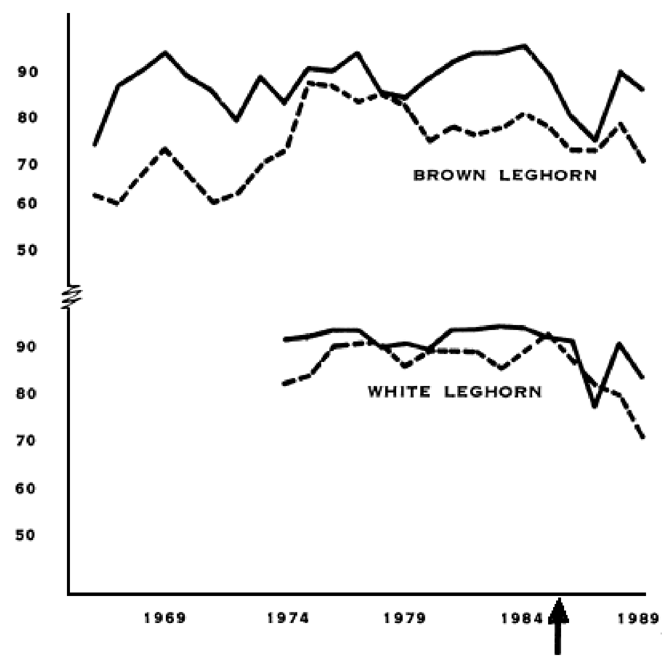

Figure 2: Fertility and hatchability of Brown Leghorn and White Leghorn conservation flocks. Solid line = per cent fertility; broken line = per cent hatch of fertile eggs; arrow = change to pedigreed random breeding of caged flock.

Fertility has remained remarkably high. There is no indication of permanent change over advancing generations. Other lines in the collection likewise have maintained their fertilizing ability.

Hatchability of fertile eggs has also remained essentially unchanged, although it is more subject to random fluctuations. A separate analysis of data (not detailed here) indicates that embryo mortality occurs both early and late as anticipated, and there has been no major change in the frequency of embryo deaths at either stage over advancing generations.

Two of the lines have passed through ‘bottlenecks’ because of epidemic disease. In 1970 the Barred Plymouth Rock breeding stock was reduced to several males and two females during a massive outbreak of Marek's disease. A sample of the line had been placed at another university in the previous year, and it was possible to rebuild the parent flock from that sample. In 1986 the White Wyandotte breeding stock declined to seven males and 20 females because of Mycoplasma infection. The flock was rebuilt from those survivors.

Only two of the lines give consistently poor reproductive performance - ‘Araucana’ and Hungarian Yellow. Both were started from very few founders, and both were reproduced over the next 10-12 generations using only about five sires and 15 dams. Since then the flocks have been held at the usual 15-18 males and 50-60 females. There are no indications that their performance has either worsened or improved since increasing population size.

The evidence is that reproductive performance of these lines has remained unchanged over many generations of non-pedigreed natural mating in floor flocks, using about 15 sires and about 50 dams per generation. The numbers of effective parents suggested in the literature for genetic safekeeping are considerably larger. Sheldon (1984) indicated that a minimum of 200 male and 200 female parents per generation should be used for important or unique breeds, and 50 males and 50 females for a less important breed or a strain of an important breed. Gowe and Fairfull (1990) have reviewed in detail the theory and practice of breeding control strains for genetic research. They suggest that there be about 250-400 effective parents for stability and minimum drift in a control strain that is used in a long-term selection study. They used 80 sires and 240 dams in maintaining the Agriculture Canada chicken egg stock control strains, and similar numbers were used in breeding the meat stock controls.

It should be emphasized that the protocol used here for chickens includes annual reproduction. Reproductive fitness declines markedly in two-year old chickens. Polkinghorne (personal communication) tried reproducing the Parafield stocks using second-year birds but found that declines in male fertility, female egg production, and livability of both sexes prohibited the practice. The author has maintained the sex-linked paroxysm mutant by breeding heterozygous males as two-year olds to young females, but the poor results from delayed reproduction probably do not justify other savings. An attempt to reproduce the naturally-mating Bronze turkey line from second-year birds was disastrous; the toms had become too heavy and geriatric to complete the mating act. In contrast, the guinea fowl and muscovy duck lines being conserved are very amenable to second-year reproduction, and the goose stocks retain good reproductive abilities until at least five years of age.

2.2 Pedigreed random mating in caged flocks

Gowe and Fairfull (1990) have shown that the pedigreed random mating system is much more effective in reducing inbreeding and genetic drift than is the non-pedigreed natural mating system, and hence it should be preferred in breeding a conservation stock. A new housing facility with individual cages for males and females became available in 1986. The four conservation lines considered to be most valuable - White Leghorn, Brown Leghorn, Barred Plymouth Rock, Light Sussex - were moved to the cage facility that year. The New Hampshire line was transferred to cages in 1988. The breeding system for these five lines was changed immediately to pedigreed random mating.

Each line is allotted a row of 100 cages. Twenty cages are for males, representing 20 sire families. In addition, 20 males are kept as reserves in a bachelor floor flock, these being full-brothers or half-brothers of the caged males. Eighty cages are for females; sixty of them are used for breeders, representing 60 dam families; twenty of them are for reserves, representing one daughter from each of the sire families. The birds are caged at 21 weeks of age and reproduction begins when they are about 11 months old.

All breeding is by pedigreed artificial insemination with random assignment of mates, except that matings of full-sibs and half-sibs are avoided. Each male is mated to three females. Pedigreed artificial inseminations are made twice each week through the breeding season. Four consecutive weekly hatches of pedigreed chicks are generated. About six progeny per dam are retained to form the next generation, to ensure that each sire contributes a son and each dam contributes a daughter.

When breeding stock is chosen at five months of age, one son of each of the 20 sires is caged and one son is placed in the reserve floor pen; one daughter of each of the 60 dams is caged, and 20 of their full-sisters or half-sisters fill the reserve cages. The selection scheme has been very successful, but occasional substitutions for missing families are needed and these are made at random.

Reproductive performance of White Leghorns and Brown Leghorns over four generations of this procedure are illustrated in Figure 2. Performance is expected to be poorer than under a non-pedigreed natural mating system for two reasons:

- multiple-sire mating can mask poor reproductive abilities of individual males;
- artificial insemination requires considerable technical and husbandry skill; for instance, the low fertility in 1987 was coincident with use of trainee technicians.

Overall, the results obtained under pedigreed random mating are compatible with those obtained earlier under non-pedigreed natural mating. The apparent decline in hatchability is believed to be an environmental effect involving hatchery operation since it occurred simultaneously in all flocks under both mating systems (Figures 1 and 2). The presumed advantage of the pedigreed system is its superior control over inbreeding and genetic drift, but that cannot be verified yet.

An unexpected finding with the pedigreed system has been the discovery of aberrant reproductive function in the Light Sussex line. That line had a long history of satisfactory reproduction under non-pedigreed natural mating. When pedigreed breeding in cages was started, it became evident that about 60% of the females were very prolific but the other 40% produced no eggs at all. Reproductive tracts of the 1988 population females were examined by Dr F.E. Robinson, University of Alberta, who found a high incidence of grossly abnormal ovaries. Further studies of this peculiarity are in progress.

2.3 Storage of tissue cultures and DNA

The possibility of using new biotechnology techniques for preservation of poultry genetic resources holds great interest. A major advantage would be avoidance of the need to maintain living populations of birds which is costly in both practical and genetic terms. Bakst (1990) has reviewed current technologies for storage and preservation of avian cells. Freeze-preservation of chicken and turkey semen can be accomplished readily, although there is very heavy selection pressure for freezing ability of semen from individual males. Embryos can now be cultured *ex ovo*, but freeze-storage of them has had only preliminary study. There are few barriers to successful freeze-storage of somatic cells.

A very large harvesting of somatic cells and DNA has been made from the 1988 generation of all 11 conservation chicken lines. This work was performed by graduate trainee, R.D. Bergen, under the supervision of Dr S.M. Schmutz, University of Saskatchewan. All of the breeding stocks were sacrificed at the end of the breeding season in spring 1989. Ovarian tissue was taken from all females for a cooperative project with the University of Alberta, and concurrently a blood sample was obtained via brachial vein from each female for extraction of DNA. Numbers of blood samples ranged from 53-82 per breed. In addition, pericardial sac tissue was taken from all Light Sussex females to establish fibroblast tissue cultures. Subsequently, pericardial sac tissue was also collected from several males of each breed for tissue culture.

The blood samples were frozen temporarily and then subjected to DNA extraction (samples were lysed and incubated with proteinase K, extracted three times with phenol and three times with chloroform, and then dialyzed). DNA has been extracted from 10-20 samples per breed and returned to freeze-storage; DNA extraction from remaining blood samples is in progress.

Duplicate samples of pericardial sac tissue were placed in culture media. About 90% of them grew satisfactorily. They were then subcultured, and then frozen in liquid nitrogen. Duplicate cultures from 90 birds are now in storage in facilities at the University Saskatchewan. For added security, some of these will be placed in permanent storage elsewhere.

It will depend on future advances in biotechnology whether these reserves of DNA and tissue cultures have any usefulness in conserving poultry genetic resources. Until then, it is necessary to continue maintaining the living flocks.

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WORLD WATCH ON ENDANGERED SPECIES

The Global Animal Genetic Data Bank

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1. Introduction

The basis of conservation programs is knowledge on breeds and information on genetic varieties, which are endangered or could be so in the near future. This information has to be reliable and it has to be updated at meaningful intervals in order to keep track of changes in criteria relevant for the survival of the breed.

Accumulation of information in a data bank means data collection and storage in a systematic order which allows quick and easy access, to perform comparisons and retrievals for any combination of criteria.

1.1 Objectives

For a Data Bank on Animal Genetic Resources we have the following objectives. To know:

- which population/breed/line/variety/resource does exist and where,
- whether the size of the breed, i.e. the number of breeding animals, is changing and in which direction,
- whether the same breed exists in different places, countries or regions,
- the specific genetic characteristics of a breed and its similarity to other breeds,
- the specific potential of the breed in a given environment,
- its importance for people living in the same area,
- whether conservation programs have been initiated
- persons or institutions that can be addressed, if more information on the breed is needed.

The list of objectives and relevant questions can be long, maybe too long and too specific in order to get the answers properly and in due time; there can be a conflict between the objectives of a data bank and the practicability of data collection for it.

2. Development of the Global Data Bank on Animal Genetic Resources

It was one of the recommendations of the FAO/UNEP Technical Consultation on Animal Genetic Resources Conservation and Management, Rome, 1980, to establish such data banks (FAO, 1981). Actions were initiated both by FAO and other organisations in different regions.

FAO developed descriptor lists and gave recommendations for creating data banks (FAO, 1986a,b,c). National data banks for animal genetic resources started to operate in India and China, each covering an enormous number of autochthonous breeds.

In Europe, the Genetic Commission of the European Association of Animal Production (EAAP) set up a working party on Animal Genetic Resources, that organized two surveys on breed resources in 1983 and 1985 in Europe (Maijala *et al.*, 1984; Maijala, 1987). The questionnaire forms for these surveys were improved and modified according to the experience from working with them. The last survey resulted in information on 553 breeds.

In 1987, the EAAP Genetics Commission approved the following recommendations of the working party:

- to cover all breeds, not only the endangered ones, of the five species cattle, goats, sheep, horses, and pigs,
- to use the English language in the answers, to repeat the survey at intervals of three years,
- to ask for the relative performance of the breed in comparison with a so called “standard breed” in the same country
- to set up a data bank.

Although EAAP was not able to give financial support, the Institute for Animal Breeding and Genetics, Hannover, volunteered to set up the data bank and was enabled to do so by a grant of the German Research Foundation.

In 1988 FAO and EAAP made an agreement, that identical questionnaire forms should be used both in developed and in developing countries, and that the information should be combined in the data bank in Hannover, which in future should serve as Global Animal Genetic Data Bank. The working party was expanded to a combined EAAP-FAO Working Party. The questionnaire was again adapted; now it covers buffalos as a sixth species and considers also the management conditions and the natural environment typical for the breed.

As a first step towards including breeds from outside Europe information from the National Data Banks in India and China will be transfered to Hannover. For this purpose, two software specialists from India and China stayed in Hannover in the summer of 1989 for four weeks to get acquainted with details of computer programs and the kind of records needed as transfer information.

The combined information from Europe, India and China will add up to 838 breeds of buffalo, cattle, goats, sheep, pigs and horses. Additional information is available from India and China for several breeds of camels, yaks, asses and poultry.

As a next step information on breeds represented in the Regional Gene Banks will be transferred to the Global Data Bank. Since each of these Regional Gene Banks will cover indigenous breeds from several countries, a broad input from developing countries is expected.

3. Present concept of data bank

The data bank was installed on a Personal Computer with a 30 MB hard disc which should be sufficient for the next few years. The data bank system dBase III+ is used with several additional programs to enter the data and for information retrievals.

The quality of the accumulated information depends on the quality of input data. The working party therefore took great care in the creation of questionnaire forms. At present they are characterized as follows:

– Six species for the start, i.e. buffalos, cattle, pigs, goats, sheep and horses. Others may follow, when the channels for data collection are established.

– The same questionnaire forms can be used for all six species.

- Information on all breeds and genetic varieties is asked for, since the status of an endangered breed is not clearly defined.
- The questionnaire includes only seven pages; it is restricted to main items which can characterize the breed (s. Table 1). In addition it asks for the address of specialists, who know more about the breed, in case more information is required.
- Because of different environmental conditions in various countries and of different measurements of traits, the production potential of a breed is evaluated not in terms of absolute production figures but by relative deviations in traits from the potential of a so called “standard breed” in the same country. For each species recommendations are given for standard breeds.
- Repeated surveys are regarded necessary in order to become aware of changes, which are important for the survival of the breed. If information on a breed is available from a previous survey, a printout is prepared to allow a check on the correctness of the stored information and to facilitate the new survey.
- Normally the information is transferred to the Global Data Bank by means of the filled in questionnaire forms. However if local centers prefer to run their own data bank, they can be supplied with software for the data input on a PC and after that the transfer can be performed by a floppy disc.
- Before the data are entered into the data bank every breed record is checked for completeness and for possible errors by a person with experience in animal breeding. If necessary the colleague who filled in the information will be addressed in order to clarify the situation.

In the appendix an example is given of a filled-in questionnaire.

Table 1: Main items asked in the questionnaire forms.

A. General information (page 1)
  - Country and species (buffalos, cattle, goats, sheep, horses, or pigs)
  - Breed or population (local and international name)
  - Main organization concerned with the breed
  - Preparation of replies (name, organization, time)

B. Origin and development of breed (page 2)
  - Origin (from which breeds, from which country, herdbook since when), immigration to the breed (breed, country, time, percentage of matings)
  - Breeding population numbers 1986 (males, females; males in A.I., herd size, changes in numbers)
  - Average age of mature animals used for breeding (o, o)

C. Breed description (page 3)
  - Colour (unicoloured, colour combinations, special signs)
  - Horns (number, shape)
  - Appearance (adult weight, withers height)
  - Genetic peculiarities (chromosome abberrations, marker genes)

D. Qualification of breed (page 4)
  - Present main use (ranking of eight alternatives)
  - Other important uses
  - Special qualifications (with references)

E. Management conditions (page 5)
  - Type, housing period, feeding
  - Specific natural environment

F. Performance records (page 5 and 6)
  - Name of standard breed for comparisons within country
  - Approximate production level of standard breed in main traits
  - relative comparisons with standard breed in specific traits
  - Validity of comparisons (production conditions)

G. Additional information (page 7)
  - Estimate of genetic distance to other breeds
  - Storage of DNA in a gene-library
  - Programs to conserve live animals of the breed
  - Additional information to be obtained where

4. Use of data bank

The purpose of the data bank is to give answers to specific questions in the context of proper use of a breed and of its conservation.

4.1 Utilization of a breed (or of animal genetic material)

- Based on the information on the specific potential of a breed, the breed may be used in a new location with similar environmental conditions.
- Based on the information on breed history, immigration, and genetic distance, the chance for utilization of heterosis in crosses with other breeds can be estimated.
- Knowledge of the specific genetic potential in quantitative traits can be used to develop a synthetic breed which combines the advantages of several breeds.

- Knowledge of the presence of major genes in a breed can be used to study their effects in more details, to identify and isolate them by recombinant DNA-techniques, and use them for later gene transfers, if this seems feasible (Smith *et al.*, 1987).
- Knowledge of the genetic potential of a breed in relation to others can be used in experiments to detect linkage of quantitative trait loci with genetic markers as a basis to improve estimation of breeding values (Paterson *et al.*, 1988).

4.2 Preservation of breeds

The status of a breed - for it to be endangered - depends mainly on the effective population size Ne and this again on the number of male breeding animals (Falconer, 1960). Thus the knowledge of the number of males is the main factor to characterize a breed as an endangered breed. In this context stored information is valuable in several aspects:

– The information ‘decline of the number of males’ can be used to prepare a list of breeds which probably will become endangered. This list can draw the attention of people without prior knowledge of the breed, to its genetic potential and to the danger of loosing it (DGfZ, 1979).

– The information on semen and embryos stored for conservation, and the number of males represented by them, is necessary to decide whether something should be done in this respect. The same holds for the information ‘programs for conservation of live animals’.

– The information ‘same breed exists in different countries’ can be used to combine the resources from different locations in order to increase the effective population size and to use limited funds for conservation in a more efficent way.

– The information ‘similarity among breeds, breed history, genetic distance to other breeds’ can help to decide, whether a given breed is a unique genetic group and deserves to be preserved as it is, or whether it would be justified, to combine the resources of similar genetic background into one population (Simon and Schulte-Coerne, 1979).

Typical for the information retrieval from the computerized data bank is the possibility to compare entries on different traits, breeds, countries and surveys simultaneously and for this reason give answers to relative complex questions.

5. Future prospects

As mentioned above, the next steps will be the integration of breed information from the Animal Genetic Data Banks in India and China, and from the Regional Animal Gene Banks in South America, Africa, India and China. This means that in these centres the available information will be recorded according to the questionnaire forms of the Global Bank.

The existence of the questionnaire of the Global Bank should not interfere with the initiative of local or regional centres to collect more information on breeds and to cover additional species. The value of such local initiatives is fully recognized.

What is asked for by the Global Animal Genetic Bank is regarded as a core information, which should be obtainable in many countries and under non-optimal conditions; it is the result of a compromise of the two objectives: to have complete information on breeds and to keep people motivated to supply it. This core information should be made available from local centres to the Global Data Bank. Nevertheless, the questionnaire forms will have to be modified and adapted in due time according to new needs and possibilities.

One additional topic deserves attention, to answer the question of who is entitled to use the information of the data bank: FAO, EAAP, national governments, research institutions, private persons? The compiled information is the result of efforts and initiatives of colleagues, animal breeders, scientists and others in many countries, who often sacrificed their spare time for the project of animal genetic resources. So we should reflect on regulations for the use of accumulated data.

In conclusion we may say that - as a result of combined efforts - we have a concept and a framework for the Global Animal Genetic Data Bank, and we also have some contents. The prospects of filling the gaps are good if we succeed to motivate our colleagues in the various countries to supply the information necessary.

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Appendix:

EAAP/FAO - Information on livestock populations (Databank on Animal Genetic Resources)

A.	**General information**		
1	Country	*Germany, Fed. Rep.*	
2	Species:	11=Buffalo, 12=Cattle, 13=Goats, 14=Sheep 21=Horses, 31=Pigs	1 2
3	Breed or population		
3.1	local name	*Hinterwälder*	
3.2	international name (see Mason's Dictionary)	*Hinterwälder*	
4	Main location of breed		
4.1	region with country	*Hochschwarzwald*	
5.1	Main organisation concerned with the breed; normally Breed Society; (name, address): *Zuchterverband Fleckvieh und Wäldervieh, 7820 Titisee-Neustadt*		
	If not 5.1 (Breed Society), please complete:		
5.2	University/state institution/others		
6	Preparation of replies Information for this questionnaire was given		
6.1	on **page 1 to 3** by		
	Name:	*Arbeitsgemeinschaft Deutscher*	
	Organisation	*Tierzüchter, Bonn*	
6.2	on **page 4 to 7** by		
	Name:	*see above*	
	Institution:		
6.3	Date of preparation:	*March* (month) *1989* (year)	

B. Origin and development of breed

		Year
1	Origin	
1.1	Breed was mainly established out of the following local breeds	
	Autochthon breed around	*1800*
1.2	Breed was mainly imported	
	from country -	
	breed - in	
	and from country -	
	breed - in	
1.3	Breed is known by its local name since	*1865*
1.4	Herdbook established (please mark "x") *X*	*1*8*8*9

2 Immigration has taken place in the last years:
for cattle, buffalo, and horses since 1950, for
sheep and goats since 1960, and for pigs since 1970.
(code: 1=5%, 2=5-20%, 3=>20%, estimated % of matings)

1	from breed	*Vorderwälder*	country	*FRG*	in	*1972*
1	from breed	*Vorderwälder*	country	*FRG*	in	*1972*
	from breed		country		in	
	from breed		country		in	

			Nos
3	**Breeding population numbers in 1986**		
3.1	Females (numbers being bred)	3.1.1 total	*2300*
		3.1.2 registered in herdbook	*259*
3.2	Per cent females being bred pure (mated to males of own breed)		*95*
3.3	Number of males total in service		*45*
3.4	Out of the above males, the number in AI-service		*5*

3.5 Changes in numbers of females:
(1=increasing, 2=stable, 3=decreasing)

until 1986 3 since 1986 2

3.6 Average herd size (females) 1986 total *8*

in private herds *8* in other herds -

4 **Average age** of animals used for breeding (months)

females *104* males *30*

5 **Storage of semen and embryos** — **Number of males, sires and dams represented**

5.1 semen X — in case of storage please mark "x" — males *12*

5.2 embryos — sires ____ dams ____

5.3 Additional information on storage can be obtained by

Zuchtverband für Fleokvieh und Wäldervieh, 7820 Titisee - Neustadt

C Breed description (please mark with “x”)

		black	grey	blue	red	brown	yellow	white	blond
1	Coat colour	black	grey	blue	red	brown	yellow	white	blond
1.1	predominantly uncoloured								
1.2	colour combinations as follows				*X*		*X*	*X*	

1.3 special colour characteristics (e.g. spotted, saddle, white head, etc)

White head, spotted around the eyes

2 Skin colour

3 Horns

3.1 typical number of horns (please mark with “x”)

	4	2	0
male		*X*	
female		*X*	

3.2 knobs only (spurs) (please mark with “x”) [ ]

3.3 remarkable horn shape (or size)

which ? *Lyra-formed horns*

4 Hair and/or wool? (only sheep and goats)

4.1 hair (please mark with “x”) [X]

4.2 wool (1=fine, 2=medium/crossbred, 3=coarse/carpet, 4=mixed) (code) [ ]

5 Adult size and weight (metric measurements)

5.1 wither height (cm) males *130* females *118*

5.2 live weight (kg) males *700* females *420*

6 Other specific visible traits, i.e. fat tail, hump, etc

please describe

7 Genetic peculiarities

7.1 chromosome aberrations ____________________

7.2 typical marker and/or major genes

gene	gene-frequency

7.3 other ____________________

7.4 additional information on genetic peculiarities can be obtained by the following institution or person:

____

D Qualification of breed

1 Present main use

1.1	milk	*1*
1.2	tractive power	
1.3	meat	*2*
1.4	wool	
1.5	fur	
1.6	vegetation management	*3*
1.7	sport, hobby	
1.8	other (state below)	

please indicate 1st, 2nd and 3rd rankings according to present importance

2 Are there other uses which are of importance - please specify

____

3 Breed has <u>special</u> qualification other than stated above) in the following fields (please mark with “x”)

3.1 quality of product for human consumption [ ]

specify ______________________________

3.2 resistance against specific pathogenic agent [X]

specify *no IBR/IPV - infections*

3.3 adaptability to climate [ ]

specify ______________________________

3.4 fertility (e.g. twinning, long breeding season) [ ]

specify ______________________________

3.5 adaptability to marginal land (e.g. mountain, marsh, wetland, semi desert) [X]

specify *very good legs to graze on steep mountains*

3.6 other

specify ______________________________

3.7 experimental results in the above fields have been published

3.7.1 by *none* for field 3 2 *

in (reference) ______________________________

3.7.2 by ____________________ for field 3 *5* *

in (reference) *none*

3.8 Additional information on the above qualifications can be obtained from the following institution or persons:

Zuchtverband für Jieckvieh und Wäddervieh, Titisee - Neustadt

for field *3 2* *3 5* *

and from ______________________________

for field [ ] [ ] *

* please fill in the field number (3.1 to 3.6) for which additional information can be obtained

E Management conditions

1 Type	2	2 Housing period	3	3 Feeding of adults	2
1 = stationary		1 = no housing		1 = total grazing	
2 = transhumant		2 = up to 2 months		2 = grazing + fodder	
3 = nomadic		3 = 2 to 6 months		3 = mixed	
		4 = over 6 months		4 = concentrate	
		5 = total housing		5 = total concentrate	

4 Special conditions, i.e. lack of water supply,
specify ______________________________

____

F Summary performance record

1 Standard breed for comparisons with country

The performance of breed (B) in specific traits is to be compared with the performance of a standard breed (SB), same trait, same measurement; *preferably one of the following most frequent breeds should be used as standard breed:*

Buffalo	
Cattle	H. Friesians, Simmental, Jersey, Hereford, Charolais
Goats	Malta, Saanen, Toggenburg, Alpine
Sheep	Border-Leicester, Merino, Suffolk, Texel, Scottish Blackface,
	East Friesian, Finnsheep
Horses	Arab, Thoroughbred, Halbred, Fjord, Percheron, Quarter Horse
Pigs	Landrace, Large White, Pietrain, Duroc

If none of the above breeds is present in the country, the most popular breed should be used as standard breed.

1.1 Name of standard breed chosen *Simmental*

1.2 Approximate production of standard breed within country

	trait		buffalo/cattle	goat/sheep	pigs
1.2.1	milk yield per year	kg	*5000*		
1.2.2	fat per cent	%	*4.01*		
1.2.3	daily gain (males	g	*1200*		
1.2.4	litter size	n			
1.2.5	lean meat	%			

Summary performance record (continued)

2 Relative comparisons

The absolute production level of breed B in comparison to the standard breed ______________ is

(code) 1 = very much lower (- 51 to - 100%)
2 = much lower (- 16 to - 50%)
3 = lower (- 6 to - 15%)
4 = <u>about equal</u> <u>(- 5 to + 5%)</u>
5 = higher (+ 6 to + 15%)
6 = much higher (+ 16 to + 50%)
7 = very much higher (+ 51 to + 100%)
8 = more than 100 per cent higher (+ 101 to + 200%)
9 = more than 200 per cent higher (>200%)

in the following traits (please enter codes in table):

trait	buffalo + cattle		sheep + goats		pigs		horses	
2.01	milk yield	*2*	milk yield		daily gain		pulling power	
2.02	% fat	*4*	% fat		feed conversion ratio		fertility	
2.03	% protein	*4*	% protein		muscularity		handling ease	
2.04	pulling power		daily gain		% lean		daily gain	
2.05	milkability	*4*	muscularity		meat quality		age at sexual maturity	
2.06	daily gain	*2*	carcass leanness		litter size		speed in gallop	
2.07	muscularity	*3*	litter size		mortality		speed in trotters	
2.08	calving rate	*4*	length of mating season		handling ease		adaptability: (in dressage)	
2.09	calving ease	*5*	lambing interval		farrowing interval		(in jumping)	
2.10	calf mortality	*2*	age at sexual maturity		age at sexual maturity		(in military)	
2.11	calving interval	*3*	wool or fiber yield		liveweight at slaughter			
2.12	handling ease	*4*	wool or fiber thickness					
2.13	age at sexual maturity	*5*						
2.14		*6*						

3 Validity of comparisons

The production conditions for Breed B (the one in question)

3.1 are about equal with the conditions for standard breed SB in above trait number(s) (please enter trait numbers

2.02	*2.03*	2.05	*2.08*	*2.11*	*2.14*	*2.*	2.	2.	2.

3.2 are probably not as good as for the standard breed SB in above trait number(s) (please enter trait number

2.01	*2.06*	*2.07*	*2.12*	*2.*	2.	2.	2.	2.	2.

3.3 are probably better than for the standard breed SB in above trait number(s) (please enter trait number

2.05	*2.10*	*2.13*	*2.*	*2.*	2.	2.	2.	2.	2.

G Additional information on the breed

1 Genetic distance

Estimates of genetic distance to the following other breeds are available:

1.1	(Breed)	1.2	(in country)
1.1.1		1.2.1	
1.1.2		1.2.2	
1.1.3		1.2.3	
1.1.4		1.2.4	

Additional information on genetic distance can be obtained by

1.3.1 ______________________________

______________________________ and by

1.3.2 ______________________________

____

2 Storage of genetic material in a "gene-library"

☐ please mark "x" if genetic material of the breed such as DNA-sequences was entered in a gene library

Additional information on this kind of storage can be obtained by:

2.1 ______________________________

______________________________ and by

2.2 ______________________________

____

3 Activities to conserve live animals of the breed

3.1 The following specific programs exist to live animal conservation (please indicate number of males and females, location, sponsor, etc), excluding individual breeders who are part of an overall program:

Förderverein Hinterwäldervich e. V. Schonau. (Premium for matings and calvings

3.2 Additional information on conservation of live animals of the breed can be obtained from:

3.2.1 *Zuchtverband für Fleckveih und Wäldervieh, D-7820 Titisee - Neustadt (Tel. 07651/1037)*

and from

3.2.2 ______________________________

ESTABLISHMENT OF A WORLD WATCH LIST FOR ENDANGERED LIVESTOCK BREEDS

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1. Introduction

The 10th Session of the FAO Committee on Agriculture (FAO, 1989) "urged FAO to devote new activities and technical support for accurate surveys, genetic classifications and risk status assessment as well as censuses" on animal genetic resources, and to "develop a World Watch List of endangered animal breeds as a support mechanism and early warning for member countries and encouraged FAO to update and publish this list regularly". Such a list should (a) point out breeds approaching dangerously small population sizes; (b) give information for initiating preservation activities; and (c) aid governments in improved use of animal genetic resources. The list should be accessible for users at all times and published in an appropriate form.

This paper aims at discussing objectives of and alternative methods for creating and maintaining such a list. It will address questions on the information needed, ways of obtaining it, frequency of collecting and up-dating, criteria to be used in classifying breeds and for moving them from one category to another, ways of disseminating the information, time required in establishing the list, and ways of forming links between countries in preservation and utilization of breeds.

For wild life, Red Data Books (RDB) on species threatened with extinction have been published since 1966, and recently a new edition on animal species was published (IUCN, 1988). There is reason to consider to what extent this system, developed by several international organizations during two decades and used for wild species of living organisms, could be applied to breeds of farm animals. Standardisation of the systems might facilitate their application and dissemination among people in different countries, but the differences in objectives and applications may not make the standardisation easy.

In farm animals, several national and regional inventories have been made during the last two decades, serving as valuable sources of information and experience. "Many of them have aimed at collecting and documenting information needed for the above purposes. Among them are the European ones (Maijala *et al.*, 1984; Maijala, 1987; Maijala and Simon, 1987, Simon, 1989b), on the basis of which the EAAP/FAO Global Data Bank on Animal Genetic Resources (GDB-AGR) was established (Simon, 1989a). The need now is to develop outputs from this data bank for utilization.

2. Needed information

The information collected in the surveys was planned to assist the decision-making of responsible governments and organizations, concerning the choice of populations for the purposes outlined below. The intention has been to make it possible to list breeds and strains on the basis of their risk status, characteristics, production systems and environments. The GDB-AGR thus greatly serves the needs of World Watch List for Endangered Livestock Breeds (WWL-ELB), but it can be discussed which parts of the information are essential for urgent actions.

2.1 Breeds or genes?

In farm animals, concern relates to measurable, economic traits of breeds and strains, even of individual genes, and to planned and controlled matings. These differences from wildlife have to be kept in mind in developing lists of endangered populations. For the present, most attention has been paid to conserving breeds and strains in their present form, but there is an increasing interest in the value of the breeds after selection. The improved communication and reproduction techniques have facilitated exchange of breeding material both between and within breeds, and rapid genetic changes within breeds. New genetic techniques have made it possible to identify, isolate and utilize individual genes. Animal breeders are interested in these genetic resources for present and future economic production. Documentation of individual genes will become topical in the 1990s, but the present discussion will concern breeds and strains and how one can group breeds together in conservation.

2.2 Information for choosing breeds for conservation

A choice for conservation is often necessary because of the great number of breeds in some areas, and of the limited resources available for conservation. The first European survey showed that there were about 1,300 “country populations” of five species and 700 different breeds, of which one third were considered endangered (Maijala *et al.*, 1984). Thus, the criteria for choosing breeds for maintenance should be made clear. These are closely connected with the motives for conservation, described, for example, by Barker (1980), Maijala *et al.* (1984), Simon (1984), Bodo *et al.* (1984) and Maijala (1986), and come under the headings of population size, biological value, genetic status and ecological value.

2.2.1 Population size and its trends

Present population size and its recent trends determine the risk status, and the need for and kind of special conservation actions. Population size largely determines the levels of random genetic drift and inbreeding in the population both before and after conservation. The concept of effective population size (Ne) is important for understanding the effects of varying numbers of males and females and of varying family size on genetic drift variance and inbreeding. Experiments with small laboratory animals give good examples of these effects (Falconer, 1981). Figure 1 shows that the heterozygosity per generation starts to decrease with accelerating rate after Ne falls below 100, while Figure 2 shows that the standard deviation of gene frequency starts to increase rapidly after Ne falls below 30. The probability of saving individual alleles with low initial frequencies increases with sample size (Sirkkomaa, 1983). It is important to know the numbers of breeding animals of both sexes, as shown by Table 1.

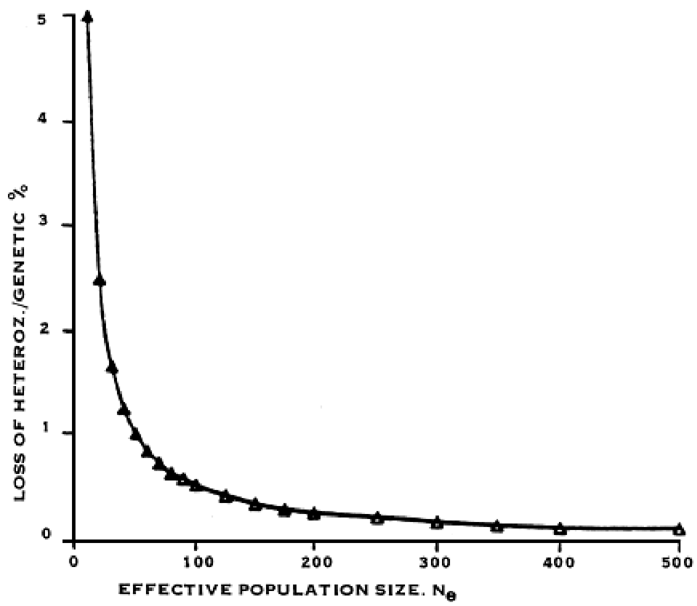

Figure 1: Loss of heterozygosity per generation with varying effective population size according to Wright (1931).

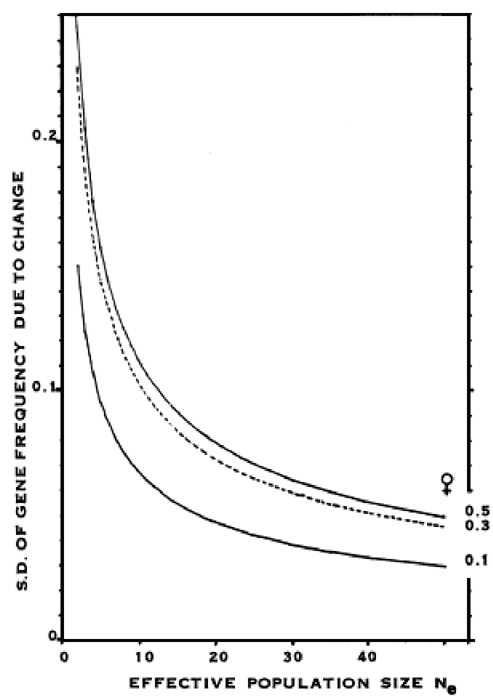

Figure 2: Random drift of gene frequency due to change $(\sqrt{pq/2N})$ at different population sizes and gene frequencies.

Table 1: The importance of the male/female ratio for Ne.

No. of males	Ne (in whole numbers) with varying numbers of females								
	4	10	20	30	40	50	60	80	100
1	3	4	4	4	4	4	4	4	4
2	3	7	7	8	8	8	8	8	8
4	8	11	13	14	15	15	15	15	15
10	11	20	27	30	32	33	34	36	36
20	13	27	40	48	53	57	60	64	67
50	15	33	57	75	89	100	109	123	133

Thus, 4 males + 4 females give the same Ne as 2 males + 100 females. Because of variations in fertility, family size, length of life, herd size etc, much higher numbers have been used for the number of females below which the population is considered endangered.

2.2.2 Value as a biological material

(a) Performance (overall performance, superiority in one component, versatility, temperament, heterosis or complementarity expectations in crosses, fertility, special characteristics).

(b) Adaptation to special environmental circumstances (climates, feeds, disease agents, water shortage, different day lengths, management systems, difficult terrains). Adaptability to extreme environmental conditions is especially important in tropical areas, found mainly in the developing countries where also about half of the ruminant farm animals are located.

2.2.3 Genetic status

(a) History and age as a separate breed.

(b) Geographical location and isolation. A long isolated population may have developed unique gene frequencies for several genes. Good examples are native Icelandic breeds (Adalsteinsson, 1981).

(c) Breed purity facilitates conservation and utilization of the valuable genetic qualities of the breed. A conventional requirement is that the influence of other populations does not exceed 20%. In the European survey in 1985, 52-75% had a pure breeding percentage of at least 80%, and only 25-44% in the different species were 100% bred pure (Maijala, 1987).

(d) Relationships within breed: gene frequencies, genetic relationships within the breed, degree of inbreeding (from analyses of pedigrees or of data on genetic polymorphisms).

(e) Relationships to other breeds, both endangered and unendangered (even in other countries), help in knowing which populations can be combined or deserve to be conserved separately. Information based on studies of polymorphisms, e.g. genetic distances between breeds (Nei, 1987), is desirable.

(f) Morphological uniqueness, in case information of blood polymorphisms is not available.

2.2.4 Ecological, cultural-historical and social value.

2.3 Information for choosing breeds for evaluation studies

In cases where the population appears promising in some respects, one may want to acquire the additional information by arranging evaluation experiments. Addresses are needed from where special information can be obtained. Information of the type referred to in Section 2.2 helps in finding out the promising candidate breeds for comparisons, provided there is information also of the environments and production systems, in which each candidate has proved itself useful.

2.4 Information for choosing breeds for efficient use

The information required for choosing breeds (Section 2.2) is also helpful in evaluating the usefulness of a breed in the present conditions of an area, either in pure breeding or in crossing with the local breed.

2.5 Discussion of alternatives

The aspects mentioned above are needed in planning conservation, evaluation and utilization of breeds. Hence, they are included in the questionnaire forms used by the GDB-AGR. Since getting all the necessary information has proved to be difficult even in Europe, it is important to consider, what will be the most essential information needed for a reasonably rapid establishment of a preliminary WWL-ELB. In order to be able to act before too many breeds disappear, the following list may be considered for each "country population", to be collected at the first attempt and included in WWL-ELB:

(i) General information: country, species, breed, main location;

(ii) Numbers of animals in breeding age: males, females, total;

(iii) Trend in numbers in last 3 years: decreasing, stable, increasing;

(iv) Percentage of females bred pure;

(v) Number of herds: 1-4, 5-9, 10-49, 50-;

(vi) Existence of health risk in case there is only one herd left;

(vii) Estimated risk status;

(viii) Some characterization of the breed: typical external features, main uses, special abilities in production, disease resistance or other economic traits;

(ix) Existence and form(s) of conservation actions.

The length of the shortened list is about the same as in RDB, but the contents differ in several respects. The possibility of pre-filling the questionnaires on item 1 on the basis of Mason's (1988) dictionary and other published information deserves to be considered. This would ensure that comparable breed names will be used in different countries. It may be sensible to pre-fill also some other items on the basis of available literature. After the most urgent compilation of the WWL-ELB has been made for rapid actions, additional information of the breeds can be collected for the GDB-AGR and WWL-ELB.

3. The European data flow system

The Working Party on Animal Genetic Resources of the European Association for Animal Production (EWP-AGR) conducted surveys in 1982 (Maijala *et al.*, 1984), 1985 (Maijala, 1987) and 1988 (Simon, 1989b), providing experience of various phases of the work - e.g. planning of questionnaire forms, channels for collecting them, time schedules, documentation centres, and problems of languages and terminologies. This should help to identify the problems to be faced in establishing the WWL-ELB.

4. Methods of collecting the information needed

In planning collection of information, compromise has to be found between the needs of getting many-sided, reliable information and the possibilities of getting replies in a reasonable time. Using the same forms for several species, restricting oneself to the most essential information and giving ready alternatives to be ticked obviously serve this aim. These aspects were considered in the European surveys made in 1982-88. The forms for the 1988 survey were accepted as also suitable in collecting information for the GDB-AGR (Simon, 1989b), being thus available also for WWL-ELB.

4.1 European experiences

In the 1982 survey, three different forms were used:

(a) List of all breeds of cattle (C), goats (G), horses (H), pigs (P) and sheep (S) within a country, with estimated total numbers;

(b) General attitude towards breed conservation within a country;

(c) Information of each endangered breed (person replying, species, breed name, length of existence in the country, possible immigration and their origins, trends in numbers in the last 10 and 3 years, number of herds, number of breeding females and males, number of male lines, breeding organization, numbers of animals/frozen semen donors/frozen embryo donors).

Replies were received from 22 of the 30 countries. The absence of some replies may be partly due to unsatisfactory questionnaire forms. In many cases, the information obtained was also incomplete and variable. For the non-responding countries, some information was collected from the literature.

For the 1985 survey, the forms were further developed. One aimed at getting information (a) of the numerical changes since 1982, and (b) of characteristics of endangered breeds for a central data bank. Five forms were used in C, G, H, P and S (Maijala, 1987). Forms a-c (general information, origin and development of breed, breed description) were to be completed by each individual breed society, and forms d-e (qualification of breed, performance records) by an independent group of scientists for objective assessment. The performances on form e had to be given as relative figures. To facilitate filling in the forms, alternatives were given to be ticked.

Replies were received from 17 countries and from 45% fewer “breeds” than in 1982. This decrease may be due to trying to collect information of both the characteristics of the breeds and of the numbers of animals. The experience gave reason to think that separating regular censuses of population sizes from characterizing the breeds might be a good idea.

The frequency of answers to different questions varied considerably among both species and countries (Maijala, 1987). The questions on the main use, management level, colours and numbers of animals were answered almost completely, while those on genetic peculiarities and times of establishing the breed or its herdbook remained often unanswered. Interesting information about the origins, population sizes and characteristics of breeds was still obtained. The big number of questions may have caused an adverse psychological effect in filling in the forms. It appeared important to define questions carefully and to give clear instructions and ready alternatives, by using experiences of previous surveys. It has to be made clear whether to use scientific or popular terms and to aim at objective information.

The forms of the 1985 survey were used as a basis for the 1988 forms, but some minor changes were made, e.g. for reporting on management conditions, relative production levels, and some additional traits (Simon, 1989a).

4.2 Globalforms

The changes for 1988 were based on discussions in the EWP-AGR, with the Nordic working party and with the Animal Production and Health Division of FAO, using European experiences from 1982-85 and considering developments in biotechnology. Some new aspects were added, even though they may complicate the forms and their filling in. However, help was provided by pre-filling the information from the 1985 survey on the forms, so that only checking was needed for the part of the previously given information.

The discussions with FAO led to an agreement on using the 1985 forms also for collecting information of breed resources in other parts of the world, e.g. from the regional data banks of developing countries (Hodges, 1984). The European data bank thus became GDB-AGR (Simon, 1989a), to which parts of the information collected on the earlier descriptors developed by FAO (1986a,b,c) for regional data banks will be transferred to the 1988 forms. Data will be collected also on buffaloes. Some additions and changes were made to the forms, to meet the needs of developing countries. This work will serve as a first attempt to establish the GDB-AGR and the WWL-ELB.

5. Channels for collecting information

It is essential (but not easy) to find the right people for collecting, assessing and disseminating the needed information.

5.1 European experiences

The EWP-AGR decided to utilize the coordinating members of the EAAP Commission on Animal Genetics for each country in carrying out the 1982 survey. The questionnaires were sent to them with descriptions of the intentions and with the request to get information of all breeds collected to a central place. They were asked to ensure that the right people in their country are approached to complete the relevant forms. The letters and forms were sent through the seven members, representing different geographical regions of Europe and different aspects of AGR conservation. They were asked to distribute the forms to the country coordinators of their regions, to check the contents of the returned forms and to send them to the chairman.

The coordinators were given a standard letter for the actual data collectors, encouraging these to ask for clarifications to open questions from them. After the return of replies, summaries of the replies were prepared and sent to the EWP-AGR-members for checking before the 1982 EAAP meeting. The checking concerned especially the classification of breeds according to their existence and endangered status, English names of the breeds, and whether country populations occurring in different countries with the same name should be considered the same breed or not. These clarifications were especially important for the breeds which in some countries were endangered.

For the 1985 survey, the coordinators were approached directly to take care of the work, since the number of EWP-AGR-members had been decreased to three, and in order to see whether a new system would produce more complete and quick replies. The aim was to ensure that the correct people are contacted, since the coordinators may be better able to assess this than any other outside group. They were asked to carry out the liaison to ensure that the responses were returned in due course. Their attention was drawn to the above principles for filling in the forms. They were advised to contact several countryman-scientists for deciding on the overall assessments for each breed, and encouraged to contact the chairman on problems with the questions. It was mentioned that the information will be stored in a data bank and be open to all those providing the information. Finally, some names and addresses were listed of countrymen who it might be useful to contact.

It is not known whether the decreased number of breeds reported (c. half of that in 1982) was due to the differences in collecting channels or forms used (Section 4.1), to the short time between two surveys, or to the lack of useful feedbacks from the earlier survey.

The coordinators were used also in 1988, but an up-dated list of them was obtained from the EAAP-secretariat. They were informed that the data will be deposited in the GDB-AGR in FRG, and that information is expected on all breeds, since the borderline between “endangered” and “unendangered” is unclear. Attention was paid to several advantages of properly compiled information on breed resources, to the increased public interest in AGR and to the duties of animal geneticists to collect information on all existing breeds.

Print-outs for the breeds on which information was received in 1985 was enclosed to assist in filling in the new information and for checking the previous one (Simon, 1989a). It was pointed out that there are detailed instructions at the end of the print-outs and that the absence of a printout meant that no information was received in 1985. The coordinators were asked to send copies of the questionnaire and of the remarks to the appropriate persons in their country and ensure their return to Hanover by the given deadline.

5.2 Channels for GDB-AGR

The European experiences show that the variability of industry structures makes it difficult to decide which channels should be used in sending and returning the forms for a particular country. There are at least four alternatives:

(i) Governmental bodies may be useful in some countries, but many ministries do not have a breeding expert, ensuring good and quick replies. However, some of them can delegate matters to suitable organizations under their supervision, so that satisfactory and timely results can be obtained. The ministries may know the national system better than any foreign expert, and they might be given special advice for delegation.

(ii) Non-government organizations (breed societies, extension organizations etc) may be more flexible and rapid in action than ministries. A good knowledge of available organizations could lead to good results. Those having commercial interest in the breed may, however, tend to give a biased picture of the characteristics of the breed, if no objective information is available.

(iii) Scientific channels (universities, research institutes, scientific societies) may be the most objective and competent source of information. Sometimes it is difficult to find a researcher interested in putting aside his other work for filling in questionnaires on topics not of current interest to him. The coordinators of the EAAP Genetic Commission were not equally active in all countries.

(iv) Interested groups of people or individuals might be formed for this work with farm animals, as occurs for wild species, but it is rather difficult for regional or national officials to find the right people. Developing a network of interested, competent people for this work in farm animals may be more difficult, but an attempt is worthy of consideration. In some cases, incentives may be needed.

The European experiences do not lead to definite preferences or standard solutions. There are error and delay potentials in each alternative. It is important to find a way of finding the right person with proper training and experience and motivation to act, and to know the system in each country. Hence, the channels have to be discussed nationally and regionally. Different systems may have to be chosen for different countries, and several systems may be needed even within one country, depending on species etc. However, more and more countries have started activities in studying and conserving national AGRs and thus have officials suitable as contact persons. Their addresses could be requested from the agricultural ministries. One way for stimulating replies could be to give access to the information about the WWL-ELB only to those countries which have provided information. At the regional level, it is reasonable to use Regional Gene Banks as focal points in collecting and returning information.

6. Time schedules

Time schedules can be considered at three levels: (a) frequency of up-dating the information; (b) times reserved for each phase of a particular collection; or (c) time of realizing the WWL-ELB for different regions or the whole world.

6.1 Frequency of up-dating

The first EWP-AGR considered it sensible to repeat a survey of the overall AGR situation in Europe at three-year intervals. The task of the second EWP-AGR was to organize these. For the present, this frequency has been followed, in spite of considerable practical difficulties, partly due to inability to compensate those replying to the questionnaires or handling them further for the work involved. Too frequent questioning may also cause weariness among them. Good and frequent feedbacks from the data bank and satisfactory financial incentives may remove this and make it possible to maintain the three-year intervals. These are desirable from the viewpoint of knowing the current situation, which can change very rapidly in the present era of effective reproduction and communication techniques. Less frequent up-dating, e.g. with five-year intervals, may suffice for the aspects on characterising breeds.

For the global system, the timetable applied in Europe is appropriate, but maybe more difficult to realize, and hence lengthening the intervals to 4-5 years is tempting. The schedule may be altered according to species, since these have different reproductive rates and generation intervals. The wide application of AI and even embryo transfer in cattle may, however, make it necessary to apply as short intervals as in pigs; sheep and goats. Another important factor affecting the interval is the population size: for small populations frequent up-dating, at least of animal numbers, is well-founded. For normal breeds with big populations, frequent up-dating is both unnecessary and difficult.

6.2 Times required for each phase of a survey

In the European 1982 survey, the questionnaires were sent to the EWP-members on 15 January. Three months were reserved for the actual collectors for returning them to the coordinators, and 2 weeks for these to return the completed forms to the EWP-members. These were in turn given 1 month to check them and send further to the chairman for preparing preliminary summaries. In each phase there were delays from the intended time schedule, but nevertheless replies from 16 countries and literature data from 13 countries were included in the preliminary report in July. In the next winter, replies were received from an additional 6 countries, so that the final report in October 1983 included questionnaire information from 22 of 30 countries. In addition, supplementary information and corrections were available from several countries, based on the preliminary report distributed to the coordinators.

The 1985-questionnaires were sent to the coordinators on 5 December 1984. Almost 4 months were reserved for the actual data collectors and 1 month for the coordinators for chasing up missing replies, checking and sending replies to the chairman. Since the number of replies received by 1 May was small, an immediate reminder was sent to several countries. This helped in getting several replies, but still the number of countries replying was 23% smaller than in 1982 and that of “breeds” reported 45% smaller.

The pre-filled 1988-questionnaires were sent to the coordinators in November 1988. These were given about 1 month for checking and/or supplementing and sending the forms to the GDB-AGR in Hanover. Until August 1989, information was returned for a total of 225 breeds from 12 countries (Simon, 1989b).

These varying experiences show that it is important to consider how much time should be reserved for each stage in collecting the forms for the GDB-AGR and how strict the deadlines set can be. Right choices are important for the quality of surveys but difficult to put into practice for different countries and unpaid work. Strict deadlines are often necessary, but they may decrease the amount of information received. Hence, predicting the time needed for a given stage of GDB-AGR is difficult.

6.3 Estimated time for establishing a WWL-ELB

Based on the above experiences it can be estimated that establishing a WWL-ELB for Europe and the countries included in the FAO pilot trial could be 3-6 months after starting the transfer of the information from the FAO descriptors to the GDB-AGR forms. This requires that competent people are found for interpreting and summarizing the data from individual experiments to these forms, and that the GDB-AGR has financial and personnel resources for checking the data received, sending preliminary feedbacks to be corrected, and preparing output lists for WWL-ELB. The same time schedule can be applied to any other region after it has reached the same stage of development in data collection as Europe and the pilot trial regions. It is very hard to predict when each particular region will reach this stage, but some developed countries outside Europe may not be far away.

It is important to start the preparation of the WWL-ELB gradually from those regions which are ready for that, so that experiences can be collected all the time and interesting feedbacks (e.g. breedwise WWL-ELBs and various groupings) can be distributed to all regions, to stimulate the work and make improvements in the system. provided the necessary actions are taken and finances allocated for the purpose, some kind of WWL-ELB might be produced within two years.

7. Documentation centres (data banks)

The first EWP-AGR, set up in 1980 (Maijala *et al.*, 1984), considered it important to store information of breeds at a central place and in an easily accessible form. The second EWP-AGR, set up in 1983, became convinced that computerization of the data is well-founded. It suggested its development at the Veterinary University of Hanover (FRG), which has scientific resources and abilities for the task and is centrally located. It needs, however, special financial support, particularly for preparing necessary computer programmes. The EWP-AGR has also concluded that the data bank can only be concerned with the species which have study commissions in the EAAP, i.e. cattle, goats, horses, pigs and sheep. The extension of the EAAP data bank to the GDB-ELB made it necessary to include also buffaloes. The Scandinavian data bank includes also poultry, fur-bearing animals, rabbits, reindeer and bees, giving possibilities for WWL-ELBs on these species in that region, and providing models for other regions. In poultry, the registry of stocks by Somes (1984) could be used as a basis and developed to include more information of characteristics and population sizes. World's Poultry Science Association might be encouraged to support this development.

In principle, it seems logical to utilize Regional Animal Gene Banks as focal points for the collection of data from developing countries, to be explored as regional data collection centres and data banks. In any case, the data will enter the GDB-AGR in Hanover, where it will be handled by computer.

8. Choice of language

Considering the great number of languages in Europe, it was considered necessary at the beginning to use only English in the questionnaires. However, other languages occurred in the replies, e.g. in giving the names and special characteristics of breeds, and comments on the forms. This caused problems in preparing summaries of the replies, e.g. on the existence of the same breed in several countries, when the names recommended by Mason (1969, 1988) were not always used. The experiences speak much in favour of using only English in giving the information. However, filling in the forms may suffer in both completeness and time schedules in countries where knowledge of English is sparse.

In the utilization of the collected information in various situations, the need of national languages is still greater. Hence, the Nordic working party has planned questionnaires in which each piece of information is located at a given numbered place on the forms, so that the numerical or coded information can be handled and understood independently of the language (Maijala and Simon, 1987). Some of the numbered places on the forms are to be filled in with numbers or gene symbols, others with a cross, thus facilitating translation to each of the 5 Nordic languages or to English without causing problems for data processing. The questions and terms in different languages can be stored in the computer memory and used in the output forms according to various needs. Remarks and added information can, on the other hand, be in a language acceptable for further handling. With even more languages in the rest of Europe, application of the same system may be more difficult. However, use of the 5-6 most commonly used languages could be a reasonable compromise, which might suit also to the GDB-AGR and WWL-ELB.

A similar question relates to the scientific terms/symbols for genetic traits/genes to be used. The problem concerns, however, all the information from gene mapping in farm animals, which started in the 1980s and will continue for a long time. Because of this development, which requires special expertise and symbol systems for DNA, the time may not be ripe for including the symbols in AGR data banks, especially since special genomic data banks have ben planned for gene mapping research.

9. Classification of breeds according to their risk status

It appears practical to classify breeds according to their risk status, as is done in the RDBs for the wild species of living organisms, where the following categories are used (IUCN, 1988):

Ex = Extinct = not found in the wild during the past 50 years;

E = Endangered (red) = danger of extinction, survival unlikely if the causal factors continue operating;

V = Vulnerable (yellow) = believed likely to move into the E-category in the near future if the causal factors continue operating;

R = Rare (white) = small population, not E or V, but at risk;

I = Indeterminate (grey) = known to be E, V or R, but there is not enough information to say which of these is appropriate;

K = Insufficiently known = suspected but not definitely known to belong to any category above, because of lack of information;

O = Out of danger (green) = earlier E or V, but the risk is over.

Some variations from this grouping have been applied in different countries. The most important criteria used in the classification have been the abundance, distribution, development trends and biological characteristics of the species.

Considering possible needs of collaborating with the people and organizations working with wild species, application of a similar classification to farm animal breeds deserves consideration. Class Ex may not be necessary, but taking into account the existence of the same breed in different countries, it may be well-founded to use Ex in surveys for individual countries. Comparisons of the results with those of other countries might reveal that animals of a disappeared breed could be found elsewhere. It appears that the categories E, V, R and O could be used also in grouping animal breeds. The category I may not be needed, since farm animals are under the supervision of man and there is usually more information available than in wild species. However, use of this category might be sensible at the preliminary stage of creating WWL-ELB. The same applies to the category K. After the major part of the WWL-EDB has been prepared, I and K might be eliminated.

The main criteria to be used in classifying animal breeds are population size, recent trends, number of herds, and extent of pure- or cross-breeding. In the European surveys, the following numbers have been required for “endangered” status: below 1000 cows, 500 ewes and she-goats and 200 sows, or between 1000-5000, 500-1000 and 200-500, respectively, in cases where the numbers are declining or the number of breeding males is below 20. Below these levels, avoidance of genetic losses in future generations is difficult, the high degree of inbreeding, which is a likely consequence, threatens the vitality of the animals, and spontaneous diseases and accidents may cause big risks. Steadily decreasing numbers of breeding animals or increasing use of crossbreeding (especially with the aid of AI) give reasons to increase the numbers of animals below which a breed is considered endangered.

In the UK, the Rare Breeds Survival Trust has set the following maximum numbers of breeding females for a breed to be classified as “rare”: cattle 750, sheep 1500, pigs 150, horses 1000, and goats 500 (Alderson, 1981). Besides, it has been considered important that an official herd book has existed over six generations, that the breed “breeds true to type”, that other breeds have contributed less than 20% of the genetic make-up in the last six generations, and that the breed has been known for 75 years. The objectives here are predominantly cultural-historical, and hence the classification is not very suitable for cases where the main interest is in economic-biological reasons for preservation of AGR, especially in developing countries.

Besides “endangered” and “rare”, the status “critical” has sometimes been used, indicating that the population is close to extinction. This may be derived from the point of Ne (about 50) below which the standard deviation of gene frequency starts to increase rapidly. The American Minor Breeds Conservancy in the USA has established three categories on the basis of the number of registrations per year. In cattle, for example, below 200, 1000 and 5000 mean “rare, minor and watch”, respectively.

In FAO (1989), it has been considered that the population sizes applied in Europe for classifying breeds as endangered need to be doubled or tripled for developing countries, because of the subdivisions and genetic isolation of nomadic populations, harsh climatic conditions and big disease risks. FAO proposes as a working rule that “when a population size approaches 5000 breeding females, the survival risk of the breed should be studied and appropriate actions initiated. These will depend upon the local circumstances of the breed, the management system, the extent of crossbreeding, the rate of decline in numbers and the certainty of the breed having unique qualities. Specific recommendations are then made for each circumstance, based upon established principles.”.

It appears sensible to apply at least the RDB-categories E, V and R (at the beginning possibly also Ex, I and K) to farm animal breeds. As the basic criterion in classification, effective population size (Ne) is useful, related as it is to the numbers of both males and females of breeding age. For example, the following limits could be considered for developed countries: E = Ne < 50; V = Ne < 100; R = Ne < 500. For developing countries, one might think of 100, 500 and 2000, respectively. The use of Ne may make it possible to use the same limits for different species, independent of their reproductive rate.

In assessing the real status of the breeds, several adjustments have to be made to these figures on the basis of trends in numbers, numbers of herds, use of crossbreeding etc. Many kinds of compromises are needed between different criteria, between ideals and possibilities, etc. Both practical experience and theoretical knowledge from different sectors are important in the assessment. Each country should have a group of experts, representing different expertises, for taking care of the assessments, since foreigners cannot know the local circumstances. These national groups should be represented in regional committees, in which different principal and methodological problems can be discussed and the breed lists of neighbouring countries can be compared for considering joint conservation, evaluation and utilization activities. The representative should have a good knowledge of the subject matter. The regional committees in turn should be represented in the global organization responsible for the establishment of the WWL-ELB. It is difficult to avoid these three levels in the planning and decision making, but it is important that the GDB-AGR can be approached also directly by individual farmers, organizations and nations, for obtaining desired information.

The principles applied in the first classification can be used also in moving breeds from one category to another at later stages of WWL-ELB. However, there may be more information, e.g. about performances in different environments in the field and in experiments, and about the presence, frequency and effects of individual genes. There is also reason to develop the systems of assessment, in order to avoid intentional biasses, unintentional errors and delays.

10. Links between national, regional and global data banks

Effective cooperation between different levels of data collection and utilization is very important for the success in establishing the WWL-ELB. The present computer techniques give good possibilities to create effective links, and there are also sufficient experts in animal genetics and breeding, partly even in the developing countries. Thus, the question becomes one of finding a flexible organization to facilitate realization of the considerable potential. One possible scheme is:

I	Global level:	GDB-AGR, Hanover, FRG
II	Regional level:	Regional data banks (about one/continent)
III	National level:	National AGR groups (numerous/region)

The efficiency of vertical connections is crucial for the system. Horizontal connections can be managed in part through the regional banks, but direct links are needed between neighbouring countries, e.g. in assessing risk statuses, conservation priorities and utilization of breeds occurring in at least two countries. Grouping into regions may be left to the national groups, using negotiating and coordinating help from FAO, if needed.

11. Estimating costs for establishing WWL-ELB

Only very crude estimates of the costs can be made without experience of different phases of the work outside Europe. Even for Europe, costs have not been estimated. To provide some basis for discussion, it can be suggested that filling in the forms for an average developed country on the basis of annual censuses, herdbooks, recording and AI statistics etc. might require 1 man-day per breed, 10 man-days per species and 60 man-days per country. Extracting the needed information from the FAO descriptor lists for developing countries may require double that number of man-days. Assessing the status of each breed carefully by an expert group, on the criteria suggested in Section 2.2, might require 10 additional man-days in a developed country and 20 days in a developing one.

Provision has also to be made for processing the data in the regional data banks and in the GDB-AGR, for checking the contents within and between countries for breed names, terms, classifications etc., and for preparing regional and global summaries and WWL-ELBs.

How finances for covering these costs can be found has not been properly discussed even for the part of Europe. In principle, each country should participate according to its share of the work load (e.g. number of breeds). However, getting a positive response from each country presupposes effective information about the value of its work. In this sense, many-sided and frequent feedbacks from the system would be needed, but these cannot of course be given before the system is almost ready. The only reasonable way of getting governments to support the system is through FAO, which has consistently worked for AGR conservation and management for a long time and with gradually increasing success, and through UNEP. In addition, the increased public interest in conservation of natural resources, including AGR, has created possibilities of establishing private organizations in many countries and improved the climate for establishing a world organization, which can acquire finances for conservation purposes. In any case, continued education is important for a lasting solution of the problem.

12. Dissemination of the information about WWL-ELB

The whole process of collecting, processing and assessing information about AGR aims at effective application and utilization. Hence, distribution of the information is necessary. This raises several problems: In which form and how frequently should the information be published? To whom can the whole information or parts of it be given and for what price? Will it be considered confidential or not? Should actions be suggested in connection with it? From where can finances be found and can these be accepted with or without rights?

Considering the substantial costs involved in the work, the distribution of outputs may have to be restricted, e.g. to those countries and organizations participating in the input and processing costs. Even here there are several alternatives: the information could be sent (a) to the people or organizations replying to questionnaires, (b) to their governments, or (c) to both. In principle, restriction is possible, but the present copying techniques make it difficult. Considering educational aspects for creating a greater public understanding and participation, restrictions may also work against the objectives of WWL-ELB. The example of RDBs. which are financed greatly by voluntary and charity organizations, speaks in favour of an open policy. The need for helping developing countries in the development of their animal production points in the same direction. Comparisons with corresponding organization for agricultural plants are difficult and do not necessarily lead to fruitful models. While plant breeding takes place largely at research institutes and in big commercial firms, the major part of animal breeding material is in private herds.

The important role played by FAO in developing documentation, conservation and utilization of AGR makes it necessary to note the special role of its member countries in distributing the information. There is reason to consider different rights and prices for those member countries which have participated in the establishment of WWL-ELB and those which have not.

The form of publishing depends on the solution of the financial and distribution problems. Considering the gradual increase in the amount and quality of the available information, loose sheets as in the RDB seem sensible at the beginning. These should contain the information listed in Section 2.2, plus some suggestions for action to the governments in question. Summaries of the data by species, regions etc should also be published. For speeding and coordinating actions by international and national organizations and governments it is important to send them letters with information and suggestions for actions. These should contain also suggestions for legislation, organization, taxation, financing, etc. The publications could be sold to interested organizations and people at prices which would cover a part of the collecting and processing costs. Income from sales depends, of course, on the quality of the publications. National governments and organizations should also be encouraged to publish popular articles about WWL-ELBs in their own languages, using information obtained from the world or regional levels.

Both governments and voluntary organizations should be encouraged to develop international funds and to search for suitable sponsors for the conservation activities in the same way as has been done for wild life.

13. Conclusions

Objectives of and methods for creating and maintaining a World Watch List for Endangered Livestock Breeds (WWL-ELB) were described. This should provide governments with early warnings of breeds approaching risk levels of population size and information for starting preservation activities. The following conclusions can be drawn:

1. Regular information is needed for deciding on the choice of populations for conservation for future needs, for evaluation studies and for efficient present use.
2. The information should concern population size and its trends, the value of each breed as a biological material in production, its adaptation to different environments and genetic status, and in future, also the presence of individual genes. For urgent actions, a preliminary WWL-ELB may be needed, resembling that in Red Data Books on wild species of living organisms.
3. Experiences of three European surveys in 1982-88 can be used in considering the practical problems in establishing the WWL-ELB.
4. In collecting the information, compromises have to be found between the information needs and the possibilities of getting replies in a reasonable time. Various means for improving the quality and speed of data collection are available.
5. Experienced animal geneticists should be used as data collectors, to get reasonably useful assessments of the value of breeds for different uses and of their risk statuses. Experts from other fields may be needed as additional members of the national groups. Governmental and non-government organizations, scientific institutes and interested people are alternative liaison links. Different systems may have to be chosen for different countries.
6. A reasonable time for getting completed questionnaires returned is 3-6 months, but reminders and some flexibility in deadlines is likely to improve the proportion of replies. A preliminary WWL-ELB might be produced within two years, a more complete one requires several years more. A three-year interval is recommended between surveys, especially for the aspects concerning population sizes. For recording the characteristics of breeds, a longer interval is possible.
7. It is well-founded to start establishment of the WWL-ELB immediately from those regions and/or species which are most nearly ready for this step and to distribute the appropriate sheets or books to be used; effectively, as models or ‘stimulators’ for the future.
8. The Global Data Bank on AGR (GDB-AGR) in Hanover, FRG, is the centre where information from every country will be stored and processed for various feedbacks. The uses of regional data banks (in regional gene banks) is recommended as intermediate phases for assessments, advices and regional co-operation in action.
9. English is recommended as the main language. Some other languages can be used for inputs and outputs, if the type of information can be recognized by its placement and if coded information is used.
10. The model of Red Data Books, modified for animal breeds, may be used for preparing preliminary WWL-ELBs. In the later stages, when the system is

developed, three categories of risk status may suffice. As a basic criterion for the classification, effective population size (Ne) is useful.

11. Three levels are needed for the work (world, region, nation). Good vertical connections are necessary, but horizontal connections are also needed in assessing risk statuses, conservation and utilization of breeds existing in more than one country.

12. Approximately 70 man-days may be required per developed and 140 man-days per developing country, for collecting the information for GDB-AGR and WWL-ELB. Costs for mailing, checking, processing and printing have to be added.

13. An effective dissemination of the WWL-ELB-information is important for its application and utilization. hence, an open policy may best serve the objectives, especially considering the need for educating officials and breeders, and for helping developing countries. Voluntary organizations should be looked for as supporters.

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ENDANGERED LIVESTOCK BREEDS IN EAST AFRICA

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1. Introduction

East Africa is one of the five regions of Africa (OAU classification). It is bounded to the north by the Sahara desert, to the east by the Indian Ocean, to the south by Zambia, Malawi and Mozambique and to the west by Zaire. The region lies entirely in the tropics, occupies a surface area of 25% of Africa, and has a human population of 130 million. The climate varies from the desert of the Sudan to the rainforest of Uganda with a rainfall pattern of 0-1500 mm and an altitude from sea level to 2600 m. Most of the highlands of Africa are also found in East Africa ranging from 1000-2000 m. The region is made up of the following countries: Djibouti, Ethiopia, Kenya, Malawi, Mauritius, Somalia, Sudan, Tanzania and Uganda. The important islands of Comoro, Madagascar, Mauritius and Seychelles form part of the region.

The region is endowed with a vast pool of animal genetic material and, in relation to the total populations of the various species in Africa, contains 55% of the cattle, 36% of the sheep and 46% of the goats (Adeniji, 1989). In terms of Tropical Ruminant Livestock Unit (TRLU), East Africa has 52% of the total in Africa. Thus, the region is very important for livestock production.

2. Endangered cattle breeds

In 1983, a review paper on endangered cattle breeds in Africa was read at an Expert Committee Meeting on Animal Genetic Resources in Africa (Adeniji, 1983). The locations of the identified breeds are as shown in Table 1.

Table 1 Location of endangered cattle breeds.

Breed	Country
Baria	Madagascar
Brune de l'Atlas	Morocco
Butana	Sudan
Creole	Mauritius
Kenana	Sudan
Kuri	Chad
Lagune	Republic of Benin Cote d'Ivoire
Mpwapwa	Tanzania
Muturu	Nigeria
Pabli	Republic of Benin
Sahiwal	Kenya

2.1 Endangered cattle breeds in East Africa

Table 2 shows the endangered cattle breeds in Africa

Table 2: Endangered cattle breeds in East Africa.

Breed	Present geographical location and production system	Total population	Main use	Main reason for being endangered	Specific trait(s) that might justify a conservation programme
Baria	Kelifely causes, N. Western Madagascar, extensive traditional system		Dual purpose		Humpless, adaptation to the environment
Creole	Mauritius	3,000	Dual purpose	Upgrading to imported exotic breed	Adaptation to the environment
Butana	North and east area of river Atbara and Kasala province, extensive system		Milk	Crossbreeding	Good dairy animal, adaptation to semi-arid environment
Kenana	Central Region of the Blue Nile province, extensive system		Milk	Crossbreeding, establishment of Kenana scheme in the natural habitat of breed	Good dairy animal, adaptation to hot arid and semi-arid environment
Mpwapwa	Mpwapwa and Malya Regions of Tanzania	10,000	Dual purpose	Lack of sustained effort to develop the breed	Adapted to semi-arid plateau of Central Tanzania

2.2 Causes for being endangered

The indigenous cattle breeds of Africa are derived from the humped and humpless types and from interbreeding of the two. These breeds have become adapted to the ecosystems, and any selection that has taken place over many years has been entirely by natural selection and dependent on survival. Thus, man in Africa has available a number of morphologically and functionally different types adapted to the prevailing conditions of the environment. Some of these breeds/strains are now endangered. The reasons for them being considered endangered are given in Table 2.

The major causes for being endangered are the lack of breeding policy and the indiscriminate crossbreeding programmes. In the case of the Sahiwal, a breed imported into Kenya from Pakistan, the narrow genetic base is the cause of being endangered. Owing to the low productivity of most of the indigenous breeds, the transfer of genes from superior indigenous/exotic breeds has brought about the dilution and loss of the genes of some specific traits in the indigenous breeds, particularly those related to adaptation. If this situation persists for long, it will eventually lead to drastic reduction in numbers of the pure breeds and may lead to the disappearance of breeds. Such breeds require conservation programmes of which an awareness has already been created and recommendations made for specific breeds (Adeniji, 1983b).

3. Other endangered livestock species

There is lack of information on the other species of livestock. The series of workshops that were recently organised on small ruminants in West, Central, East and Southern Africa did not come up with any breed/strain considered to be endangered. It is, however, possible that some of the adapted indigenous breeds/strains may be endangered. An attempt will be made in the near future to gather such information on all other livestock species including poultry.

4. Conservation programmes

Specific recommendations were made on the conservation programmes on some of the identified endangered breeds (Adeniji, 1984). For others, documents have been produced on how the conservation programmes could be initiated and implemented, for example: 'Conservation of the Kenana breed in Sudan' (Cunningham, 1987) and 'Efficiency of nucleus breeding schemes in dual purpose cattle of Tanzania' by J.S. Kasonta and G. Nitter (a research paper supported by DAAD grant for JSK - Deutscher Akademischer Austauschdienst). Both documents emphasise the usefulness of the nucleus breeding schemes in the conservation of these breeds. Kasonta and Nitter proposed a two-tier breeding scheme through separating all recorded cows into a nucleus and pre-nucleus herds which will lead to an increase in genetic gain. The Mpwapwa cattle at the research station would be considered the nucleus with very intensive recording and selection while the pre-nucleus will comprise of herds of selected progressive farmers with more or less intense data collection. Cunningham's recommendation of an open nucleus breeding structure, in which documented selection will be carried out on government station and supplemented by selection in village herds is similar to the one above. Thus, both schemes will lead to the improvement of the breeds involved. This is considered appropriate to the prevailing livestock production systems.

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ENDANGERED LIVESTOCK BREEDS IN WEST AFRICA

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1. Introduction

West Africa is a region clearly defined by natural geophysical boundaries. On the south and west it is bounded by the Atlantic ocean, its northern border delimited by the Sahara Desert, and the East by the Cameroun Mountains. Starting from approximately 5ºN latitude and extending to over 20ºN latitude, it lies entirely in the tropics (between the equator and Tropic of Cancer) with the characteristic feature of high ambient temperature. It covers an area of about 7.9 million square kilometres, has a human population estimated for 1980 to be over 112 million and is made up of 17 political entities or countries: Mauritania, Senegal, Gambia, Mali, Guinea, Guinea Bissau, Sierra Leone, Liberia, Ivory Coast, Burkina Faso, Ghana, Togo, Benin, Niger, Nigeria, Chad and Cameroun.

Generally speaking and from the animal production perspective, the region has a number of noteworthy features:

- It spans an area that extends from the very humid coastal swamps, inland through rain forest, Guinea and Sudan Savanna to the Sahel, semi-desert and very dry desert.
- There are 2 main climatic seasons: rainy and dry and the vegetation in any area generally corresponds to the total rainfall and length of the dry period. Thus, there are areas with prolonged dry spells of up to 8 months (towards the north) and wetter areas with a dry period of only about 4 months in a year (to the south).
- Within the region there are no formidale geomorphs which severely restrict movement of livestock and people. The few highlands: Fouta Djallon, Togolese mountains and the Jos plateau are all less than 2000 m in maximum altitude but the inland area is well watered by numerous rivers.
- Most of the people (>60%) are engaged in agriculture with a majority practising mixed (crops and livestock) farming systems.
- These features greatly influence the agricultural practices of the people of the region, especially in the livestock sector where the ruminants depend mostly on natural fodder availability.

2. The domestic livestock breed situation

All domestic livestock species thrive in West Africa. Tables 1-3, compiled from Mason (1951, 1988), lists the recognised breeds of cattle, sheep and goats and horses. Intermediates (derived from crosses between the breeds), if definitive, are also shown. Mason's classification also recognised one general breed each for pigs (the West African, found south of latitude 10º-14ºC); for poultry (the indigenous); and for buffalo (the bush cow/Congo buffalo). A summary of the breed and intermediate numbers, according to species, is given below.

Table 1: Naturally occurring cattle types in West Africa [1].

Breed name	Primary location	Related types/varieties	Distinguishing character/genotype
(A) Bos indicus/Zebu			
Azaouak	E. Mali, C. Niger & N.W. Nigeria	Tuareg (Niger bend, Mali)	Short homed
Fellata	Chad & W. Sudan		"
Maure	Mauritania & W. Mali		"
Shuwa	Chad & N.E. Nigeria	Kilara	"
Sokoto/Fulani Gudali	N.W. Nigeria		"
Adamawa	N. Cameroun	N'Gaoundere	Medium horned
		Banyo (with some Red Bororo blood (Cameroun)	
		[Yola] (with some Dwarf shorthorn blood) (N.E. Nigeria) [3]	"
Diali	S.W. Niger		Medium horned
Gobra	Senegal		Lyre-horned
Sudanese Fulani	Mali	Toronké	"
White Fulani	N. Nigeria		"
Red Bororo	E. Niger, N. Nigeria, W. Chad & N. Cameroun		Long-lyre homed
(B) Bos taurus/humpless			
Kuri	Lake Chad area	Jotko (with some zebu blood (Bornu, Nigeria)	Big, bulbous horns
		Kanem (with Arab [shoa] zebu) (Chad)	
N'dama [2]	Fouta Djallon, Guinea	N'Gabou (Guinea Bissau)	Long/short lyre horns
		Gambian	
		N'dama Petite and Grande (Senegal)	

West African Shorthorn[2]		Savanna:	Bakosi (Cameroun)	Short horned
			Baoulé (Ivory Coast)	"
			Somba (N. Togo, Benin)	"
			Ghana Shorthorn	"
			Doayo (N. Cameroun)	"
	South of West Africa	Dwarf:	Lagune (Ivory Coast, Togo	Dwarf
			Benin, Ghana)	"
			Gambia dwarf [3]	"
			Muturu (Nigeria)	"
			Manjaca (Guinea-Bissau)	"
(C) Naturally occurring intermediates				
Bambara	S.W. Mali			N'dama × W. Africa zebu
Biu[3]	Bornu, Nigeria			Dwarf Shorthorn × White Fulani
Borgu/Keteku	Benin, Nigeria			N'dama/Dwarf Shorthorn × zebu, probably White Fulani
Djakoré	Senegal			N'dama × Senegal Fulani
Pul-Mbor	Cameroun			Red Bororo × Adamava
Toubou	N.E. Nigeria			Red Bororo × Kuri
White Sanga	Ghana			Ghana Shorthorn × White Fulani
Wodabe	Cameroun			Red Bororo × White Fulani

[1]Source: Mason, I.L. (1988)

[2]After ILCA (1979)

[3]Thought to be extinct

N = north, W = west, S = south, E = east

Table 2: Common goat and sheep types of West Africa

Name	Main location	Varieties	Distinguishing trait/genotype
(A) Goat breeds			
West African long-legged (Sahelian)	North of West Africa	Nigerian (Kano brown, Katsina light brown, Bornu white, Red Sokoto/Maradi and Damagaran dapple-grey)	Long-legged, haired
West African Dwarf	South of West Africa		Dwarf, haired
Intermediates Baguirmi	Chad		W. African long-legged × W. African dwarf, haired
(B) Sheep breeds [1]			
Fulani	Senegal to Cameroun	Bornu (N.E. Nigeria, N. Cameroun, and Chad)	Long-legged haired and thin-tailed
		Samburu (Mali)	
		Toronké (Senegal and Mali)	
		Uda (N. Nigeria, Niger, Chad and Cameroun)	
		Y'ankasa (N. Central Nigeria)	
Maure	North of West Africa	Black Maure	Long-haired
		Touabire	Short-haired
Tuareg	Sahara, Niger		
Macina	Central Delta of Niger, Mali	Goundoun	Coarse-wooled
West African dwarf (Djallonké)	South of West Africa		Dwarf, haired and thin-tailed

[1]Source: Mason, I.L. (1988)

Table 3: Main horse breeds and types in West Africa[1].

Breed name	Main location	Varieties	Origin/genotype
West African Barb	West of West Africa	Beledougou (Mali)	From Barb (Maghreb, N. Africa)
		Hodh (Mali-Mauritania)	
		Sahel (Mali)	
		Sulebawa (Nigeria)	
West African Dongola	East of West Africa	Bahr-el-Ghazal (Chad)	From Dongola (Sudan)
		Bornu (N.E. Nigeria)	
		Hausa (N. Nigeria, Niger)	
West African ponies	North of West Africa	Bhirum (N. Nigeria)	
		Bobo (Burkina Faso)	
		Kirdi (S.W. Chad)	
		Koto-koli (N. Benin, Togo)	
		M'Bayar (Senegal)	
		M'Par (Senegal)	
		Torodi (W. Niger)	
Intermediates			
Bandiagara	Niger bend, Mali		Dongola × Barb
Djerma	Middle Niger		Barb × Dongola
Mossi	Burkina Faso		Dongola × Barb
Yagha	N. Burkina Faso		Dongola × Barb
Songhai	Niger bend, Mali		Dongola × Barb

[1]Mason, I.L. (1951,1988)

Species	Number of breeds	Intermediates
Cattle	15	8
Sheep	5	-
Goat	2	1
Horse	3	5
Pigs	1	-
Poultry	1	-
Buffalo	1	-

The summary shows that cattle, by far, have the largest number of breeds, followed by horses, and the small ruminants, respectively. The number of breeds is most probably a reflection of interest or activity with respect to the species. Another inference from the lists is that except for cattle all the breed names are mostly collective names: West African long-legged, the indigenous fowl/pig, West African dwarf, etc, and such names refer to a large collection of greatly differing types distributed sometimes over the entire region, or in a particular ecozone within the region. And though breeds may arise spontaneously in nature, they are maintained and sustained by either human activity or by other factors which are protective and favourable to their continued existence, e.g. isolation under favourable conditions. Otherwise, breeds within a species being cross fertile will interbreed in the absence of any restrictive barriers resulting in the "loss" of some breeds.

Although fairly reliable data on livestock numbers (according to species) are available, accurate numbers, broken down according to breeds, are either unavailable or scanty for the region; usually livestock breed numbers for any area taken over a period of time can give a good indication of the status of the breed over that period. It is therefore only with cattle that one can find numeric evidence of endangered status since cattle are the most prominent.

The cattle breeds were split into two groups (Tables Ia, Ib) by phenotype and origin (Joshi *et al.*, 1957; Epstein, 1971). An important point to keep in mind with cattle of West Africa is the influence of disease and vegetation on their distribution. Trypanosomiasis has generally been held to be the most important factor limiting the spread of the Zebu to all parts of the region. Thus the more humid tropical forest and Guinea Savanna areas to the south of the region - with thick undergrowth and densely wooded river basins which favour the *Glossina* species, vectors of this disease - are inimical to the Zebu which otherwise might have been successful in those ecozones. The only breeds of cattle which can survive in those zones without heavy chemotherapy are the Ndamas, and the West African Shorthorn or its variants. These two breeds are thought to possess some tolerance, if not resistance, to the disease. Relative to other breeds, their numbers are few but as has been suggested by Stewart and Jeffrey (1956), some of the strains of the West African Shorthorn may be tolerant to specific local strains of the trypanosomes. So there might be a need for protection of such types.

Another interesting breed of cattle is the Kuri found around the shores of Lake Chad. This cattle breed has large bulbous horns which many believe help the cow to stay afloat and swim long distances.

The Kuri and the Muturu are identified as being endangered, both are humpless *Bos taurus* types.

3. The criteria for a decision of "endangered"

These two breeds which are few in number relative to other cattle breeds in the region have been declining rapidly in recent times. Table 4 shows the numbers for the Muturu while the total number of Kuri cattle has been put at 7000 head.

There are many reasons for the rapidly declining numbers. First, is competition from more productive breeds, e.g. the Zebu is generally accepted to be a better meat and milk animal and some are more adapted to wider ecological zones as compared to the Kuri or Muturu which have not been shown to perform very well outside their rather restricted econiche. Secondly, in the case of the Muturu, cattle rearing is of secondary importance to the mainly arable farmers who keep these animals. The herd is usually not tended and the animals are tethered during the day to prevent damage to crops. No supplementary feed is routinely offered and the animals are not milked. Populations of the Muturu were decimated during the Nigerian civil war. This has also happened even more recently to the population of Kuri cattle during the Chadian war.

Table 4: The population of the West African Shorthorn relative to cattle population of countries where they are found[1].

Country and breed	Population in study area ('000)	Total cattle population in area ('000)	% Shorthorn
Savanna Shorthorn			
Ghana Shorthorn (Ghana)	616	*777*	79.27
Baoule (Burkina Faso)	484	2550	18.98
Baoule (Ivory Coast)	250	516	48.44
Somba (Togo)	144	214	67.28
Somba (Benin)	75	726	10.33
Keteku (Nigeria	82	8235	0.99
Doayo (Cameroun)	7	2917	0.23
Sub-total	*1658*	*15935*	*10.40*
Dwarf Shorthorn			
Muturu (Nigeria)	38	8235	0.46
Lagune (Benin)	20	726	2.75
Muturu (Liberia)	15	25.5	58.82
Sub-total	*73*	*8986.5*	*0.81*

[1]After ILCA/FAO/UNEP (1979)

For other species, e.g. pigs, poultry and horses, not much information exists on the breeds in respect of unique traits (if any), numbers, productivity to identify superior genotypes. But some evidence exists that some may have desirable genetic traits worth preserving. Further information is needed. Meanwhile unless some action is taken, indiscriminate crossbreeding or breed replacement with exotic poultry and pigs may lead to complete extinction of some local strains.

4. Activity for preservation

Action in this area has been largely by the international organisations: IBAR, FAO/UNEP and ILCA. These organisations either individually or collectively have taken steps, such as collecting information on breeds through questionnaires to member states, establishment of data banks, and organising the establishment of breeding programmes which could, in turn, lead to genetic improvement of the threatened breeds and increase their numbers and competitiveness.

These actions are considered important steps in the conservation and better use of genetic resources for now and the future.

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ENDANGERED LIVESTOCK BREEDS IN SOUTH ASIA

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1. Introduction

South Asia, comprising India, Pakistan, Bangladesh, Nepal, Bhutan and Sri Lanka, has very rich animal genetic resources which are reflected by the availability of almost all important economic species of livestock, viz. cattle, buffaloes, sheep, goat, pigs, camel, equines (asses and horses), yak and mithun, and poultry (chickens, ducks and guinea fowl), and a number of breeds in each of these species. Efforts to document these breeds in greater detail have more recently been made (Acharya, 1982; Acharya and Bhat, 1984; Hasnain, 1985; Kharel and Pradhan, 1986).

The region has important tropically-adapted dairy, draft and dual purpose breeds of cattle, dairy breeds of buffaloes, carpet wool breeds of sheep and highly prolific breeds of goats. The cattle germplasm from the region has been utilised for developing tropically and sub-tropically adapted breeds of dairy and beef cattle in a number of other regions. Similarly, the dairy buffalo germplasm from the region has been utilised for improving productivity of swamp and low producing riverine buffaloes in major parts of South-East Asia, Europe and South America. The region has also contributed to the improvement of breeds of goats in other regions and Jamunapari has been the major breed exported from the region.

2. Large nondescript population

In spite of a large number of descript breeds, a major part of the population of livestock is nondescript. There are basic problems of identification, evaluation and management of animal genetic resources in the region for want of organised animal breeding activity. There are no breeding societies or agencies as exist in agriculturally advanced countries to register animals of a particular breed to maintain herd/flock books and ensure purity of breed or type. Little systematic effort has been made to evaluate the indigenous breeds in their native environment and traditional husbandry practices and take up steps for their conservation and further improvement through selection. There exist a few State/Central Government/private breeding farms which maintain herds of important breeds for production of breeding males for distribution to the farming communities or placement in government institutions providing breeding services to the farmers.

3. Herd books

India was signatory at the International Convention held in Rome in October 1936 to establish herd registry associations and had initiated herd registration of the cattle breeds, viz. Gir, Hariana, Kankrej, Ongole, Sahiwal, Sindhi and Tharparkar; and buffalo breeds, viz. Murrah, Surti and Jafarabadi. The herd book scheme of the Government of India aims at compiling, analysing and publishing production and breeding data. The Government and private organisations and farmers having animals meeting the standards of performance laid down are registered in the herd book. This information has been utilised to some extent in procuring breeding bulls. The State Government of Haryana, where the Murrah breed of buffalo is located and has great internal and foreign demand, has taken steps to ensure retention of superior germplasm through providing incentives to owners of animals performing according to the standards laid down and ensuring that such animals are not disposed of, more particularly animals in the first two lactations.

4. Evolution of indigenous breeds

Most of the breeds of livestock and poultry that exist in the region have evolved through natural selection for adaptation to agro-ecological and management conditions. Artificial selection based on social or economic needs of the breeders would have been practised only to a very small extent. Most of the indigenous breeds are very well adapted to harsh physical, health and nutritional environment and long migration in certain areas.

5. Dilution/loss of genes through crossbreeding/grading-up

The lack of appreciation of the productivity of indigenous breeds, especially in prevailing conditions of management, eagerness to rapidly improve genetic merit, availability of important biological tools such as semen freezing and artificial insemination, have led to the possibility of massive transfer of genes from superior indigenous/exotic breeds. Due to the circumstances explained earlier, especially lack of organised breeding activity, there is a lot of further intermixing of breeds located in the same region or with the breeds which observe transhumance/ migratory system. These trends could lead to dilution and even loss of some of the important genes related to adaptation.

6. Need for evaluation

Logically, the effort should be to have more detailed surveys of available animal genetic resources in their native environment to allow their description, evaluation and differentiation. This would utilise physical conformation, body measurements and performance characteristics included in multivariate analysis, as well as utilising gene marker characters, viz. cytological, immunological, biochemically polymorphic and molecular genetic in nature - such as restricted fragment length polymorphism, DNA finger printing, etc.

7. Definition of breed

The population of livestock and poultry in a given location with certain well-defined physical conformation characters, distinct local names and differentiable from other breeds in the vicinity is generally considered as a breed. Given the circumstances prevailing, regarding the organisation of breeding activities, there is a likelihood that a large number of these breeds may not be genetically distinguishable. For example, the breeds of cattle in India can be grouped in 4-5 basic types. This is also the case with sheep in Rajasthan where earlier all breeds were grouped as Bikaneri but they have now been distinguished as eight distinct breeds. These could, however, be grouped under three distinct types on the basis of their fleece type. While it is necessary that steps should be taken for more detailed description and evaluation of each of the better known/less known breeds and their genetic differentiation, utilising more modern tools of molecular genetics, it is also necessary that the breeds which are threatened to extinction should be considered for conservation by both *in situ* and *ex situ* methods.

8. Breeds of livestock in South Asia

Breeds of cattle (dairy, draft, draft and dairy, dairy and draft), buffaloes (dairy, draft and meat), sheep (apparel wool, carpet wool and meat, carpet wool, meat and dairy, dairy, carpet wool and meat), goats (fleece, dairy and fleece, dairy, meat, fleece and dairy, dairy and meat, and meat), pigs, poultry, horses, camel, yak and mithun in

India, Pakistan, Nepal, Bangladesh, Bhutan and Sri Lanka are presented in Tables 1, 2, 3 and 4.

9. Breeds requiring conservation

The livestock census in the countries in the region is taken by species and not by breeds. It is, therefore, extremely difficult to know the exact number of animals of a particular breed except through the number of animals of a species in the area comprising the home tract of the breed. Further, with little organised breeding effort to ensure the purity of a breed, a large proportion of animals are nondescript even in the breeding tract of a descript breed, further creating problems of determining the numbers of animals of a particular breed. Information with respect to the breeds needing conservation in the region was sought from both the senior research and development officers of these countries. On the basis of the information made available as well as personal discussions with senior officers of these countries connected with animal husbandry research and development programmes, the breeds of different livestock species showing serious decline in their numbers and needing conservation effort are presented in Table 5.

The number of animals for a breed to be classified as endangered (Alderson, 1981; Maijala, 1982) may not justify most of these breeds to be called endangered. However, some of the breeds, such as Toda buffalo, Nilgiri and Hissardale sheep, Double-humped camel in Ladatch area of India, would need immediate conservation effort.

In addition to the proper description and evaluation of different breeds in their native environment and their genetic differentiation, it will be necessary that the surveys of animal genetic resources estimate population statistics and the rate of changes over time, especially in relation to the breeding strategy being followed. It will also be necessary that the quinquennial census is done not only on species basis but on breed basis, so that the number of animals of a particular breed and the trends in the numbers are available. Thus the need for taking steps for conservation of the breed can be determined.

Table 1: Breeds of cattle in South Asian countries

	Countries					
Type	India	Pakistan	Bangladesh	Nepal	Bhutan	Sri Lanka
Dairy	Red Sindhi Sahiwal Karan Swiss Karan Fries Sunandini	Red Sindhi Sahiwal				
Dairy and draft	Tharparkar Gir	Tharparkar				
Draft and dairy	Deoni Gaolao Hariana Kankrej Krishna Valley Ongole Rath Siri	Bhagnari			Siri	
Draft	Amritmahal Bachaur Bargur Dangi Hallikar Kangayam Kenkatha Kherigarh Khillari Malvi Mehwati Nagori Nimari Ponwar	Dhanni Lohani Rojhan	Bengal Chittagong Red	Nepalese Hill Kachcha Siri Tarai Lulu		Sinhala

Table 2: Breeds of buffaloes in South Asian countries.

	Countries					
Type	India	Pakistan	Bangladesh	Nepal	Bhutan	Sri Lanka
Dairy	Murrah Nili-Ravi Surti Jafarabadi Bhadawari Godavari	Nili Ravi Kundi		Lime (Nepalese Mountain buffalo)		
Draft and meat	Kalahandi Manda/ Parlakimedi/ Ganjam Nagpuri/ Pandharpuri Sambalpur Tarai Jerangi South Kanara Toda					

Table 3: Breeds of sheep and goat in South Asian countries.

	Countries					
Type	India	Pakistan	Bangladesh	Nepal	Bhutan	Sri Lanka
Sheep						
Apparel wool	Kashmir Merino	Karnah				
	Nilgiri					
	Hissardale					
	Avivastra					
	Bharat Merino					
	Karnah					
Carpet	Chokla	Kachhi		Bhyanglung		
	Nali	Kajli		Baruwal		
	Pattanwadi	Kalah		Jumli		
	Avikalin			Kagi/ Lampuchchera		
	Gaddi					
	Rampur					
	Bushair					
	Bhakarwal					
	Poonchi					
	Gurez					
	Changthangi					
Meat and carpet wool	Muzzafarnagri	Bibrik				
	Jalauni	Harnai				
	Deccani	Khijloo				
	Bellary	Waziri				
	Ganjam	Thal				
	Balangir					
	Shahabadi					
	Chotanagpuri					
	Coimbatore					
	Marwari					
	Magra					
	Jaisalmeri					
	Pugal					
	Malpura					
	Sonadi					
Meat	Nellore	Michni				Jaffna
	Mandya					
	Hassan					
	Mecheri					
	Ramnad					
	Kilakarsal					
	Vembur					
	Ramnad White					
	Madras Red					
	Tiruchy Black					
	Kenguri					
Carpet wool meat and dairy		Baluchi				
		Khurasani				
		Lohi				
		Hashtnagri				
		Rakhshani				

Carpet wool meat and fat		Lati Tirahi		
Dairy and carpet woold		Damani Kaghani Kuka		
Goat				
Dairy/ meat	Jhakrana Beetal Jamnapari Barbari Surti	Bari Thori		
Meat	Bengal Ganjam Malabari Kannai Adu Osmanabadi Sangamneri Kutchi Zalawadi Gohilwadi Mehsana Sirohi Parbatsar	Chaper	Bengal	Singhal Tarai Nepalese Hill
Fibre/ hair	Gaddi Marwari Changthangi Cheghu	Kaghani		Chayangez
Dairy		Damani		
Dairy, meats, fleece		Dera Din Panah Kamori Leri		
Dairy and fleece		Baluchi		
Meat and fleece		Sirli		

Table 4: Breeds of pigs, poultry, camel, horses, yak and Mithun in South Asia.

	Countries					
Type	India	Pakistan	Bangladesh	Nepal	Bhutan	Sri Lanka
Pig	Indian wild pig					
	Andaman Island wild pig					
	Eastern region wild pig					
Poultry	Aseel					
	Kadaknath					
	Ghagus					
	Busra					
	Chittagong					
	Miri					
	Daothigir					
	Brown Desi					
	Danki					
	Titri					
	Harringhatta					
	Black					
	Kashmir					
	Faveralla					
	Kalasthi					
	Loalab					
	Naked Neck					
	Punjab Brown					
	Tani					
	Tellichery					
	Ankaleshwar					
	Nicobari					
Camel	Bikaneri					
	Jaisalmeri					
	Sindhi					
	Kutchi					
Horses	Kathiwari	Baluchi		Bhutia		
	Marwari	Hirzai		Tangan		
	Bhutia	Waziri		Tarai pony		
	Manipuri					
	Spiti					
	Zaniskari					
Asses Yak and Mithun	Indian wild asses					

Table 5: Breeds requiring consideration for conservation.

Type	Countries India	Pakistan	Bangladesh	Nepal	Bhutan	Sri Lanka
Cattle	Bachaur Dangi Kenkatha Siri Kherigarh	Lohani Rojhan	Chittagong Red *	Achhani*		
Buffalo	Toda *					
Sheep	Nilgiri * Hissardale * Mandya Bhakarwal Poonchi Karnah Gurez					
Goats	Jamnapari Barbari Surti					
Camel	Double humped camel*					
Poultry	All indigenous breeds of poultry					

*will require urgent consideration

10. Breeding policy to ensure maintenance of purity of indigenous breeds

Realising the importance of indigenous breeds, the Government of India has defined breeding policy for livestock. The crossbreeding with exotic, superior breeds will be confined to nondescript and low-producing animals and the descript breeds will be improved through selection within breeds.

11. Conservation efforts

The Government of India has taken steps for conservation of indigenous livestock germplasm. For that purpose it has set up a Bureau of Animal Genetic Resources supported by an Institute of Animal Genetics and a number of species-related research institutes/centers, State Agricultural Universities, State Departments of Animal Husbandry and non-governmental organisations. The Bureau, supported by these bodies, will take up large surveys for the description and evaluation of indigenous breeds and to identify breeds needing conservation effort. The Bureau will coordinate the national effort which will be funded by the Government of India. The Bureau will also be an animal genetic resource data bank and gene bank. Samples of cryo-preserved genetic material will be kept at the Bureau and the participating agencies.

Major breeding research programmes now involve improvement of indigenous breeds through selection. These programmes utilise existing institutional farms maintaining the same breed as associated herds, alternatively taking up Open Nucleus Breeding Schemes (ONBS), taking up field recording of performance data, and utilising farmers' herds or flocks in genetic selection. These steps will allow maintenance of large populations of indigenous breeds *in situ.*

The utilisation of existing institutional farms maintaining indigenous breeds under ONBS should allow not only quicker genetic improvement, but also allow cryo-preservation of large samples of semen and embryos from selected animals.

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THE ENDANGERED LIVESTOCK BREEDS IN EAST ASIA

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1. General situation concerning the resources of livestock and fowl breeds in East Asia.

1.1 China

(a) China has a long history of livestock and fowl with rich gene resources.

According to archaeological studies, the Chinese people had started animal domestication as early as the neolithic age or, say, ten thousand years ago. As a major source of livelihood, animal-raising was well developed about seven or eight thousand years ago. Since the livestock and fowl were raised under complex ecological conditions, and affected by different social economic situations for a rather long period of time, they had been artificially selected and raised for different purposes, so that different livestock and fowl breeds evolved with their own characteristics. Furthermore, some Chinese livestock and fowl breeds have had great influence on the evolution and development of some livestock and fowl breeds in foreign countries.

China is a country with great and rich livestock and fowl resources. Since the founding of the People's Republic of China, much attention has been paid to develop animal husbandry and the utilization of livestock and fowl resources. In order to ascertain the current resources of different livestock and fowl, planned investigations and research projects have been organized many times since the 1950s. That on the largest scale and longest time duration was carried out from 1976-1984. For this survey in the whole country, the Ministry of Agriculture and the local governments at all levels allocated large amounts of money. Thousands of scientists, experts and technicians from universities and colleges of agriculture, central and local academies of animal sciences as well as those working at the grass roots, were organized by the administrations of animal husbandry in 29 provinces, autonomous regions and municipalities (except Taiwan). After the investigation, much information and data had been collected and sorted out. The resources of livestock and fowl breeds in China have thus been basically ascertained. There are more than 300 domestic livestock and fowl breeds and groups of varieties, including 29 horse breeds, 20 ass breeds, 42 cattle breeds, 18 buffalo breeds, 5 yak breeds, 4 camel breeds, 35 sheep breeds, 37 goat breeds, 64 pig breeds, 72 chicken breeds, 30 duck breeds and 21 goose breeds.

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

(b) Characteristics of Chinese domesticated animal and fowl resources

The many breeds of Chinese domesticated animals and fowl have various characteristics. For example, Yunnan Zebu is well adapted to the tropical and subtropical climates in the south and resistant to external parasites; Erlunchun horse and Ming pig in the North-east are adapted to cold climate and severe environment in the north; Nanyang cattle and Luxi cattle are good for both meat and draught purposes and can be fed on roughage; Tibet range sheep, Liaoning cashmere goat and Inner

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

1.2 Japan

Japan has relatively rich and varied livestock and fowl resources among countries of East Asia. The exotic breeds and crossbreds play an important role in animal production. For instance, Japan cattle, were developed and improved after selecting original local breeds for meat purposes and crossing with exotic breeds.

In Japan there are also some endangered livestock and fowl breeds. These livestock are preserved basically as living relics. According to statistics (1983), there were nearly 30 livestock breeds preserved, including 17 chicken breeds, 6 horse breeds, 4 goat breeds, 2 cattle breeds and others.

1.3 DPR of Korea

There are only a small number of livestock and fowl breeds native to the DPR of Korea. They were low in productivity and have been improved by crossing with imported breeds.

1.4 PR of Mongolia

Livestock and fowl breeds native to PR of Mongolia are sheep (Mongolian sheep, Kazakh sheep), goat, cattle (Mongolian cattle), yak, horse (Mongolian horse), Camel (Bactrian camel). Among these livestock, cattle, sheep and horse have been crossed with exotic breeds and improved.

2. The importance of preserving local livestock and fowl breeds

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

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

3. Ways of protecting livestock and fowl resources in East Asia

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

3.1 China

In China, the protection and preservation of livestock and fowl resources have been carried out in the following three ways, namely: to protect live animals and fowl, frozen semen and frozen embryos. The protection of live animals and fowl is the main method. It was carried out relatively early and has been used in cattle, sheep, pigs, horses and fowl. Obvious results have been obtained in protecting small-tailed Han sheep and Hu sheep by establishing protected areas and farms. For example, small-tailed Han sheep in the west of Shandong Province are a coarse-wool breed with high fertility. As wool was greatly needed in the 1960s, production of wool in the country was raised by crossing breeds but the fertility was reduced. Later, it was found that high fertility is a particular attribute of the Chinese Han breed of sheep. So the Ministry of Agriculture has paid great attention to the small-tailed Han sheep and allocated some special funds to develop them. The local governments took some protective steps that made the number of small-tailed Han sheep Increase from 30 000 in 1977 to 300 000 in 1988. It has become a breed highly appreciated in production by the people.

Another example is the Langshan chicken well-known in the world for a long time. Once it was on the verge of extinction. Jiangsu Province has taken active measures and established protection breeding farms for this chicken. After more than 20 years of selection and protection, this excellent breed is under good care and preserved.

3.2 Japan

In Japan the major form of animal protection has been to preserve the indigenous livestock breed resources. Three ways of protection are adopted, i.e. protection by the broad mass of people; protection by the local production area of breeds; and at the national level, keeping these animals as a heritage of nature. These breed resources represent basically the endangered livestock.

4. Reduced or endangered animal resources in East Asian countries

4.1 China

In China, with the development of a commodity economy in animal husbandry, the challenge faced by the local breeds has been increased. Large numbers of foreign breeds introduced from abroad for cross-breeding and improvement have caused a reduction in the number of breeds or species, making some of the breeds become endangered livestock (Table 1).

4.2 Japan

In Japan, according to the information given by the preservation committee, only 2 breeds of cattle, 6 breeds of horse, 4 breeds of sheep and 17 breeds of chicken are on the endangered list (Table 2).

5. Suggestions for protecting and preserving the livestock and fowl breed resources

China is an East Asian country with very rich livestock and fowl genetic resources. In Asian and East Asian countries, local breeds have been influenced to some extent by being hybridized with and replaced by foreign breeds. Yet China has a vast area and a rather complicated natural ecological environment. Especially in the south-east and the south-west and the Huang-Huai-Hai regions in China, natural protection regions have formed where a lot of specific animal and fowl breeds have been distributed and protected now, so that many breeds in those regions have been preserved.

China is also a developing country. The economic resources used to protect and preserve effectively the genetic resources of livestock and fowl breeds are not sufficient. Therefore, related international organizations, such as FAO, should co-operate with the Ministry of Agriculture of China to establish several protective regions, sperm banks, and embryo banks for some endangered livestock and fowl populations and species that have become almost extinct or greatly reduced in number. This is also required to carry out studies on the development and utilization of these genetic resources in China.

Acknowledgement

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Table 1: Endangered local breeds in China.

Breed	Name	Number ('000)
Horses	Baichatieti horse	0.4
	Erlunchun	0.1
	Yiwu	thousands
	Jinjang	0.1
	Yongnin Tibet	0.4
	Zhongdian	0.7
Donkey	Lingxian	0.4
Cattle	Dulong	0.02
	Ebian Spotted	1.0
	Zaosheng	0.5
	Sanjiang	0.55
	Wenling Humped	1.0
	Zhoushan	0.5
Sheep	Lanzhou Large Tailed	1.0
	Henan Large Tailed	2.0
	Guide Black Fur	2.0
Pigs	Bamaxiang	some
	Guanzhuang Spotted	0.6
	Panlang	0.15
	Dingxian	0.05
	Longlin	1.0
	Yangxin	1.0
	Daweizi	1.3
	Hang	1.1
	Gangzhongnan Spotted	1.3
	Hongqiao	0.84
	Wei	0.3
	Debao	1.5
	Fuan Spotted	0.2
	Pingtan Black	0.25
	Liubai	0.2
	Qianshao Spotted	1.2
	Lanxi Spotted	1.5
	Bihu	0.4
	Beijiang	0.2
	Yayang	0.2
	Chalu Black	0.74
	Pudong White	1.0
Chicken	Beijing You	3.0
	Monkey	rare
	Pudong	rare
	Fighting Cock of China	0.2
	Jingyangsimao	0.05
	Miyi	0.5
	Emei Black	1.6
	Dongzhong Dwarf	0.05
	Nandanyao	0.5
Duck	Jinxidama	0.2

Table 2: An example of endangered local breeds in Japan.

Breed	Name	Number
Cattle	Mishima	30
Horse	Tsushima	50
Goat	Tokara	50
Chicken	Long Feather Fowl	39

ENDANGERED LIVESTOCK BREEDS IN SOUTH AMERICA

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1. Introduction

In the developed countries, most of them located in the temperate regions, the selection conducted for centuries by breeders and researchers, together with a recent application of modern technologies, created breeds with high production levels. The increasing need for animal products in the developing countries, mostly located in the intertropical zone, is causing a quick substitution of the “local” breeds. Even though these “local” breeds present lower production levels than the exotic ones, they are extremely well adapted to the tropics, where they have been naturally selected for centuries. In many cases, it has been observed that the replacement of the “local” breeds by the exotic ones, has led to very disadvantageous situations, due to the lack of adaptation of the latter to the tropics. In general, well planned crossbreeding programmes are much more appropriate than the upgrading of the “local” breeds with the ones selected for the temperate zones.

The subject of animal preservation is relatively new in South America. However, this quick substitution of the “local” breeds by the exotic ones, less adapted, has just recently awakened the consciousness of breeders and researchers that do not want to witness their complete disappearance.

Unfortunately it is not an easy task to get information about what is being done, in terms of animal preservation, in each one of the South American countries. But we can be sure that most of the preservation being done refers to criollo cattle, as shown in another FAO publication: “Recursos Genéticos Animales in America Latina” published in 1981, where of 13 papers, 8 described criollo cattle, 3 described native species, 1 presented methodology while only 1 presented results of other 2 livestock species: sheep and goats. This paper will show endangered breeds of different species in many South American countries, with special reference to criollo cattle for the reasons stated above.

2. Argentina

2.1 Cattle

2.1.1 The Argentine Criollo Cattle

The Criollo cattle was introduced into Argentina through four different routes:

(a) Northwest: from Peru through Bolivia and Chile;
(b) North: through Paraguay;
(c) East: through Brazil; and
(d) La Plata river: brought directly from the Iberian Peninsula.

For more than four centuries, these cattle have been subjected almost exclusively, to natural selection, resulting in a tremendous genetic variability, which allows them to produce in different environments: from Jujuy (close to the Andes) to the Chaco (semi arid region in Northern Argentina) and to the Humid Pampa area, in the South.

Presently, a 200 cow criollo herd is being evaluated by the National Institute of Agricultural Technology (INTA) at Leales, Tucumán.

The criollo cows of Argentina are of medium size with mature weights ranging from 400 to 440 kg and the daily milk production varies from 4 to 6 kg. They do not present calving difficulty and have good mothering ability, with a low mortality rate of 3% from birth to weaning. Bulls are much heavier, ranging from 600 to 800 kg. This sexual dimorphism is very interesting, as a relatively small dam can produce heavy male calves.

Production traits of criollo cattle compared to Hereford and Nellore can be seen in Table 1.

Table 1: Production traits of Argentine Criollo, Hereford and Nellore cattle

Breed	No.	Calving rate (%)	Mortality rate (%)	Weaning weight (kg)	Gain (kg/ha/year)
Criollo	2109	75	2.0	174	93.2
Hereford	626	77	10.8	146	68.5
Nellore	653	76	6.4	179	89.5

Source: Sal Paz (1985)

The Argentine Criollo can not be considered as threatened by extinction anymore. It has emerged out of a period of expansion and has a potential utilization in the beef industry of that country, especially in the Northwestern region. A Breed Association has been formed, which shows the enthusiasm of some breeders.

3. Bolivia

3.1 Cattle

3.1.1 The Criollo Yacumeño

The Criollo Yacumeño is raised in the Espiritu Ranch, located in the Beni region, between 14 and 15 degrees South, close to the Yacuna river. The Beni is a flood plain with a humid tropical climate in the Amazon Basin. There is a marked rainy season (October to April), with a mean annual rainfall of 1800 mm, ranging from 1500 mm to 2500 mm.

The Yacumeño cattle are similar in colour to the Jersey, and all the cows and bulls are dun or red although calves with large white patches are born giving confirmation that this characteristic is a recessive (Wilkins, 1984).

Some production traits of the Yacumeño Criollo cattle can be seen in Tables 2 and 3.

Table 2: Weights of Yacumeño Criollo cattle.

Weights	Males		Females	
	No.	kg	No.	kg
Weaning	2494	169	2512	151
24 months	1535	260	1519	215
Mature (50 mo.)	-	435	-	-

Source: Bauer et al (1989).

Table 3: Production traits of Yacumeño Criollo Cattle

Trait	Mean
Calving rate	78.0%
Mortality rate	
before weaning	5.3%
after weaning	9.1%
adult	2.0%
Carcass Weight	
males (44.4 mo.)	212 kg
females (60.5 mo.)	147 kg

Source: Bauer et al (1989).

3.2 Sheep

Among the 7 million sheep existing in Bolivia, 5 million are of the criollo type, and can be found in the Altiplano. Wool production is very low (800 g/sheep/year), and due to its inferior quality, it is not adequate for sale. However, the criollo sheep of Bolivia serve for subsistence, as they produce the fiber for clothes, and a limited amount of meat (an average of 8 kg of meat/ carcass) for their owners.

4. Brazil

4.1 Cattle

4.1.1 The Caracu

Among the Brazilian Criollo breeds, the Caracu has, by far, the largest population. After a dramatic reduction, mostly due to the importation of zebu cattle from India, in the beginning of this century, the Caracu has greatly increased numerically and in popularity in recent years.

Many positive research results called attention to this breed to such an extent that today many breeders have waiting lists for their bulls. All this interest completely changed the situation of the Caracu, which can not be considered in danger of extinction anymore.

The Caracu cattle breed has been kept as purebred only in some isolated situations:

- in the state of Minas Gerais, in the region of Poços de Caldas, where it has been selected for milk production, originating the so called Caracu Caldeano;
- in the state of Sao Paulo, the Instituto de Zootecnia keeps a Caracu herd in the Experimental Station of Sertaozinho, evaluating its potential as beef producers; and
- a few herds of Caracu were maintained in the states of Parana and Santa Catarina, where cold winters and the poor quality of the pastures were obstacles to the adaptation of European breeds for beef production.

In a trial evaluating different breeds of bulls bred with Nellore cows for beef production, the Caracu was demonstrated to be superior to the Nellore, Santa Gertrudis, Holste in and Brown Swiss (Razook *et al*, 1986).

In feedlot trials, Caracu steers showed their superiority to Guzerat, Nellore and Gir.

Male puberty is earlier in the Caracu than in the Gir, Guzerat and Nellore breeds (Valvasori *et al*, 1985).

The breed is blonde in colour, with a cream coloured variation occurring as a recessive in some populations. Hooves are light coloured and the muzzle and vulva are pigmented light brown. It is larger than any other Criollo breed, and cows of over 700 kg and bulls of over 1200 kg have been shown in cattle shows. It has heavy horns that grow outward, down and forward. It has dual purpose characteristics, and one owner, in a favourable environment, reported a mean yield of some 2300 kg of milk in his 1000 cow herd. (Wilkins, 1986).

4.1.2 The Mocho Nacional

The Mocho Nacional or National Polled breed is phenotypically very similar to the Caracu but, obviously, hornless. Some slight differences in head shape have been suggested.

This breed can be considered as an example of the extinction of a breed. When the conservation programme started, the entire surviving population consisted of three bulls and eight cows, found in the states of Sao Paulo and Parana. Since then, after many semen and embryo collections, the population has increased a little, through embryo transfer, to a total of 25 animals.

It is perhaps fortunate that this breed, that has the minimum number of individuals for successful multiplication suggested by Yamada and Kimura (1984), demonstrably possesses a genetic character that is dominant and useful: it is polled. In a report written after his consultancy to CENARGEN, Wilkins (1986) stated that he could not see any possibility of the multiplication of the Mocho Nacional into a viable population. We do agree with him, but we also believe that the cryopreservation of semen and embryos of this breed is very important, for future utilization. And for this reason, this small herd is kept in an Experimental Station near Brasilia, where semen and embryos have been collected.

4.1.3. The Crioulo Lageano

Also called Franqueiro, the Criollo of Lages breed is found on one private property near Lages in the state of Santa Catarina. This environment can not be called severe, though the area suffers a cold winter. The herd consists of 280 adult females and 20 bulls and is reported to be inbred and to contain some zebu blood.

This breed is descended from animals brought by Spanish Jesuits, and has been selected for more than three centuries on acid and rocky soils, at high altitudes and in the cold winters of Southern Brazil.

Like all unselected Criollo populations, the herd contains black, brown and white cattle and combinations of these colours. The horns are described as long and lyre shaped, curving upward, forward and outward.

This herd is being evaluated under the same conditions as the breed is raised in its original region, that is, native pastures without supplementation. Means of some traits of the Crioulo Lageano are presented in Table 4.

A crossbreeding programme has been established in the state of Santa Catarina, where Crioulo Lageano bulls are used in Nellore and Charolais cows.

This programme is an incomplete diallel in which the only matings excluded were the ones among Crioulo Lageano dams with Nellore and Charolais sires. Even though the results are still partial, the evidence suggests that:

(a) The best performance at weaning (average age of 173 days) was presented by the offspring of Nellore × Charolais (148.0 + 7.98 kg), followed by purebred Crioulo Lageano (136.6 ± 4.70 kg) and by Crioulo Lageano × Charolais (125.0 ± 7.63 kg);

(b) The best milk production was obtained from Crioulo Lageano cows, followed by the Charolais.

Table 4: Production parameters of Crioulo Lageano cattle.

Trait	Mean weights (kg)
Birth	29.3
Weaning	161.0
12 months	180.0
24 months	241.0
36 months	307.0
Mature[a]	429.0
Milk production per day[b]	5.1

[a] Weight of mature cows suckling calves.

[b] Milk production: one milking per day, the calf is separated from the cow for 14 hours.

4.1.4 The Curraleito or Pé-duro Crioulo

The Corral or Hard Hoof Criollo is from the semi-arid Northeast of Brazil, an area of dense thorn scrub. The origin of this breed is the cattle brought to Brazil by the Portuguese settlers, and is a result of its surviving in the hostile environment conditions of that Brazilian region. According to Athanassof (1956), this breed descends directly from the Mirandesa and, particularly, from the Beiroa type which can still be found in Portugal and in the Spanish Province of Leon.

The exceptional rusticity of the Curraleiro, and its capacity to survive on native pastures of adverse regions, where other types of cattle would have little chance to survive, are two characteristics that justify the conservation of this breed. The Curraleiro is endangered by the threat of extinction not only due to its crossbreeding with zebu breeds, but also due to the systematic castration of the bulls, by the breeders who want to upgrade their herds to zebu blood, with the excuse that the Curraleiro is small and late maturing. This explains how the breeders are quickly substituting this breed by others, mostly zebu, which, they say, produce more beef on better quality pastures, though they are not adapted to the poor native pastures of Northeastern Brazil.

A herd which contains 107 females and 43 males is now kept by EMBRAPA on the Octávio Domingues Experimental Station, near Sao Joao do Piauí, in the state of Piauí. Some production parameters were obtained, as can be seen in Table 5.

Table 5: Production parameters of Curraleiro cattle.

Trait	Males	Females
Mature weight (kg)	337.3 ± 55.0	228.6 ± 36.0
Birth weight (kg)	19.3 ± 4.0	17.2 ± 2.4
Fertility rate (%)	-	72.0
Mortality rate (%)	5.0	5.0

Source: Carvalho *et al.* (1986)

4.1.5 The Pantaneiro

The Crioulo Pantaneiro or Swamp Criollo comes from the Pantanal or swamp lands of the states of Mato Grosso and Mato Grosso do Sul, on the border with Bolivia, and is also called Tucura or Cuiabano.

Due to the difficulty of access to very many properties in the Pantanal, the present size of population is not known, but it is very unlikely to be large. It is supposed that there are still animals in very small groups scattered among the four million zebus of the zone.

In 1985, a group of cows and bulls was bought by EMBRAPA, and this herd is now kept in Fazenda Nhu-mirim, which belongs to CPAP (Agricultural Research Centre for the Pantanal), 210 km East of Corumbá, state of Mato Grosso do Sul. In 1988, there were reported to be 5 bulls, 40 cows and 15 heifers between 2 and 3 years of age at Fazenda Nhu-mirim.

The production parameters determined for this herd can be seen in Table 6.

Table 6: Production parameters of Pantaneiro cattle.

Trait	Males	Females
Mature weight (kg)	375.0 ± 7.0	298.0 ± 41.0
Birth weight (kg)	22.0 ± 3.0	19.0 ± 3.0
Calving interval,(days)	-	404.0 ± 72.0
Calving rate (%)	-	70.0

Source: Mazza *et al.* (1987).

A trial was initiated in 1986 to compare the performance of zebu cattle with the Pantaneiro, and a herd of 40 Nellore cows on Fazenda Nhum-mirim is being recorded for this purpose. Data include birth weights, weaning weights, post-weaning gain, weight at parturition, and mortality and fertility rates.

4.2 Buffaloes

4.2.1 The Tipo Baio

EMBRAPA-CPATU (Agricultural Research Centre for the Humid Tropics) keeps a herd of Brown-Type buffaloes in the Experimental Station situated in the low Amazon area. The number of animals is very reduced in the Amazon Region, and the herd kept by EMBRAPA has 90 animals. Table 7 shows mean weights at birth and at weaning.

Table 7: Mean weights at birth and at weaning of “Tipo Baio” buffaloes.

Weight (kg)	Males	Females
Birth	34.1 ± 4.7	35.6 ± 2.3
Weaning	217.8 ± 22.4	193.8 ± 30.6

Source: Marcos *et al.* (1987a)

This breed is well adapted to the adverse conditions of the Amazon region. Adult mean weights are around 550 kg for females and 750 - 800 kg for males.

4.2.2 The Carabao

The first buffaloes brought to Brazil were the Carabao. They were brought to The Marajó Island by the end of 19th century. Indiscriminate crossbreedings have been reducing this population very quickly. For this reason, EMBRAPA-CPATU (Agricultural Research Centre for the Humid Tropics) decided to keep a herd which contains 110 animals, in the Experimental Station situated in the low Amazon area, preventing its extinction.

Some results of the evaluation of Carabao buffaloes can be seen in Table 8.

Table 8: Mean weights at birth and 12 months of age, and birth rate of Carabao buffaloes.

Trait	Males	Females
Weights (kg)		
birth	32.1 ± 4.4	31.5 ± 4.4
12 months	233.0 ± 14.6	222.2 ± 14.1
Birth rate (%)	-	96.8

Source: Marcos *et al.* (1987b)

Adult mean weights are slightly lighter than for Tipo Baio buffaloes: females weigh 480-500 kg while males weigh 700 kg.

4.3 Pigs

With the establishment of an industrial structure, based on well developed exotics and their crosses with “local” breeds, there has been a decrease in the number of pigs of “local” breeds and, consequently, an increase in the number of pigs of the high-yielding exotic breeds.

The smallholders raise animals of the “local” breeds in an extensive system, with low technology levels, but it is well known that, even though these animals present low production levels, their survival rate is extremely high.

EMBRAPA-CENARGEN has started a survey trying to identify nuclei of these “local” breeds, with the help of five other research institutions: EMBRAPA-CNPSA (National Research Center for Pigs and Poultry), UFP, UFSC and UFMG (Federal Universities of Parana”, Santa Catarina and Minas Gerais, respectively), IAPAR (Agricultural Research Institute of Parana).

Some of the already identified “local” breeds are the following: Piau, Moura, Caruncho, Pirapetinga, Nilo and Canastra. This survey has started just recently, and there are no available results about the production potential of these “local” breeds yet.

4.4 Goats and Sheep

4.4.1 Goats and Sheep of the Northeastern Region of Brazil

The conservation of the four “local” breeds of goats (Moxotó, Marota, Canindéand Repartida), and of the two “local” breeds of hairy-wool sheep (Santa Ines and Morada Nova) is being conducted in the Northeastern region of Brazil by EMBRAPA-CNPC (National Research Centre for Goats). The project is divided in many segments distributed among seven states of that Brazilian region, as can be seen in Table 9.

Table 9: Distribution of "local" breeds of goats and sheep in the conservation and evaluation programme, among the Northeastern states of Brazil.

Species	State	Breed	Institution
Goats	Alagoas	Marota	EPEAL
	Bahia	Repartida	EPABA
	Ceará	Canindé	EPACE
	Paraíba	Canindé	EMEPA
	Pernambuco	Moxotó	IPA
	Piauí	Marota	UEPAE-Teresina
	Rio Grande do Norte	Canindé	EMPARN
Sheep	Alagoas	Santa Ines	EPEAL
	Bahia	Morada Nova	EPABA
	Ceará	Morada Nova	EPACE, UFC
	Paraíba	Santa Ines	EMEPA
	Pernambuco	Morada Nova	IPA
	Piauí	Santa Ines	UEPAE-Teresina
	Rio Grande do Norte	Morada Nova	EMPARN

Source: Figueiredo *et al.* (1987b,c)

This programme is financed by the development bank of the Northeastern region, and the goals are to conserve and to multiply the breeds, and later, distribute animals to fanners. The researchers involved in this programme, however, do not believe that this *in situ* conservation will last long, since the breeders are much more interested in raising the exotic breeds. The cryopreservation is an urgent need and has just started. A small herd of Moxotógoats has been brought to CENARGEN, in Brasilia, where a cryopreservation programme (including storage of frozen semen and embryos), started in April 1989.

According to Figueiredo *et al.* (1987a), the four local breeds of goats can be described as follows:

<u>4.4.1.1 The Moxotó goat</u>

The Moxotóis the most readily identifyiable local type. It takes its name from the MoxotóValley in the state of Pernambuco. The animals are uniform in colour, size and type. The uniformity in colour is automatic since it is this trait that makes them recognizable or causes them to be unique. Their uniformity in size and type suggests that they are of similar genetic origin and tend to breed true. The animals are medium size relative to some of the smaller indigenous types and the larger exotics. Typical weights for mature females range from 30 to 40 kg. Their colour is light cream, almost white, with black points. Black is found as a stripe or line on the dorsal surface, on the underline and on points such as the feet, legs and face. Most are horned with males having relatively small horns. The ears tend to be medium size and erect.

<u>4.4.1.2 The Repartida goat</u>

The goat known as the Repartida appears to be similar in form and functions to that of the Moxotó. The term Repartida apparently refers to a unique colour pattern consisting of dark forequarters and points (face and legs) with a fawn or cream colour over the rest of the body. The reverse or reciprocal colour pattern, in which the rearquarters are dark, is almost as frequent. Most of the animals are horned with medium-sized erect ears. Body weights and reproductive rates approximate that of the Moxotóbreed.

4.4.1.3 The Canindégoat

The Canindéis also similar to the Moxotó and Repartida in size, form and function. In this case, the name apparently originates from or has a common origin to that of the city of the same name in the state of Ceará. As with the above types, the Canindéis distinguished largely by its colour. It is usually black with a yellow belly and a small amount of yellow or tan occasionally occurring on the face as eye stripes. The size is similar to the Moxotóand Repartida. It remains to be determined whether these animals are unique in production traits or whether they merely represent colour variation of animals with the same or similar genetic beckground. All of the above types have short fine hair and produce good quality leather. It is assumed that since they have evolved in the region, they are reasonably well adapted to local conditions.

4.4.1.4 The Marota goat

This breed is also known as Curaca, which is derived from a city of the same name in Bahia state. The Marota or Curaca is a solid white goat which appears to differ from the other native types. Some animals have longer, coarse hair. Perhaps this is indicative of genes of the Saanen and/or Angora which are thought to have been introduced into Brazil in earlier years. To the extent that these hypotheses are true, it might be assumed that they produce less desirable skins and are less well adapted to the local or tropical conditions. However, these points remain to be confirmed by more conclusive studies. Under controlled conditions, body weights, milk production and reproductive rates appear to equal or exceed that of the other native types.

The two most important woolless indigenous breeds of sheep in Brazil are the Morada Nova and the Santa Ines. The description of these two breeds were presented by Figueiredo (1981).

4.4.1.5 The Morada Nova Sheep

The name Morada Nova was given to the red variety by Prof. Octavio Domingues, during his visit to Northeast Brazil in June 1927, because he first saw them in Morada Nova county, state of CearáOther names which have been used are Deslanado do Nordeste (= Northeastern woolless), Deslanado vermelho (= Red woolless) and Deslanado branco (= White woolless). At a meeting held by the Ministry of Agriculture in Fortaleza, Cearáin October 1977, it was decided to use the name Morada Nova for both varieties, red and white.

According to Domingues (1954) the red, white and spotted hair sheep are descendant from the Bordaleiro of Portugal which came to Brazil at the time when these virgin areas were being populated. These Bordaleiro sheep are distinguished by their coat, which is a mixture of hair and wool. In the course of time, natural selection favoured the survival of woolless individuals with short, goat-like hair in the midst of others with longer, coarse hair and even with varying degrees of wooliness. The Morada Nova is very similar to the red African breed of Venezuela.

4.4.1.6 The Santa Ines Sheep

The Santa Ines breed results from the crossbreeding between the Morada Nova (red or white) and the Bergamasca breed of Italy. It inherits the roman nose, lop ears and traces of wool from the Bergamasca and its hair coat from the Morada Nova. The White Pele de Boi of Bahia was included with the Santa Ines breed (white variety). The Santa Ines may be red, pied, black or white.

4.4.2 *Criollo sheep of the Southern Region of Brazil*

Besides the two woolless indigenous breeds of sheep, Brazil has one hairy-wool breed of sheep that inhabits the Southern region: the Crioulo Lanado sheep.

4.4.2.1 The Crioulo Lanado Sheep

The hairy-wool Criollo Sheep from Rio Grande do Sul (the Southernmost state in Brazil) seems to have originated from the “Churra” Spanish sheep, brought by the first settlers to America. It is interesting to mention that similar animals can be found from Peru to Uruguay, which may indicate that they all have the same origin.

Even though this breed produces a very coarse and hairy - wool, considered of inferior quality, it is important to emphasize the superiority of the breed in precocity, fertility and resistance to internal parasites, if compared to more specialized breeds. These positive traits can be interpreted as adaptation of this breed to that environment.

The population of the Criollo sheep in Rio Grande do Sul has been decreasing very quickly, and today only 5 to 6 herds with 30-50 animals in each, can be found. EMBRAPA-CNPO (National Research Centre for Sheep) keeps a herd of Criollo sheep, where besides the *in situ* conservation, an evaluation programme is being conducted. Some information, collected by Vaz *et al.* (1987), can be found in Table 10.

Table 10: Production parameters of Crioulo Lanado sheep of Rio Grande do Sul - Brazil.

Trait	Mean value
Adult weight (kg)	34.40
Lamb birth weight (kg)	3.16
Lamb weaning weight (kg)	16.04
Weight gain (weaning till 1st shearing) (kg)	10.00
Greasy fleece weight (kg)	1.76
Staple length (cm)	22.50
Birth rate (%)	87.30
Weaning rate (%)	74.70
Mortality (to weaning) (%)	14.40

Source: Vaz *et al.*(1987)

4.5 Horses

4.5.1 *The Pantaneiro*

The Pantaneiro Criollo horse, that is descendant from animals introduced by the first settlers, of Portuguese origin, adapted to the swampy area of the Pantanal Matogrossense, has also been subject to indiscriminate crossing with other breeds, but to a much lesser degree than in the case of Criollo cattle. However, it has suffered considerable losses in recent years when equine infectious anaemia was introduced into the area. This breed has been playing an important role in the development of that region. No other breed can resist as well as the Pantaneiro horse the adverse conditions of the Pantanal, with its flooded grazing lands. Crossbreeding with Arab and Thoroughbred horses is a common management which is threatening this breed with extinction.

EMBRAPA-CPAP (Agricultural Research Centre for the Pantanal) owns a small herd of these horses at Fazenda Nhu-mirim, and has started a study of body measurements, and the ratios between them. The same Research Centre is undertaking a survey to identify the existing nuclei and the geographic distribution. In a second phase, blood tests will be made (blood typing and karyotypes).

4.5.2 The Lavradeiro

The Lavradeiro Criollo Horse, also known as the Wild Horse of Roraima, consisted of a population of about 1000 animals until 1982, but today they do not exceed 200 due to intensive hunting. The Lavradeiro horse constitutes the only horse population developed in conditions similar to those of the Cerrado (Savanna) of Central Brazil, and represents an extremely valuable potential genetic resource. The Cerrado is a region of about 180 million hectares with 39% of all cattle existing in Brazil and, for this reason, it is easy to imagine the importance that the Lavradeiro horse may represent to the beef cattle industry of that region.

Besides its adaptation to adverse climatic conditions, these animals survive under a very poor diet, and are possibly resistant to external and internal parasites (Beck and Martins, 1986). Even though it has great potential importance, the population of the Lavradeiro horse has been decreasing dramatically in recent years due to predatory hunting and to indiscriminate crossbreeding with horses of breeds which are exotic to that region.

EMBRAPA is trying to establish a nucleus of Lavradeiro horses in the state of Roraima, before it is too late.

4.6 Donkeys

4.6.1 Jumento Nordestino

The disappearance of the Northeastern Criollo donkey is imminent as well, and if this really happens, will cause a serious problem for the human population of that region, since they are accustomed to use the donkeys for transport, draft and field work. Azevedo *et al.* (1984) showed the seriousness of this subject: the population of these donkeys was around 2 700 000 in 1967, decreased to less than 700 000 in 1982, which corresponds to a reduction of 74% in 15 years. This decrease is mostly due to the slaughter by abatoirs that export the meat to Japan and to some European countries.

The North-eastern donkey is being conserved by EMBRAPA in cooperation with EMPARN (Rio Grande do Norte Agricultural Research Corporation) that keeps a herd in Terras Secas Experimental Station, in the state of Rio Grande do Norte.

5 Colombia

5.1 Cattle

5.1.1 The Romosinuano

The Romosinuano is a polled criollo breed found in the valley of the Sinu river, located in the Northern humid tropical coastal plains of Colombia, where the annual rainfall is about 1700 mm and the mean temperature is 27.5ºC.

This breed has been selected for beef production at the National Agricultural Investigation Centre, Turipana, and is very similar to the Brazilian Mocho Nacional.

The animals have a red coat colour and short hair, with a pigmented skin that may be either red or black. Two of its most valuable characteristics are tameness and high fertility (de Alba, 1987). Tick resistance and heat tolerance should be also mentioned.

Weights of Romosinuano cattle can be seen in Table 11.

Table 11: Weights of Romosinuano cattle.

Weights (kg)	Males	Females
Weaning		
210 days	170	156
240 days	220	190
18 Months	285	-
Mature	700	470

Source: de Alba (1987)

A Breed Association was formed in 1976 with interested breeders increasing every year.

5.1.2 The San Martinero

The San Martinero is found in the Llanos of Colombia (Eastern lowlands), a zone with a mean annual temperature and rainfall of 23-25ºC and 3000-3500 mm, respectively. According to de Alba (1987), some Durham bulls were imported into the area about 100 years ago, but perished very quickly. A few offsprings survived, from which the San Martinero evolved. They have a good record on poor soils and long drought periods, reaching heavier weight for age than zebus or common Llanero cattle under harsh conditions.

The animals present longer hair than the Romosinuano and the coat colour is not exclusively red, but dun and black marks are common. They are taller than other cattle of the Llanos, but horns and ears are similar to other Colombian criollo cattle.

The San Martinero is a beef breed and is very much used in crossing with zebu cattle. Results of crossbreedings with Zebu and Charolais bulls were shown by Gonzalez (1976) (Table 12).

Table 12: Crossbreeding San Martinero dams with Zebu and Charolais bulls for beef production (weights, kg).

Genetic group	Birth weight	Weaning weight	18-month weight
San Martinero	29	175	222
Zebu	26	179	224
F_1 with Zebu	33	195	213
F_1 with Charolais	30	213	260

Source: Gonzalez (1976), cited by Wilkins (1984)

5.1.3 The Costeno con Cuernos

The Costeno con Cuernos is another criollo breed of Colombia and is found in the coastal plains of the Northern region of that country.

A government herd is maintained on 400 hectares in a Station located in Cerete, Cordoba, where the mean annual temperature and rainfall are 27.5ºC and 1235 mm, respectively.

This dairy breed has suffered the consequences of conservation schemes followed with few input ideas, and is almost extinct. According to de Alba (1987) it is estimated that in all Colombia only about 571 individuals remain, and the area surrounding the experiment station is wholly interested in beef. As its name implies, this breed is horned with lyre shaped horns. It is a dairy breed with red coat colour. Average weights are 700 kg for bulls and 500 kg for cows.

Even though the Costeno con cuernos is considered as a dairy breed, the cows present a milk let-down problem as shown by Rubio (1976) in Table 13.

Table 13: Milk Production of Costeno con Cuernos cattle.

	Cows milked w/calf at foot	Cows milked without calf at foot
No. of lactations	376	789
Mean lactation lenght (days)	266 ± 42	96 ± 26
Mean lactation yield (kg)	996 ± 154	296 ± 4

Source: Rubio (1976).

5.1.4 *The Blanco Orejinegro*

The Blanco Orejinegro of Colombia is found in the slopes of the Andes, a region with a mild climate, with mean temperature ranging from 18ºC to 24ºC and a mean annual rainfall of 1800 mm.

Describing this breed, de Alba (1987) stated that its producing ability is lower than many of the better types of criollos yet it deserves very serious considerations for its resistance and, in some individuals, total immunity to attacks of external parasites *(Dermatobia hominis).*

The animals have a white coat colour with black ears and muzzle. They possess a very thick hide which may be responsible for their resistance to external parasites. Weights of Blanco Orejinegro and crossbreds are shown in Table 14.

Table 14: Weights of Blanco Orejinegro (BON) and crossbreds in Colombia.

	Birth weight (kg)		Weaning weight [1] per day of age (kg)	
Genetic group	Males	Females	Males	Females
Pure BON	28	2	0.78	0.56
F_1 with Zebu	36	32	0.83	0.80
F_1 with Charolais	33	31	0.85	0.77

[1] weaning occurred at 270 days

Source: Rodrigez et al (1971)

A government herd is maintained at the El Nu Station, Antioquia, where it is also used in crossbreeding with Jersey and Holstein breeds. There is a Breed Association that recognized about 3080 head as pure Blanco Orejinegros (de Alba, 1987).

5.2 Sheep

5.2.1 *The Colombian Criollo*

The criollo sheep accounts for 70% of the Colombian population of sheep. Very similar to the Spanish Churra sheep, the Colombian criollo present an adult mean weight of 38 kg (Mason, 1981). The wool is utilized in the home textile industry.

5.2.2 *The Colombian African*

The Colombian African sheep are thought to have been imported during the slave trade period, in the 17th and 18th centuries, from the Western coast of Africa. Even though they are often called criollo, the animals of this breed have a completely different origin from the wool sheep. They may present two different colour varieties: yellow and dark red-to black. Age at first calving is 15-19 months, while the mean calving interval is about 8 months.

6. Uruguay

6.1 Cattle

6.1.1 The Uruguayan Criollo

Presently, Uruguay has just one herd of Criollo cattle, which is maintained by the Uruguayan Army close to the border with Brazil. No evaluation is being made, and it seems that the government is not interested in their preservation.

6.2 Sheep

6.2.1 The Uruguayan Criollo sheep

Very similar to the criollo sheep found in the Southern region of Brazil, the Uruguayan criollo sheep have a unique characteristic: the males have four horns, two being vertical and the other two curled.

The wool industry in Uruguay is very important and well known worldwide for its quality. The improvement of the Uruguayan herd was directly proportional to the importation of animals of exotic breeds, and to the decrease in numbers of the criollo sheep, which have long, thick and low quality wool. Like the Brazilian criollo lanado sheep, the Uruguayan is highly resistant to internal parasites, and have high fertility rates.

7. Venezuela

7. Cattle

7.1.1 The Limonero or Venezuelan Milking Criollo

According to Wilkins (1984), the two important herds of criollo cattle in Venezuela have the same origin, although one herd is selected for dairy characteristics and the other for beef. Both herds were formed from the criollo herd that was founded at Maracay in 1954. The Maracay herd was formed from purchases made in Venezuela, Costa Rica and Nicaragua, and therefore was partially related to the Turrialba herd in Costa Rica.

A group of cattle with undesirable dairy characteristics was transferred from Maracay to Calabozo in the Central plains of Venezuela in 1966 in order to form a beef herd to use in crossbreeding studies with zebu and European breeds.

The foundation animals came from an area near the Limon river, which gave its name to the breed. The mean annual rainfall and temperature of that region are 920 mm and 27.4ºC, respectively.

Similar to most of the criollo breeds, Limonero is red in colour, with pigmented skin and short hair. The cows can be milked in the absence of the calf, and the mean lactation yield is about 1800 kg (Abreu *et al*, 1976; Muñoz and Deaton, 1981).

A 200 cow herd is being kept at the Carrasquero Station, a centre for artificial insemination and livestock recording programme for 10 neighboring farms with 3000 adult criollo females.

8. Other South-American Countries

8.1 Cattle

Ecuador and Peru have mountain ecotypes of criollo cattle in the Sierra region. The animals are long haired and of smaller size than most of lowland criollos. No research, conservation or improvement are believed to be underway in Peru, while in Ecuador there is a 200 cow herd being maintained on the Tropical Agricultural Experimental Station of Pichilingue, Quevedo.

In Paraguay, the Criollo Chaqueño has been "improved" through crossbreedings with British breeds like Shorthorn, Sussex, Hereford and Devon, and today it is difficult to find pure criollo herds.

The situation in Chile is even worse. It is believed that no pure criollos can be found anymore.

9. Conclusions

In South America, most of the species and/or breeds of the criollo type have disappeared or are in danger of extinction. Until recently, there was almost no interest in their conservation. It seems that, finally, there is a sign of awareness of many South American countries in terms of recognition of the importance of the conservation of animal genetic resources.

The quick substitution of the "local" breeds by the exotic ones, less adapted, has just recently awakened the consciousness of many breeders and researchers that do not want to witness their complete disappearance.

Fortunately, in 1987, the Food and Agriculture Organization of the United Nations (FAO) decided to create seven Regional Animal Gene Banks in the developing countries, two in South America (Argentina and Brazil), and the other five in: Mexico (for Central America and the Caribbean), India, China, Ethiopia and Senegal. Looking for a place to establish the Gene Bank in Brazil, FAO decided to indicate EMBRAPA/CENARGEN, located in Brasilia, due to the work this Centre has already done in this area. It is expected that this Gene Bank will open at the beginning of 1990, receiving semen and embryos from all over the continent, with a duplicate being sent to INTA-Argentina, for safety reasons. With simultaneous efforts by FAO, EMBRAPA and INTA, the chances of organizing a strong Regional Animal Gene Bank for South America are much greater, and consequently the chances of preserving many of the endangered breeds of our continent are also increased.

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ENDANGERED LIVESTOCK BREEDS IN LATIN AMERICA

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1. Introduction

When we talk about "livestock breeds" we really mean "adapted population" to a given environment. In the present context we have to differentiate between those which originated in America and those which originated elsewhere.

Adapted populations of animals were endangered since man hunted or managed them, particularly during this century. Human population has increased so much that in many areas of Latin America not only adapted livestock populations have disappeared, but also wild animal species have become extinct and many others are in real danger of disappearing in the next decades. Some of these species could be domesticated and have important roles in the support of human needs. FAO could not tackle the problem of wild species but there is a need for their preservation and therefore it is necessary to consider them.

This paper is devoted mainly to cattle. However, sheep, goats, poultry and swine, among the introduced species, and camelidae, guinea pigs and capybaras, among the native ones, could be subject to the same considerations.

2. The evolution of cattle conservation

In Latin America, the first reports about the adapted "breeds" were made in the early 1950s. The Venezuelan and Colombian breeds were the first to be described; publications concerning their characteristics are available from 1952 onwards. In general, the populations found in the northern part of South America (Colombia and Venezuela) could be distinguished as breeds. They have phenotypic characteristics that could make them easily differentiable; such is the case of "Blanco Orejinegro", "Sanmartinero", "Romosinuano", "Caracu" (Brazil), etc. In these cases, the colour coat and the presence of horns make these populations look uniform and therefore they may be classified as breeds. There are other populations like the ones in Bolivia and Argentina, which are well adapted to certain environments, but they do not have a uniform colour pattern or a uniform shape and size of horns. However, one could find groups of individuals with similar phenotypic characteristics that belong to different populations; this might be a good point for discussion because some people think they are equally adapted to quite a different environment. The populations were subjected to "improvement" for almost a century with specialized beef or dairy breeds which after three or four generations, showed a pure adaptation. The introduction of highly productive breeds looked promising in the first two or three generations due to heterotic effects. There were scientists in Latin America, like Dr J. de Alba, to name only one, who realized the value of adapted populations in the early 1950s and who started a very important line of thought towards preserving these populations. Several efforts were made in different countries, in official institutions and by private ranchers, in order to preserve the cattle that were endangered. In order to mention some of them, we have to recognize the work of CATIE in Turrialba, Costa Rica; The Agricultural Colombian Institute (ICA), in Colombia; The International Centre for Tropical Agriculture (CIAT), with the support of the

British Government, in Santa Cruz, Bolivia; and the National Institute for Agricultural Technology (INTA), in Argentina.

FAO realized the importance of such efforts and organized, in cooperation with PNUMA, an expert consultation for Latin America in November 1978 in Bogota, Colombia. The papers and conclusions presented at the meeting were published by FAO in 1981. A similar meeting took place, thanks to the efforts of FAO, in different regions of the world and, finally, in 1980, FAO held a technical consultation in Rome on Animal Genetic Resources Conservation and Management. As a result, the programme on germplasm animal conservation started very successfully. This showed a good response by individual countries but, more important, a good conservation scheme was started and, hopefully, gene banks for animals will be established in the near future. These efforts, with the help of FAO, will materialize in gene banks at regional level with duplications that will assure the preservation of these populations.

Simultaneously, the maintenance of adapted populations was increased and some countries, like Brazil, started a strong programme to detect and save groups that were almost extinct. It can be concluded that the efforts made so far have been successful in order to save these populations.

3. Today's management towards improvement

A series of projects were started in order to compare the performance of the Criollo breed with crossbred as well as other purebred populations. In most cases the “purebred Criollo” had a similar performance to some crossbreds resulting from a combination of introduced breeds and yet better than the newly introduced breeds. These comparisons were made under extensive conditions, subject to environmental stress due to either nutritional restrictions, unfavourable climatic conditions and/or the presence of parasitic or organic diseases.

In general, the Criollos had a better reproductive performance and a similar or slightly worse productive performance. The final outcome, when reproductive and production traits are combined, show, in general, that the native (adapted) populations did better. Due to these results, there are people in several places trying to “improve” the adapted population and increase their productivity. There are many examples in modern animal breeding showing that what at a given time was considered an improvement had later to be admitted as a deterioration. Therefore, there is a need for a careful definition of selection goals for the adapted populations.

Unfortunately, with cattle when mistakes are made, it is generally too late to go back to the original situation. It is also true that introducing permanent changes through selection takes a long time and, therefore, precautions should be taken to accumulate evidence indicating whether a wrong direction was taken before it is too late to recover the original population. Selection for higher production might be one of the dangers facing the Criollo population because they might lose adaptability. We might say that under stress conditions those that reproduce best will be the ones that produce the least and *vice-versa.* Therefore, natural selection has favoured those individuals with limited production capability. If we think of milk production for instance, Criollo cows do have a well-shaped udder of an intermediate to small size. Milk production is not high. Probably high enough to assure a good start for the calf's survival and moderate growth but not too high to prevent the next heat whilst milking. This is a good mechanism to adapt the population to poor environment.

When people try to increase milk production or growth rate through selection of adapted populations, it might lead to a loss of capability for adaptation.

We may be entering a new era. Until now it was necessary to convince producers and administrators that those poor-looking animals were the best for those production systems where they reproduced freely and certainly that they had become adapted throughout four centuries of natural selection. We might be faced now with the problem that because this was a convincing argument, the attempt now is not only to try to utilize the adapted populations but to go a step further making the animals “better”. However, the final outcome might be worse without having that intention. Once again, man can be a menace for the adapted populations. But given this opportunity, with the aim of keeping and making livestock more profitable, there is the possibility that the breeds are not endangered any more numerically, but are harmed in other ways.

There is another situation that could well be harmful to the well-adapted populations. This can occur where human intervention not only is trying to change the mean performance, as in the previous case, but is also changing the variability by introducing non-additive genetic effects (again perhaps without any intention to do so).

There are several examples in which managers of Criollo populations are trying to interchange bulls or semen in order to decrease inbreeding. In the cases where Criollos have well-defined coat colour (like the ones mentioned above), there should not be any problem. Nobody would propose using bulls or semen from Romosinuano in a Blanco-Orejinegro population; but this is not the case for undefined coat colour breeds. As a matter of fact, in these cases there is no variability in colour, and general patterns are fairly similar so that people could think that the population is the same. However, under that assumption they are making “crosses” and the result is the appearance of some degree of heterosis.

We have examples where semen from Romosinuanos in local populations was utilized in Argentina. There is another case where a “composite” population of cows was bred to bulls from Costa Rica, Cuba, Colombia and Brazil. In both cases, the cross produced better growing calves and good heifers, but this may be the product of hybrid vigour. Although there is no direct evidence, it is possible that if these populations have been isolated for three or four centuries (particularly in environments with different characteristics) the level of heterosis when crossed with these populations might be even higher than when breeds from Great Britain are crossed. In the latter case, the literature shows levels of heterosis for some traits of 3-5%: these breeds were isolated not as long as the Criollos and developed in similar environments. Therefore, we might suspect the presence of hybrid vigour when Criollo populations are combined. Consequently, the selection of bulls and heifers might be masked by non-additive genetic effects. There is no danger with this from the point of view of adaptability but there could be disappointment when the degree of segregation increases in the following generations, and it could work against the adapted populations or the Criollo breeds. It seems clear that there is a real need for the immediate preservation of all these populations because their management is likely to decrease their adaptability. Therefore, it is important to recommend to FAO the implementation of its gene banks at regional level as soon as possible.

Once implemented, it would be possible to use the population in as many experiments or situations as necessary and still retain the possibility of going back to a starting point whenever needed.

ENDANGERED BREEDS OF SHEEP

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1. Introduction

The loss of genetic variability is a common feature among breeds of farm animals. In an evolutionary time scale, this loss was usually balanced by the acquisition of new mutations, but during the last few decades, the phenomenon of loss of variability has been greatly accelerated without the opportunity of being balanced by an increase in the generation of new variability.

The main causes of genetic loss are external (for example disappearance of the sheep industry) or internal (for example, the replacement of a traditional breed with a more selected one). Therefore since the end of the 1960s, a series of national and international agencies, especially FAO, have been struggling to preserve a level of genetic variability suitable for future needs in the creation of strains well adapted to the various systems of breeding (FAO and UNEP, 1976, 1984a, b; FAO, 1981; Hodges, 1987).

In sheep, the situation of endangering varies according to the type of the resource. These resources have been classified by Mason (1951, 1957, 1969) followed by Lauvergne (1982, 1987a) into traditional populations, standardized breeds (simple or synthetic) and selected lines.

The endangered situation in each type of population will be now examined and then solutions will be suggested according to the type of the resource.

2. How to identify endangered genetic stocks

2.1 Traditional populations

The traditional populations are those derived from the first steps of breeding after domestication, with breeders acting by decreasing the pressure of natural selection and by offering new mating opportunities to the reproducers without exerting a strong pressure of artificial, directed selection.

In this situation a number of mutations which would have been eliminated in the wild state are kept. It results in a high genetic variability seen particularly in coat colour, but also observed in horn shape, fleece architecture and other visible traits.

The populations of sheep which appeared in the Middle East at and near the place of domestication spread everywhere in the Old World (Europe, Africa and Asia) (Lauvergne, 1979a, b). An early internal loss of genetic originality (Lauvergne, Renien and Audiot, 1987) in the Middle East arose when man discovered that sheep could produce wool - fine unmedulated fibres with continuous growth, suitable for producing fabrics of high quality. This has resulted in a marginalisation of the traditional populations of sheep when subsequent waves of migration of at least partially standardized breeds (woolly and white) were made from the Middle East centre of differentiation.

Therefore, the pure traditional populations may be found as relics in isolated areas, such as islands (North Atlantic islands, Corsica) or in zones isolated by climate and/or relief or distance, for example Turkish coast of the Black Sea, south coast of the Caspian Sea.

The identification of traditional populations is complicated because observations are made of variable external aspects of individuals. This means that the description is only a “genetic profile” which gives frequencies of the various phenotypes, genotypes and/or alleles. Genetic profiling gives a description which allows comparison between traditional populations and may help in measuring genetic erosion.

A method of visible genetic profiling suggested by the work of Löfvenberg and Johansson (1952), Berge (1958), Adalsteinsson (1970), Lauvergne and Adalsteinsson (1976) and Adalsteinsson and Wardum (1978) has been proposed by Lauvergne (1988a) for a survey in the Mediterranean (Lauvergne, 1988b) and has been applied to the following stocks which could be considered as close to traditional populations: Ushant (France: Abbéand Benadjaoud, 1988), Karakachan (Bulgaria: Alexieva ef al., 1988), Icelandic (Iceland: Adalsteinsson, 1988), Corsican (France: Franceschi and Vallerand, 1988) and Landes (France: Benadjaoud, 1988).

These analyses allow a reconstitution of the profiles of the early traditional populations which stocked Western Europe and allow measurement of the degree of genetic erosion of most of the remaining stocks, especially those on the continent.

In places where visible genetic profiling has not been performed it is difficult to identify the traditional populations and therefore to measure the degree of erosion.

2.2 Standardized breeds

The standardized breeds are derived from traditional populations after breeders have chosen given standards of size, head profile and other visible traits.

In the sheep, the process of standardization is rather ancient and was initiated to produce woolly fleeces, preferably white. It probably traces back at least to the Persian Empire (Laurans, 1977). The first stage was evidently a stage of proto-standardization, with an incomplete standardisation of the appearance and without a given written status, flock-book and registration system.

The change towards a modern standardization of sheep breeds is also old and exemplified by the Merino of the King of Spain (Laguna Sanz, 1986). However, a great increase in the number of modern standardized breeds took place in England at the end of the 18th century and these spread to continental Europe, the Americas, South Africa, Central Asia (with the Karakul), Australia and New Zealand and other places.

Lists and catalogues of standardized breeds are made and continuously updated in most sheep-breeding countries. Surveys according to geographical zone have been made (see for example Mason, 1967, for the Mediterranean). World surveys were made by Ryder and Stephenson (1968), Terrill (1970) and Mason (1951, supplemented in 1957, revised in 1969 and 1988). Mason indicated clearly those breeds which may be considered as standardized.

We have seen that the genetic erosion of traditional populations started with the creation of standardized breeds in the Middle East which have spread, with the Middle East acting as a diffusion centre. Mason (1967), among others, pointed out that this makes the study of sheep genetic resources especially complex.

Establishing a scenario of stocking in the past for each country or zone provides some help in solving the problem of mapping the endangered standardized breeds. Such a method was proposed by Lauvergne (1988a) at the Mediterranean symposium of 1986 (Lauvergne, 1988b) and has been applied to Italy (Rubino and Renieri, 1988), France (Bougler *et al.*, 1988) and the Mediterranean (Muzzolini, 1988).

The standardized breeds are unequally organized into breed societies. Different societies put more or less emphasis on selection, improvement and promotion. Several factions have developed in sheep breeding including those emphasizing multiple purpose, wool, milk or meat traits. This results in sometimes tremendous genetic erosion among standardized breeds.

The last stage of standardized breeds is the creation of synthetic breeds by crossing several established breeds and selecting for various traits. These new breeds are intermediate between standardized breeds and selected lines. They are usually not endangered.

2.3 Selected lines

Selected lines represent the latest achievement of selection under the control of man for increasing productivity in the various modern breeding systems. Usually they start from a standardized or synthetic breed and are now widely found in poultry and pig breeding, though not yet to any large extent in sheep. These stocks are not endangered.

3. Sugestions to protect sheep genetic resources

3.1 Traditional populations

3.1.1 Location and identification

As suggested here, there is a large deficiency in the identification of traditional sheep populations. Therefore, intially, the remaining stocks must be identified and described. Using visible genetic profiles would appear to be very practical for this purpose.

3.1.2 Conservation

Having identified the type, size and location of the nuclei of traditional populations, their conservation may require different approaches. If the stock is in immediate danger, an emergency rescue may be necessary. If there is less urgency, the following suggestions are made to attempt to maintain the genetic variability:

(a) keep, without distortion and as long as possible, the breeding system in which the stock is used (provided it does not itself produce loss of genetic diversity, e.g. deliberate, close inbreeding);

(b) organise a network of demonstration farms, inside the network of national and regional natural parks, in which the traditional flocks can be kept more or less with the same breeding patterns as those traditionally used;

(c) use the network of agricultural schools and research institutions locally or internationally to create a series of conservation flocks.

3.2 Standardized breeds

It is necessary to classify and compare these stocks in order to avoid having different names for essentially the same stock and to measure the degree of genetic erosion which stocks have undergone.

3.2.1 Classification of standardized breeds

Several methods of classification have been proposed. Lauvergne (1987a) proposed a method to be used within a country with criteria such as the degree of complexity, degree of exoticism and the degree of genealogic control. In the future these classifications will be made using modern methods of measuring the genetic distance between breeds. Vienne and Damerval (1985) have reviewed these methods which trace back to the 1960s.

Benadjaoud (1987) compared a series of autochtonous French standardized breeds. One approach used was to combine several observations of archaism for size, tail length, ear length and nose profile in an index of archaism, plotted according to a factorial analysis of correspondence. Another more classical approach consists of using gene frequencies and biometrical measurements (Nei, 1972, or Rogers, 1972).

The clusters of points representing different breeds plotted on a three-dimensional diagram allow rapid distinction between families of breeds. This provides a much more objective approach to classification of standardized breeds and therefore a better basis for conceiving conservation programmes.

3.2.2 Updating inventories

A prerequisite of conservation is the continuous updating of the inventory using all types of available genetic information. This is the purpose of an EAAP project (Maijala *et al.*, 1983) and a FAO project (FAO, 1986a, b) which are now a common EAAP/FAO project with a computerized data bank in Hanover (Simon, 1989).

Lauvergne (1987b) made inventories of sheep and goat populations in France using a simplified version of the EAAP questionnaire used in France by Bougler (1985). This version provides a new list of breeds with a new classification of these breeds and provides a new set of genetic information, such as a coat colour genetic formula. In the future, the family - as defined by the analyses of genetic distance - to which every breed belongs, will be mentioned.

A similar approach could use a standardized summary of the data for each country stored in the central computer of the EAAP/FAO programme quoted above and with periodical publication.

3.2.3 Conservation

(a) *Using breeders societies:* The practical protection of standardized breeds rests on the will of breeders to keep them. This will is sustained by their economic interest.

(b) *Using the network of national and regional, natural parks:* As for the traditional populations, this means of conservation is based on the dual needs of keeping livestock corresponding with the system of breeding previously used along with showing the type(s) of agriculture the natural park is supposed to exhibit. Some units of this type are *the Living Historical Farms* network of operating displays of ancient agriculture and breeding in the USA, or the network of “demonstration farms” of the Rare Breeds Survival Trust in Great Britain.

(c) *Using the schools of agriculture and research institutions:* This method is precarious because the funds of keeping breeds are subject to budget reductions. A good example of continuous genetic conservation over a 200 year period is that of the Merino flock at the National Sheep Fold of Rambouillet, France. Research institutions often prefer to use experimental flocks of particular genetic type.

(d) *Developing appropriate breeding systems which allow conservation of genetic resources:* A good example of this is the use of small ruminants in extensive systems in specialized situations. For example, sheep can be used to keep an open landscape in the Atlantic zone where intensive agriculture is not allowed or in clearing fuel breaks where forest fires are a problem. In these situations one can use old breeds which have no use in intensive breeding systems.

(e) *Other approaches:* One can also use the facilities of frozen semen and/or embryo banks. This means of preservation has been proposed (FAO and UNEP, 1984b) but has not been well developed. It may be important in the future, but requires precise identification and description of the resources. It also requires a network of facilities to provide the specimens which will be needed.

Another possibility for preservation of genetic traits is to use marker lines, as suggested earlier. One can produce a marker line for one given gene, for a given set of genes or for several alleles in segregation. A series of such lines will only be possible if the identification of mendelian factors in sheep is improved and a standardized nomenclature is set up. The work done by the COGNOSAG will help in this way (COGNOSAG, 1988, 1989).

3.3 Selected lines

These do not require special attention for their preservation at the present time.

4. Conclusions

A short paper such as this can provide only an overview. It will have fulfilled its purpose if it encourages acceptance of new concepts which are simple improvements on previous approaches used by authors studying genetic resources of farm animals.

A new notion to be emphasised is the need for a more precise classification using more and more quantified criteria for comparing stocks within the traditional populations and the standardized breeds. These two groups contain the majority of the endangered stocks.

A new set of methods allowing measurement of the degree of genetic erosion has been tested in continental Europe and in the Mediterranean with the help of scientists of various research institutes (National Institute of Agronomic Research, France; Institute of Animal Production, faculty of Veterinary Medicine, Perugia, Italy; Institute for Zootechny and Cheese of Sassari, Sardinia, Italy; and others) and the support of agencies such as the EEC with its AGRIMED programme (a programme for developing agriculture in the Mediterranean), EAAP, FAO, PHILOETIOS network and CHIEAM/ICAMAS.

It is hoped that in the future it will be possible to develop this research in cooperation with the above-quoted institutions and agencies in order to better identify and keep the still largely unknown genetic variability in sheep.

Abbreviations

AGRIMED	Agriculture in the Mediterranean (a development programme of the EEC in the Mediterranean)
CHIEAM/ICAMAS	International Centre for Advanced Mediterranean Agronomic Studies
COGNOSAG	Committee on Genetic Nomenclature of Sheep and Goats
EAAP	European Association for Animal Production
EEC	European Economic Community
FAO	Food and Agriculture Organization
PHILOETIOS	Research network sponsored by CHIEAM, EAAP, EEC and FAO
UNEP	United Nations Environment Programme

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ENDANGERED BREEDS OF POULTRY AND DUCKS

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1. Introduction

Poultry and ducks are two of the most important commodities among ‘other’ livestock in Indonesia and South-east Asian countries. The native chicken and ducks have been raised for centuries either for meat or egg consumption. To fulfil the increasing demand of poultry and duck meat and eggs, the government has introduced the “Bimas” (“Mass Guidance”) program to promote the production of poultry and duck meat and eggs. To support the success of the program, there has been a tremendous increase of importation of improved breeds of poultry and ducks, either as Great-grand parent stock, Grand parent stock, Parent stock or Final stock. Consequently the development program for native chickens and ducks have been somewhat neglected and forgotten for some time. The government has introduced the intensification program for native chicken and ducks which is called “INTAB” and “INTIK” (native chicken and ducks intensification) only very recently which indicates, after some years of experience, that the farmers who raise the imported breeds of poultry and ducks do not always make a profit.

Most of the farmers with small capital resources are now returning to raise native chickens or ducks. However some breeds of native chicken and duck now have “endangered” status and some of them have even become extinct. The aim of the present paper is to discuss the status, the strategy and efforts to preserve the genetic resources of endangered breeds of native chicken and duck, with particular reference to Indonesia.

2. Chicken and duck population in South-east Asia and Indonesia

The chicken and duck population in Asian countries is shown in Table 1. The population of chickens increased by about 17.1% in Indonesia, 1.8% in Malaysia and 1.3% in Thailand, but decreased in the Philippines by 14.5% and by 35.7% in Singapore and remained steady in Brunei Darussalam.

Table 1: Chicken and duck population in Asian countries ('000 head).

	Indonesia		Malaysia		Philippines		Singapore		Thailand		Brunei Darussalam	
Year	Chicken	Duck	Chicken	Duck	Chicken	Duck	Chicken	Duck	Chicken	Duck	Chicken	Duck
1983	177 167	25 436	55 000	-	62 000	5 000	14 000	1000	78 000	14 000	-	-
1984	196 373	24 693	55 000	-	59 000	6 000	12 000	1000	78 000	19 000	2	-
1985	187 502	23 870	55 000	-	52 000	5 000	10 000	1000	79 000	19 000	2	-
1986	201 677	27 002	56 000	-	53 000	5 000	9 000	1000	79 000	29 000	2	-
1987	207 551	28 278	-	-	-	-	-	-	-	-	-	-

Source: FAO Bulletin of Statistic (1986)

The duck population increased by about 11.2% in Indonesia and 42.8% in Thailand, but remained steady in the Philippnes and Singapore.

However, the population data from Indonesia (Table 2) indicates an increase of improved (imported) chicken numbers of about 37.7% in layer and 44.8% in broiler as compared to only 2.2% in native chickens and 13.5% in native ducks.

Table 2: Poultry population in Indonesia ('000 head).

Year	Native chicken	Layer	Duck	Broiler[1]
1983	159 462.5	28 102.1	23 781.4	-
1984	166 814.9	29 559.3	24 693.6	13 261.1
1985	155 628.8	31 784.9	23 870.5	13 018.1
1986	165 575.7	38 687.8	25 008.9	14 301.4
1987	162 990.9	38 687.8	27 002.0	19 195.6

[1]Population in one month
Source: Anonymous (1988)

2.1 Constraints

In contrast to developed countries, most animals in developing countries are kept in traditional ways. Each farmer has only 2 to 50 native chickens which get most of their feeds from rubbish and waste near the house, in the garden, along the streets, gutters, and rice fields. They are sometimes fed low quality feeds such as rice bran, broken rice, coconut meal and various other by-products. Thus the native chicken is usually called the “scavenging” bird. Ducks are usually taken to the rice fields in the morning to get their feed during the harvesting season and taken home in the afternoon. Each farmer has about 10 to 50 native ducks.

The farmers keep animals mainly for cash income, savings, or as a hobby, and have little knowledge of animal husbandry due to lack of education and commitment. Less than 20% of the animals are raised for commercial purposes. Fanners have very little capital which makes it difficult to buy feed concentrates.

Livestock generally use only 5% of farm capital and contribute relatively little to gross farm income (Sabrani *et al.*, 1982). The average farm size is about 0.6 Ha in Java and 1.5 Ha in the outer islands, averaging 0.98 Ha for all of Indonesia, and continous to decline with time (Hill, 1973; de Vries, 1972). Even worse, livestock owners are not always land owners. Basuno (1983) found that in a village in West Java up to 40% of livestock owners were landless.

With the contraints mentioned, should farmers totally switch to intensive poultry and duck production to meet the demand for meat and egg consumption? If this system is going to be adopted, are we ready with the high input, high cost technology required to continously supply imported breeds, concentrates and vaccines? We have a good experience and lesson from the poultry industry which has been very popular for the last 10 years. The poultry industry has produced profit and income for the farmers for some years, but now the poultry farmers complain of the very expensive imported ingredients used in concentrates such as maize, soybean meal, and fish meal. Price of poultry products such as broiler meat and eggs has also fluctuated during the year making the business unattractive to farmers. The strategy for improving animal production and increasing the income of the farmers has been discussed by Gunawan (1988b).

3. Breeds of native chicken, ducks and production characteristics

In contrast to imported chickens which produce 250–300 eggs per year for layers and achieve 2 kg body weight at 8 weeks for broilers, native chickens generally produce less than 150 eggs per year and achieve 1 kg at 20 weeks of age. Supraptini and Harimurti (1977) reported that the egg production was 163 eggs per year under intensive management condition. Hardjosworo and Tuttle (1977) reported that the production was between 55–78 eggs per year, whereas Wattimena *et al.* (1974) reported the production between 30–40 eggs per year under village condition. The average live body weight was 454 g, 1027 g and 1525 g at 10, 20 and 30 weeks, respectively, under village condition. Egg production averaged 72 eggs per year. A very high mortality up to 68.5% was recorded in 5 villages in West Java and occured between 0 to 6 weeks of age (Kingston, 1979). Under intensive management condition, an average body weight of 1718 g was achieved at 20 weeks of age. Similarly Wihandoyo and Mulyadi (1986) reported an increase of body weight and egg production of native chickens and a reduction of mortality to less than 10% under intensive management condition.

The domesticated native chicken *(Gallus domesticus)* originated from jungle fowl in Southeast Asia (Thomann, 1978). There are some morphological differences between strains within and between regions in Indonesia.

Five distinct groups of native chicken have been identified as the Black Kedu, White Kedu, Pelung, Nunukan and Sayur. The description is as follows. The “Black Kedu” originated from Kedu area in Central Java. They have black colour for feathers, beaks, eyes, shank and toes with black or red single comb. The current population is about 5000 birds. The morphology of “White Kedu” is similar to White Leghorn. The feathers, beak, shank and toes are white with red single comb. The population is nearly extinct. Both Black and White Kedu are good layers.

The native “Pelung” originated from Cianjur, West Java and has been raised as a hobby since 1930. The size is bigger than the Kedu chicken with a very long shank. The combination of colours vary from red, white and black, yellow, black, red and white to black, grey, red and yellow. The price of the cockerel is very high as it could produce a long and beautiful crow. The population is less than 5000 birds.

The “Nunukan” originated from Tarakan Island in East Kalimantan. The size is smaller than the Black Kedu with short shanks and a slow feathering. The feather colour is uniformly brown and red, with yellow beak, skin and shank and red single comb. The population is about 3000 birds.

The “Sayur” is the most cosmopolitan among these four strains and scattered over all regions. The population is the highest among these - the current population could possibly exceed 100 million birds. They have large variation in colour, morphology and production characteristics.

The growth rate and egg production of the 5 distinct groups is shown in Tables 3 and 4. The growth rate of the “Pelung” is the highest, followed by Black Kedu, Sayur, White Kedu and Nunukan. The Black Kedu has the highest egg production, followed by White Kedu, Pelung, Nunukan and Sayur.

Table 3: Body weight of native chicken (Sayur type) and their crosses with imported breeds.

Breeds/ crossbreds	Age (weeks)	Body weight (g)	Body weight gain (%)
Sayur × Sayur[1]	10	552	-
Sayur × Rhode Island Red[1]	10	737	33
Sayur × Sayur[2]	12	751	
Sayur × White Leghorn[2]	12	871	16
Sayur × Sayur[3]	12	713	-
Sayur × Black Kedu[3]	12	975	11
Sayur × Sayur[4]	8	560	-
Sayur × Broiler[4]	8	1016	81

Source: 1. Supraptini, Mansyur and Martojo (1977)

2. Rubino (1976)

3. Hardjosubroto et al. (1977)

4. Mulyadi et al. (1979)

Table 4: Body weight (g) of 5 strains of native chicken

Age (week)	Strain				
	Sayur	Black Kedu	White Kedu	Nunukan	Pelung
4	148	165	140	151	161
8	370	313	404	423	370
12	708	575	739	665	669
16	932	765	950	1010	1165
20	1408	1480	1320	1203	1668

Source: Cresswell and Gunawan (1982)

There are various other strains of native chicken such as ayam “Gemara” (Silky feather), “Walik”, “Bekisar” (the cross between Sayur and jungle fowl), “Kate” (dwarf chicken) and “Bungko”, but there are as yet no records of their morphological and production characteristics.

There are some distinct morphological differences between native ducks of different regions such as West Java, Central Java, East Java, Bali, Lombok, North Sumatra and Kalimantan.

A study on the genetic differences between regional strains was carried out at the genome level. The samples were taken from the major breeding areas in Java and Eastern islands. An analysis of protein polymorphisms was performed, 20 loci were screened, of which eight were found to be polymorphic (Tanabe *et al.*, 1984). The dendogram (Figure 1), based on genetic distance between the populations, indicated that West and Central Java strains were genetically similar, but different to the strains in East Java, Bali and the nearby island of Lombok. The Alabio and Medan (North Sumatra) were genetically distinct from the Java ducks. The imported Khaki Campbell was found to be more similar to the West/Central Java strains, which is consistent with the report that such a duck was one of the founders of that breed.

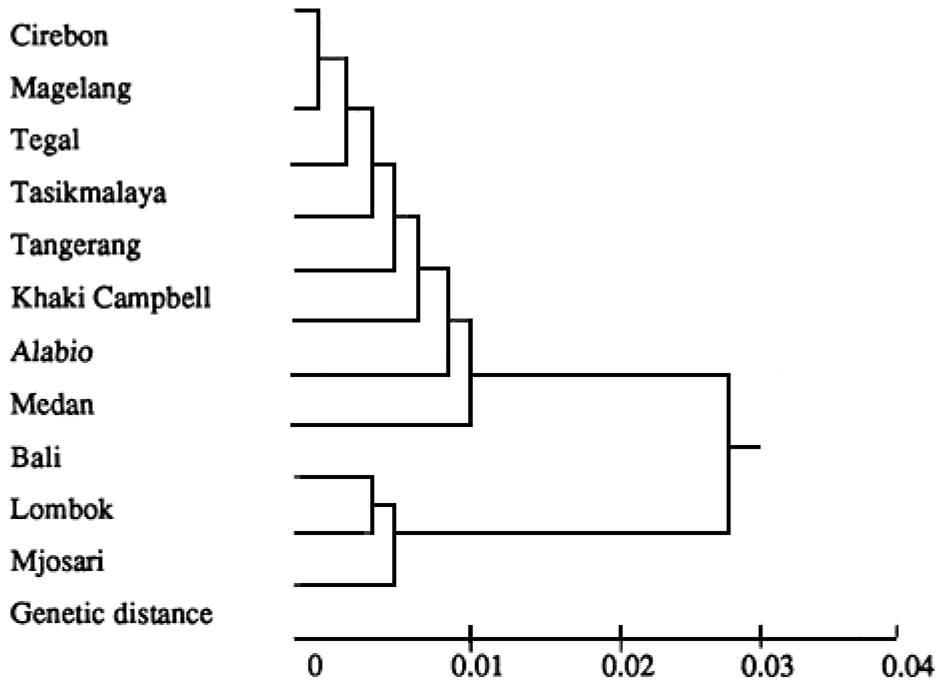

Figure 1: Dendogram showing the genetic distance of local ducks. Source: Gunawan (1988c)

The duck population was estimated to be about 27 million and they contributed about 30% of all eggs consumed in the country in 1978. They have been raised for centuries under traditional systems, and are herded in the rice fields, canals or rivers where they obtain their feeds. Very little information is available on their relative performance under these systems. Some studies reported the egg production of Tegal ducks in the traditional herding system ranged from 121 to 127 eggs (Gunawan and Hetzel, 1983) and ranged from 84 to 151 eggs under home-based herding (Kingston, 1980) and under semi-mobile herding from 98 to 151 eggs per year (Setioko *et al.*, 1985). Recently, the government development programs have started to encourage an effort to increase duck egg production through intensive management. Some earlier work had been done by improving feeds and management system and it was reported that Tegal and Alabio ducks laid 180 and 174 eggs over a ten-month period and over 12 months the Tegal ducks produced 212 eggs (Chavez and Lasmini, 1978). Others reported that averaged egg production to 68 weeks of age for Tegal, Alabio, and Bali ducks were 135, 180 and 179 eggs, respectively (Hetzel, 1984). In South Kalimantan under intensive management systems, Alabio ducks produced at an average 245 eggs per year and ducks are raised not only for egg but also for meat production (Naware and Iberani Ardi, 1979). Meat from native ducks is also now popular in various other parts of Indonesia such as Central, East Java and South Sulawesi. However, there have been no evaluations of Indonesian breeds for meat production under herding management. Under a high level of feeding, Hetzel and Simmon (1983) reported that the Indonesian breeds (Alabio, Tegal and Bali ducks) reached about 1.3 kg and feed conversion of 3.2 at 8 weeks of age and 1.6 kg and 4.7 at 12 weeks.

4. Genetic conservation and improvement

Genetic conservation of endangered breeds faces in Indonesia and South-east Asia the common problems. The countries tend to have a low appreciation of their own native breeds. The general assumption is that exotic breeds are better. As a consequence, indiscriminate crossing and the associated risk of losing some of the high genetic potential of local breeds cannot be avoided. In fact a lot of evidence indicates that the exotic is not always better than the local breeds. Some other factors could accelerate the loss of local genetic resources. These include the lack of information and inventory of the potential value of the native breeds, accumulation of genetic drift, the reduction in fertility due to the problems of mating system and inbreeding depression, natural selection, the loss of genetic variation within and between native breeds, and much selection pressure based only on morphological characteristics, feather colours etc.

Important stages of action which have been started to preserve the native breeds are as follows (Gunawan, 1988a):

1. Inventory, documentation, geographical distribution based on agro-ecosystem of the native breeds.
2. Evaluation of the local breeds, imports and their crossbreds.
3. Conservation and utilization of the local genetic resources based on the criteria such as the rarity of the native breeds, genetic distance between and within breeds, unique biological morphological and physiological characteristics and economic benefit.
4. Organisation of data bank and news letter.
5. Training courses on the conservation and utilization of the local genetic resources.

Steps 1,2 and 3 are basically conducted at the Research Institute for Animal Production, universities, and Research Institute for Biological Sciences. Step 4 and 5 are carried out in the Research Institute for Animal Production and the Indonesian National Commission for the Local Genetic Resources. The characteristics of some of the native breeds of chicken and duck were mentioned in earlier. The efforts in conserving and utilizing the genetic resources of native chicken and ducks through genetic selection and crossbreeding are reported below.

A long-term genetic selection within the endangered breed of “Black Kedu” has been carried out over the last 3 years in the Resesarch Institute for Animal Production. The breeding objective is to increase the purity of the Black Kedu by increasing the gene frequency of the black colours and improving egg production. The selection criteria are colour of the beak, eyes, comb, feathers, shanks, toes and anus, egg production and broodiness. The method of genetic selection is the “independent culling level” (ICL). The gene frequency of black colour for each of these traits and egg production has been increased over the last three years and the average broodiness has been reduced from 147 days per year to about 107 days (Gunawan, unpublished).

Evaluation of crossbreeding between strains of native chicken and imported breeds was carried out and results are presented in Table 5.

Table 5: Egg production of strains of native chicken

Traits	Strain				
	Sayur	Black Kedu	White Kedu	Nunukan	Pelung
Age at first egg, day	151	138	170	153	161
Age at 40 % production, day	184	166	202	186	193
Peak production, %	55	75	72	62	44
Hen day production %	41.3	58.8	54.0	50.0	32.5
Hen day production, eggs	151	215	197	182	119
Av. egg weight, g	43.6	44.7	39.2	47.5	40.6
Feed consumption (g/day)	88	93	82	85	93
g feeds/g eggs	4.9	3.6	3.8	3.6	7.1

Source: Cresswell and Gunawan (1982)

A genetic improvement and breeding program of Indonesian layer ducks has been carried out since 1978 at the Research Institute for Animal Production and the scheme is shown in Figure 2. From the results of evaluation of the performance of three Indonesian native breeds such as Alabio, Bali and Tegal and an exotic Khaki Campbell under intensive management system, Alabio, Tegal and Khaki Campbell ducks were selected for further genetic improvement. The genetic selection program has successfully increased egg production and the results are presented in Table 6. The successful utilization of additive genetic variation among individuals within breeds was followed by the utilization of non additive genetic variation through crossbreeding between selected Alabio, Tegal and Khaki Campbell ducks and the results are shown in Table 7. The estimated heritability for egg production traits were also calculated and the results are presented in Table 8. A simple economic analysis is presented in Table 9, taking into account only total feed cost during rearing and laying periods and the main income from the sale of eggs.

The results from Tables 6,7,8 and 9 demonstrate the success of genetic improvement of native ducks through genetic selection and show that crossbreeding between strains of native and imported ducks has produced crossbred ducks with high egg production and high profit margin, e.g. BPT AK (crossbred between selected Alabio and Khaki Campbell) produced 297 eggs per year with feed efficiency 3.0 and the highest profit margin of about Rp. 9999/duck/year compared to other breeds/crossbreds.

The results thus indicated that a proper selection of native breeds of duck and crossbreeding with imported breeds produced a new breed of duck with combination of complementary superior traits originating from both breeds. These results will help to explain and promote the importance of maintaining and conserving the genetic resources of native chicken and ducks, because the imported breed itself does not always perform as well as the native one.

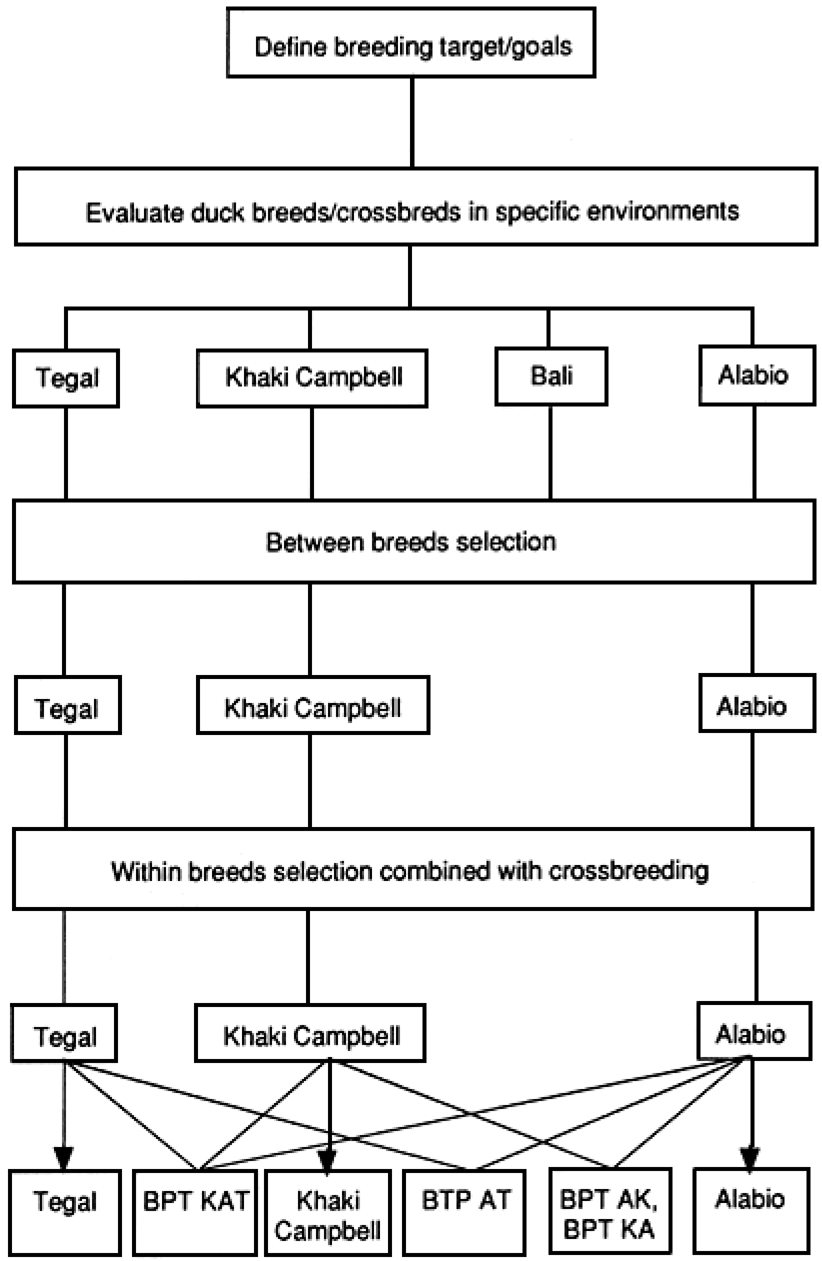

Figure 2: Schematic diagram showing steps of duck breeding program conducted by the Research Institute for Animal Production.

Source: Gunawan (1988c)

Table 6: Heritability estimates for egg production traits

Traits		h^2±s.e.
Age at first laying		0.21 ± 0.026
Egg production at	44 weeks	0.52 ± 0.034
	52 weeks	0.39 ± 0.035
	68 weeks	0.38 ± 0.032
	72 weeks	0.44 ± 0.021
Egg weight at	44 weeks	0.22 ± 0.026
	52 weeks	0.24 ± 0.037
	68 weeks	-0.03 ± 0.037
	72 weeks	0.42 ± 0.032
Per cent egg production at	44 weeks	0.60 ± 0.027
	52 weeks	0.54 ± 0.035
	68 weeks	0.28 ± 0.030
	72 weeks	0.39 ± 0.214

Source: Gunawan (1989)

Table 7: The survivors egg production to 72 weeks of age in the parental populations and selected populations.

	Survivors egg production to 72 weeks	
Breed	Parental population means + s.d.	Selected population means + s.d.
Khaki Campbell	230 + 50	241 + 49
Alabio	200 + 66	220 + 64
Tegal	212 + 63	230 + 60

Source: Gunawan (1987a)

Table 8: Egg production characteristics of Alabio (AA) and Khaki Campbell ducks (KK), crosses between these two breeds (BPT AK and BPT KA), and crosses between Alabio (AA), Tegal (TT) and Khaki Campbell ducks (BPT AT and BPT KAT).

	Genotype						
Trait	AA	BPT AK	BPT KA	KK	BPT AT	BPT KAT	s.d.
No. of ducks housed	105	114	95	109	79	35	
Age at first eggs (days)	163[a+]	148[b]	153[b]	150[b]	165*	156[ab]	26
Survivors egg production to 72 weeks	220[a]	297[d]	274[c]	24l[b]	249[b]	282[cd]	58
% Survivors egg production to 72 weeks	64[a]	83[d]	78[c]	71[b]	72[b]	81[cd]	16
Av. egg weight 16–72 weeks (g)	62.9[ab]	61.8[ab]	62.8[ab]	57.3[d]	65.0[c]	63.4[a]	3.5
Egg mass 16–72 weeks (kg)	13.9[a]	18.5[b]	17.1[bc]	13.8[a]	16.2[c]	18.2[bc]	1.4
Egg specific gravity at 72 weeks	1.085[a]	1.085[a]	1.085[a]	1.084[a]	1.085[a]	1.081[a]	0.003
Feed intake (g/day) 16–72 weeks	148[a]	141[ab]	151[ac]	135[b]	160[c]	150[abc]	9
Feed intake/egg mass 16–72 weeks	4.2[a]	3.0[b]	3.5[c]	3.9[d]	3.8[d]	3.3[bc]	0.3
Cumulative mortality (%) to 72 weeks	16.0[ab]	4.1[C]	24.3[a]	20.5[a]	2.8[c]	6.7[bc]	9.6

[+]The means (within rows) with different superscripts differ significantly at the 5% level (P<0.05).

Source: Gunawan (1987b).

Table 9: A comparison of profit margin between breeds and new breeds of ducks

Breeds/ crossbreds	Feed intake (g/day)		Total feed cost (Rp/duck) 0–72 wk	Egg returns to 72 weeks (Rp/duck)	Ratio return/ total feed cost	Profit margin to 72 weeks (RP/duck)
	0–16 wk	16–72 wk				
Alabio (AA)	106	148	27 955	27 500	0.98	-455
BPT AK	112	141	27 126	37 125	1.36	9 999
BPT KA	107	151	28 470	34 250	1.20	5 780
Khaki Campbell (KK)	98	135	25 558	24 100	0.94	-1458
BPT AT	116	160	30 284	31 125	1.02	841
BPT KAT	100	150	28 448	30 200	1.24	6 820

Source: Gunawan (1987b).

5. Conclusion

Native chickens and ducks have been kept in traditional ways for centuries in South-east Asia. To fulfil the increasing demand for meat and egg consumption, much attention has been paid to the development program of imported breeds but without proper evaluation. Consequently, the percentage rate of increase of the native population is only between 5 and 30% of the rate of increase of the imported breeds; in fact some native chicken and duck breeds have now reached endangered status. Some efforts have started to protect further losses and to conserve the genetic resources of native breeds of chicken and duck through a genetic improvement program.

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ENDANGERED SOUTH AMERICAN CAMELIDS

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1. Introduction

In the pre-Hispanic past in South America there were many camelids, both wild and domestic, occupying extensive geographical areas. The domestic species - Llama (*Lama glama*, Linnaeus, 1758) and Alpaca (*Lama pacos*, Linnaeus, 1758) - although largely eliminated from its original habitats, are at present maintained as essential resources efficient at utilising extensive areas of high land (3600 – 5000 m) where it is not possible to grow crops or raise profitably animals of European origin. The conservation of these species is assured because of their importance for the Alto-Andean economy.

Wild species, on the other hand, such as guanaco (*Lama guanicoe*, Muller, 1776) and Vicuna (*Vicuena vicuena* (Molina) Miller, 1924), are still endangered despite efforts to conserve them. This paper reviews the situation of these last two species, the history of their near extermination and present and future measures for conservation.

2. Population and distribution

The camelid population in South America is estimated at 7.5 million of which 53% are in Peru, 37% in Bolivia, 8% in Argentina and 2% in Chile (Table 1). Of the total, domesticated species account for 91 % and wild ones for the remaining 9%. There are slightly more llamas than alpacas and more guanacos than vicunas. Over 90% of the alpacas and more than 60% of the vicuñnas of the whole continent are in Peru, 70% of the llamas are in Bolivia, and almost all the guanacos (96%) are in Argentina.

Table 1: Estimated population of South American camelids ('000).

	Domestic		Wild		
Country	Llamas	Alpacas	Vicuñas	Guanacos	Total
Peru	900.0	3020.0	60.0	5.0	3985.0
Bolivia	2500.0	300.0	4.5	0.2	2804.7
Chile	85.0	0.5	16.0	20.2	121.5
Argentina	75.0	0.2	9.0	550.0	634.2
Ecuador	2.0	-	-	-	2.0
Colombia	0.2	-	-	-	0.2
Total	*3562.2*	*3320.7*	*89.5*	*575.2*	*7547.6*

Sources: Novoa (1981), Cardozo (1980), Guzman (1980), Cajal (1981), Brack Egg (1980).

Of the four South American camelid species, the guanaco at present shows the widest range of ecological adaptation, being found in areas covered with grass or dwarf shrubs from sea level up to 4250 m (Franklin, 1982) or 4500 m in the Andes (Raedeke, 1979). Its more northern distribution is at 8ºS in the Department of La Libertad, Peru. From there it extends southwards along the mountain range as far as Isla Navarino off Tierra del Fuego, and towards the east across Patagonia - also being found in the Curamalal Mountains and La Ventana in the Province of Buenos Aires, Argentina, to the north.

Four geographical subspecies of guanaco have been described: *Lama guanicoe guanicoe* (Muller, 1776) is found south of 35ºS in Patagonia and Tierra del Fuego; *Lama g. huanacus* (Molina, 1782) on the western slopes of the Chilean Andes; *Lama g. cacsilensis* (Lonnburg, 1913) on the high plateaux in the south of Peru, Bolivia and north-east Chile; *and Lama g. voglii* (Krumbiegel, 1943) north of 32ºS on the eastern slopes of the Andes of Argentina. They are all dark brown, with the ventral region white and the face grey.

The distribution of vicuna is limited to the Puna (Andean plateaux at an altitude of 3700–4000 m). The northernmost distribution is at 9º30' in the Department of the Ancash in Peru, and the southernmost in the province of Atacama in Chile.

Two geographical species of vicuna have been described, both of which are cinnamon-coloured. The first, *Vicuna vicuna mensalis* (Thomas, 1917) is found between 9º and 18ºS and the second, *Vicugna vicugna vicugna* (Molina, 1782) is found between 18º and 24ºS; the latter is bigger and does not have a tuft of white hair hanging from its chest like the *mensalis* subspecies.

3. Past extermination and present conservation

3.1 Vicuñas

The Inca civilisation practised various forms of wildlife conservation and management (Gilmore, 1950). The extermination of the vicuna is a post-Hispanic phenomenon. Simon Bolivar was the first to warn of this danger and in 1825 he promulgated a decree, in the city of Cusco, prohibiting their slaughter, similar provisions were made in Peru in 1920, 1926, 1936 and 1940, which were ineffective in preventing indiscriminate hunting. In 1946 a close season was established in Argentina, Chile and Bolivia, but processing and marketing of “imported” vicuna by-products were allowed.

In 1966, Peru established, by Supreme Resolution No. 157-A, the National Vicuna Reserve at Pampa Galeras, 450 km south of Lima. This reserve was urgently needed since the world population of vicuna had fallen by 98% in the previous 20 years. Early in 1950 there was an estimated population of 400 000 in the Andes (Koford, 1975). At the end of the 1970s, due to indiscriminate hunting, the population had been reduced to less than 10 000 in Peru and to less than 2000 in the remaining countries (Grimwood, 1968; Jungius, 1971).

In June 1968, the species was declared by IUCN to be in danger of extinction, and in September 1969 Peru promulgated a new law protecting the vicuna. In 1970, Chile decided to found the Lauca National Park and Bolivia established the Pampa Ulla Ulla Reserve.

In 1969, Peru and Bolivia signed a convention for the strict protection and conservation of the resource, prohibiting all international trade (Cardozo, 1985). Argentina adhered to this convention in 1971 and Chile in 1973, thus embarking on a multi-national collaborative effort. The initial objective of the Pampa Galeros Reserve in Peru was to conserve an endangered species, but it was so successful in increasing the size of the population (Table 2) that it was decided to launch a project for the rational utilisation of the vicuña, expanding the area of protection to zones around the Galeros Reserve. This project was designed to increase the production of marginal lands through re-population and use of vicuñas, particularly in peasant communities. The area of management and protection was extended from 6500 ha in 1967 to 550 000 ha in 1980, with a major increase in the vicuña population (Table 3). Similar results were achieved in the Lauca national Park in Chile (Table 4).

Table 2: Development of the vicuña population in the protected area of Pampa Galeras (6500 ha), 1967–1980.

Year	Males	Females	Offspring	Offtake	Undifferentiated
1967	56	369	179	219	-
1968	58	330	165	202	116
1969	103	552	229	150	54
1970	129	454	252	215	56
1971		1356		332	3
1972	316	854	392	461	95
1973	258	1083	434	565	26
1974	402	1185	747	517	169
1975	623	1718	900	674	188
1976	655	1749	964	904	271
1977	754	1748	1029	1076	192
1978	848	2159	1076	1123	442
1979	517	2543	371	1947	210
1980	669	2160	602	903	78

Source: PEURV Management Division Office, Pampa Galeras, Brack Egg (1979), Brack Egg (1980).

Table 3: Development of the vicuna population in the total area of Pampa Galeras and surrounding areas between 1965 and 1979.

Years	Total population	Increase	Total annual increase (%)
1965	1 000	-	-
1969	3 298	-	-
1970	4 543	1 245	37.8
1971	5 883	1 340	29.5
1972	7 281	1 398	23.8
1973	9 343	2 062	28.3
1974	12 865	3 522	37.7
1975	17 916	5 051	39.3
1976	24 750	6 843	38.2
1977	29 463	4 713	19.0
1978	38 643	9 180	31.2
1979	43 471	4 828	12.5
Average (%)			*29.7*

Source: Brack Egg (1980).

Table 4: Development of vicuna population ion the Lauca National Park.

Year	Animals
1973	1 093
1974	1 253
1975	2 176
1976	3 057
1977	4 080
1978	6 233
1979	7 033
1980	7 990
1981	9 762
1982	12 403
1983	14 617
1984	16 382

Source: Torres Santibañez (1985)

In 1977, the Ministry of Agriculture of Peru classified the vicuna as a species in a vulnerable situation (Resolution No. 01710–77 AG-DGFF) and in 1978 the Peruvian Government declared the project for the rational utilisation of the vicuna to be a special project of the Ministry of Agriculture - which gave it administrative and economic independence in conducting integrated development, re-population, management and production of vicuna throughout the country.

In Chile the initial area protected by the Lauca National Park was re-classified, one area of 137 883 ha being set aside for conservation and another of 209 131 ha for integral management of the vicuna and its habitat. The National Forestry Corporation has plans to establish units to protect existing populations and to introduce vicunas to other regions. Similar progress is being made in Bolivia and Argentina.

In 1979, on the basis of the above experience, Peru, Bolivia, Chile and Ecuador decided to enter into a new convention for vicuna conservation and management, which is now in force. At present the vicuña is protected; its status was changed by IUCN in 1981 from an endangered to a vulnerable species (IUCN, 1982).

3.2 Guanacos

In 1977 the guanaco in Peru was declared an endangered species (Ministerial Resolution No. 0170-77-AG-DGFF). There is, however, a small population near the Pampa Galeras Reserve which, due to protection, is now growing in number. Moreover, in 1981, the Calipuy National Reserve was established (Supreme Decree No. 004-81-AA) in Santiago de Chuco in the Department of La Libertad where the largest population of guanacos in Peru - and the northernmost of the continent - is found (Franklin, 1975).

In Chile the guanaco population dwindled steadily bringing it close to the condition of an endangered species (Miller, 1973) until 1975 when CONAF (National Forestry Commission) started a successful programme to protect populations in Tierra del Fuego and in the Torre del Peine National Park (Franklin, 1981). At present one of the large populations on the continent is to be found on Chilean soil in Tierra del Fuego where there are about 12 000 animals.

In Argentina, Raedeke (1979) estimated the original guanaco population at between 30 and 50 million; their habitat had, however, been taken over by more than 45 million sheep and 25 million cows. At the end of the 19th century the population of guanaco had been reduced to a few hundred thousand (Denier de la Tour, 1954). The expansion of sheep and cattle raising and of agriculture in Las Pampas and Patagonia contributed to the reduction. In the early 1950s guanacos continued to decline in numbers having been eliminated in most of northern and southern Argentina (Gilmore, 1950; Denier de la Tour, 1954). The present situation of guanaco in Argentina needs to be clarified; it is assumed that indiscriminate hunting without proper management and conservation cannot continue much longer.

In Bolivia there were probably never very many animals, the present figure being estimated at no more than 200 animals.

4. Future action

4.1 Results obtained and their importance for practical management

The experience of Pampa Galeras and other reserves has yielded the following results which could have a practical application in wild camelid management.

(a) Full protection against clandestine hunting is clearly the best form of management to ensure the conservation of these animals at the present time.

(b) Although there are plenty of domestic animals in the Pampa Galeras, the population of vicunas and guanacos has increased. This indicates that effective protection against hunters has been the key factor in the increase of the population and that its re-establishment is possible despite the use of natural grassland in common with domestic animals.

(c) Vicuñas graze peacefully with alpacas and llamas in the same area. However, sheep are a source of disturbance since they are usually accompanied by shepherds and dogs. Although the vicunas are temporarily frightened away by the presence of shepherds, they come back to their territory as soon as the sheep have withdrawn.

(d) Qualitative observations on the use of grasslands indicated that, compared with the vicuna, llamas are less efficient, alpacas are about the same, and sheep are more efficient.

(e) Although limiting the population of domestic livestock, particularly sheep, is a useful management tool in areas where conservation has high priority, the control of domestic herds on land belonging to peasant communities is not realistic.

(f) When the animal population density increases in protected areas like Galeras, the animals tend to scatter and re-populate neighbouring areas.

(g) One practice that has proved successful is the transfer of vicunas to other areas for purposes of re-population.

4.2 Limitations on future conservation and management programmes

The history of the project for the re-establishment of the vicuna in Peru offers important lessons for the future. Until 1978, the project was in Galeras and its major source of finance was the cooperation agency of the Federal Republic of Germany. From 1979 to 1982, when it was treated as a special project, the PEURV (Special Project for National Utilisation of Vicuñas) took priority in the allocation of Government budgetary resources. This enabled action in Galeras to be strengthened and the work of protection to be started at national level. At the end of 1982, PEURV became part of INFOR (National Forestry and Wildlife Institute) which meant that its resources were taken over by this new organisation and diverted to other purposes. During this period the project lost most of its specialised staff and although it recovered part of its operational capacity in 1983, the situation has not improved due to limited financial resources.

It is now recognised that both PEURV's operational capacity and the Government's financial capacity through the treasury were overestimated. They are still far from attaining the objective of re-populating 15 million ha in the Upper Andes to increase profitability of marginal lands for the benefit of peasant communities and rural enterprises through production of vicuna meat, skins and fibres. The only positive achievement is a big increase in the animal population.

With PEURV, the State was responsible for management, obtaining access to land and later compensating the communities for the use of their pastures. This was done with 11 communities in the core of the Pampa Galeras but compensation was negligible and it was difficult to involve other communities. As a result, the role of villages in protecting the resource was passive and insignificant.

On the basis of this experience, an alternative plan was prepared in 1987 defining two working areas: (a) protection areas, and (b) production areas. In the first, the State protects animals against clandestine hunting, leaving nature to make the necessary adjustments, and in the second, flocks are managed to obtain the best possible economic returns.

To encourage peasant participation, the new plan provides for a gradual shift from control and vigilance toward production. In this case, the objective is not the re-population per *se*, but ensuring that the peasant community considers the vicuna as one more possibility for production. It is obvious that the change cannot consist merely in supplying vicunas; management technology is also needed and financial assistance to launch community management projects.

All this requires research to elaborate a management model that could be transferred to the communities. Initial financial support is also needed, and the shift in emphasis and the processing and marketing of products under State control must be legally defined.

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APPENDICES

APPENDIX 1

COAG/89/6
October 1988

COMMITTEE ON AGRICULTURE, TENTH SESSION, ROME, 26 APRIL–5 MAY 1989

Preservation of Animal Genetic Resources

I. INTRODUCTION

1. Very few species of livestock and birds have been domesticated by mankind. Five species of mammals and two species of birds supply most human needs for milk, meat, eggs, animal fibre and draught animal power. In addition there are another ten or so species of domesticated mammals with high specific adaptations, such as the camelids, high-altitude bovines, small rodents and elephants. Within these few species, however, there are many breeds, each having special features and adaptations, which have been developed by thousands of years of domestication in different environments. Since all the breeds within a species can interbreed, there are almost unlimited options for new genetic combinations.

2. The process of human civilization and animal domestication over thousands of years meant that breeds were isolated from each other and, in many cases, developed special adaptations to specific environments; thus change occurred gradually. Today mankind is moving at a much faster rate: livestock, historically limited to a specific location, are now moving across the globe as live animals or as germplasm. Crossbreeding is a major force behind enormous increases in animal production and productivity. However the process has a worrying side effect, namely the overall reduction of genetic variation in a species. Wherever animal development has taken place, attempts to improve the breeds have simultaneously placed some of them at risk.

3. In developing countries programmes to increase animal productivity nearly always result in attempts to introduce exotic germplasm, either as purebreds or to contribute to crossbreeding with the local breeds. The technique of artificial insemination and the ability to freeze semen which can be shipped easily and stored indefinitely have all contributed powerfully to this process of change. The newly developing techniques of embryo transfer appear likely to offer another means for introducing genes from different breeds. Increasingly therefore local indigenous breeds are being diluted and threatened. Mankind now faces the certainty that unique and specially adopted traits of livestock in developing countries will disappear unless preventive measures are taken.

4. Rarely are plans laid for preservation of the local breeds when new breeds are first introduced. If the enterprise is successful, then after the trial period, exotic germplasm soon spreads from the pilot trial to the animal population at large. Silently and unnoticed the numbers of animals of the indigenous type decline and these breeds become threatened, rare and eventually extinct. The process is hidden and occurs without public awareness.

5. This paper therefore addresses the following issues. Indigenous breeds have already been lost and others with unique genetic characteristics are declining numerically and are at risk. Documentation on the status of many breeds is frequently not available. It is especially lacking in developing countries. A policy of awaiting accurate information may be too late to prevent a crisis situation. There are preservation methods suited to developing country conditions that can play a major role in preventing the erosion of genetic diversity.

II. RATIONALE FOR THE PRESERVATION OF ENDANGERED BREEDS

6 Why should efforts be made to preserve endangered breeds? Some argue that there is no need to be concerned since automatic adjustments will take place. Others feel that the loss of unique genetic material is unacceptable. These arguments have been widely debated and are presented in summary here.

(i) The Case Against Institutionalized Preservation

7. The case against formal mechanisms for preservation in essence states that if a breed is economically useful it will be preserved by market forces. The counter argument that its utility may well be in another time and place is refuted by antipreservationists who maintain that competent breeders and breeding companies will take steps to ensure that all the genetic variation they may need in the future remains available to them. While this argument may have validity with some domestic animal species in developed countries, clearly it does not hold in developing countries where many indigenous breeds are of no interest to anyone other than their current owners, who are crossing with exotic breeds.

8. The other case against preservation is the cost. It is a plausible argument. Modem society is reluctant to fund a very long-term project for which no economic or financial returns can be quantified and where indeed for some preserved breeds there may never be any.

(ii) Justification for Preservation

9. Animal genetic diversity is part of the earth's natural heritage. The loss of a unique breed is an irreplaceable reduction in the natural profusion of life forms. Today human life at the simplest levels depends upon animals for work and clothing and, in the case of some pastoralists, for staple food. At higher levels animals provide some of the most highly valued components of diet. The loss of civilization's cultural heritage is not accepted in other areas of life. Preservation of the genetic diversity of plants and of wild animals for example, although incomplete, is already established. Yet there is an equally clear scientific and economic case for the preservation of the endangered indigenous livestock breeds as an important aspect of human cultural heritage.

- **Scientific**

10. Breeds with unique physiological or other traits are of great interest. In the past such breeds have provided missing links in the genetic history of a livestock species by the study of blood groups, protein polymorphisms and morphological characteristics. For the future the developing science of molecular engineering will eventually identify which DNA sequences cause the distinctive breed traits. Although the new techniques of genome mapping, transfer of DNA within and between species and the production of viable transgenic animals are far from application, they are the focus of intensive research and will have an impact on animal production and health in future decades. Preservation is also a long-term programme. The preservation now of breeds with unique DNA will undoubtedly contribute in time to the yield from long-term research in molecular engineering. Also biotechnology eventually will contribute new and cheaper methods of preservation, for example by the simple storage of catalogued DNA. It would be a tragic commentary on mankind if, at a time when scientific progress opens up molecular opportunities for man's selection of animals, some unique livestock genetic resources resulting from thousands of years of natural and human selection were lost.

- **Economic**

11. Genetic variation, both between and within breeds, is the raw material with which the animal breeder works. Therefore any loss of genetic variation will limit man's capacity to respond to changes in economic forces for the exploitation of animal production in tomorrow's world.

12. Livestock improvement depends upon the preferred use of certain breeds or genes over others. Depending upon the genetic improvement method used, the original genes are either diluted or lost, resulting from crossbreeding or breed replacement. Even in situations where no new breeds are introduced, selection and inbreeding inevitably lead eventually to reduced genetic variation within an indigenous breed. History teaches that it is then essential to have the options of choosing from a wide variety of other breeds. In developing countries there are many breeds whose unique genetic qualities are associated with the ability to survive and produce, albeit at a low level, under disease stress and in hostile or highly specific environments. The loss of such breeds means the loss of specific adaptation traits and the DNA sequences which code for this ability.

13. High performance breeds today in many developed countries are derived partially or completely from breeds which, in the economic conditions of earlier centuries, were of little general interest. They survived through economic and physical isolation and were there for the finding when changing market demand and production systems rendered them attractive. This lesson can be forgotten only at the peril of lost flexibility to meet future economic changes in livestock production.

(iii) Summary of the Justification for Preservation

14. There is large genetic variability within the domestic species and there are many breeds. These indigenous stocks are disappearing due to the use of imported stock through breed substitution and crossbreeding. Many indigenous breeds have special adaptive traits, including for example, disease resistance, climatic tolerance, ability to use poor quality feed and to survive with reduced supplies of feed and water. Although difficult to quantify without specific research programmes, it is likely that they also have excellent ability to convert limited feed supply into protein. In the current situation there is a lack of scientific, economic and genetic evaluation among purebred indigenous and exotic breeds, in crosses and in different environments. In the future, due to changing circumstances for livestock production and animal products, the genetic variations which exist in these breeds may be required.

15. The case for preservation is therefore based upon: (i) the economic imperatives for ensuring flexibility in future animal production since market forces alone are not adequate to deal with the problem in developing countries (ii) the scientific value of the genetic material and (iii) human heritage interest. All are valid reasons for establishing preservation programmes. The underlying economic motive is insurance. Since future economic returns cannot be calculated, the question of whether to proceed is highly dependent upon the costs of establishing and operating preservation programmes. The cryogenic storage of semen and embryos offers a method with very low maintenance costs once the samples have been collected. It is a cheap form of insurance to implement immediately without awaiting either full documentation of breeds at risk or their extinction.

16. Having evaluated the different arguments and perspectives, and having received requests from many member countries for assistance, FAO is already committed to the support of preservation of animal genetic resources in developing countries. Clearly it is neither necessary nor desirable to preserve everything. FAO is committed to an approach to identify priorities, areas of need, the development of low cost techniques and to sound scientific methodology with the aim of supporting national governments to cooperate using TCDC principles.

III. WHEN IS A BREED IN DANGER?

17. Various estimates have been made on the minimum number of live animals required to maintain a breed. Those by Alderson (1981) and Maijala (1982) given below provide two estimates of breed population sizes for five animal species.

Species	No. of Breeding Females	
	Alderson	Maijala
Cattle	750	1000
Sheep	1500	500
Pigs	150	200
Horses	1000	-
Goats	500	200

18. These estimated population sizes are for endangered breed populations in developed countries and are at best indicative figures. In developing countries and particularly in harsh environments some additional factors must be considered. Geographic distribution of a breed can lead to clustering of effective breeding sirelines. Thus subdivisions and genetic isolation of nomadic breeding populations can double or treble the effective population size needed to maintain a breed above the endangered threshold size. Also the risk of population loss resulting from disease or adverse climatic conditions such as drought make it clear that breed population sizes much higher than those suggested by Alderson and Maijala may be needed in most developing countries.

19. Consequently much greater caution must be exercised when the ‘survival’ of endangered breeds in developing countries is in question. FAO proposes as a working rule that when breed population size approaches 5 000 breeding females, (total population of about 10 000 animals) the survival risk of the breed should be studied and appropriate actions initiated. These will depend upon the local circumstances of the breed, the management system, the extent of crossbreeding, the rate of decline in numbers and the certainty that the breed has unique qualities. Specific recommendations are then made for each circumstance, based upon established principles.

IV. PRESERVATION METHODS

20. There are two methods available: (i) live animals and (ii) cryogenic storage of germplasm.

(i) Live Animals

21. Until a few decades ago the preservation of rare breeds was largely a hobby of individuals who kept a few animals for their own interest. Additionally some zoological gardens kept a few specimens. These preservation activities were largely limited to breeds of curious appearance. Preservation actions by governments occurred mainly in Eastern European countries where herds and flocks of landrace types of domestic stock were maintained on some state farms. These activities were not systematically planned to ensure that all declining breeds were preserved. Also, apart from the socialist countries, little government interest was involved and virtually no public finance.

22. In recent decades community and government awareness has grown about the serious loss which is likely to occur in the absence of more planned programmes of preservation. An increased amount of activity to preserve live animals of endangered domestic species has occurred in West and East Europe and in Canada and the USA. The active support groups vary from country to country. Occasionally they include governments. Also private organizations have been established simply to promote and

operate preservation activities for livestock. Livestock parks of rare breeds are growing in popularity for show to the public. Sometimes government finance is made available to specially designated organizations; elsewhere payments are made to owners for each animal of a recognized endangered breed which they keep and breed regularly. The prolific Taihu sheep in China are an example of this method. In some developed countries, such as the UK, governments have declined to invoke legislation and activities are organized by private organizations which receive donations from the public and which are generally motivated by cultural-historic interests. An early and successful example of this private action is the Rare Breeds Survival Trust formed in the UK in 1973. It is dependent not only on contributions from the community but also upon revenue taken from visitors to the farm parks where endangered and ancient landraces are kept. In the 1950s the US Congress passed a law to ensure the preservation of the Texas Longhorn breed of cattle as part of the country's living heritage. Two herds were established in state parks and ensured that the breed survived when otherwise it would certainly have become extinct. Today there is a revival of interest among commercial ranchers and the breed is no longer endangered.

23. Live animal preservation has several advantages. A breed can gradually respond to changing external influences and performance evaluation is possible. However because of high costs (Table 4) only small populations can be kept and even in the best designed breeding programmes, genetic variability declines. There is also the danger of losing a unique herd due to disease.

24. Smith (1984) has estimated the minimum size of a breeding unit and the number of breeding animals that should be replaced annually to keep inbreeding levels to about 0.2 percent a year. This is shown in Table 1:

Table 1: Minimum number of animals required for conservation by management (Smith, 1984).

	Cattle		Sheep		Pigs		Poultry	
	Male	Female	Male	Female	Male	Female	Male	Female
Size of breeding unit	10	26	22	60	44	44	72	72
No. of breeding animals entering/year	10	5	22	12	44	18	72	72

25. Brem (1988) considers an inbreeding level of 1 percent per generation tolerable. In order to continue to breed and select successfully on quantitative traits a herd size of about 100 animals is necessary. Table 2 indicates the genetically effective population size and expected increase in inbreeding in a small herd maintained for preservation of a breed. It should be noted that small numbers of males reduce the effective population size drastically.

TABLE 2: Number of animals, effective population size and increase in inbreeding (Brem, 1988).

Number of males	Number of females	Total numbers	Effective population size	% Increase of inbreeding * per generation
50	50	100	100	0.5
20	80	100	64	0.78
10	90	100	36	1.39
1	99	100	3.96	12.63
20	50	70	57.1	0.88
10	50	60	33.3	1.50
1	50	51	3.92	12.75

* assuming random mating

(ii) Cryogenic Preservation

26. It is possible now to store a wide variety of living cells for long periods of time. In fact the maximum length of storage time has not yet been experimentally measured as it appears to be indefinite when cells are stored at the temperature of liquid nitrogen (-196ºC). Outstanding progress has been made with sperm cells of most domestic species and the techniques are now routine. Embryos of several mammalian species may now be frozen and subsequently used to produce a normal animal.

27. Most hazards that apply to live animal preservation can be overcome by storage of frozen cells at lower costs. Three techniques are currently available:

(a) Deep-freezing of sperms and oocytes

(b) Deep-freezing of embryos

(c) Deep-freezing of genes

- **Sperms and Oocytes**

28. The deep-freezing of semen (sperms) is suitable for all domestic animals including poultry, especially chicken and turkey. The techniques of freezing, storing and thawing of semen are well documented and need no further elaboration. However it can be difficult to collect semen from untrained males of indigenous breeds kept under extensive conditions. While all the genetic information of a mammalian breed is contained in semen from a prescribed number of males, a relatively complex breeding system over several generations is needed to regenerate a purebred population from semen alone. Steps also need to be taken to avoid inbreeding in this process. Smith (1984) has estimated that 25 sires per breed are needed to prevent inbreeding when the males are used rotationally on each other's daughters.

29. With cattle, mature oocytes can be frozen. If they are stored in addition to semen, then in vitro fertilization techniques, which are developing rapidly, may be used to produce purebred embryos, which may then be implanted in females of other breeds to recreate the lost breed. It may be useful in certain cases to preserve pieces of ovaries from slaughtered animals.

- **Embryos**

30. The cryopreservation of mammalian embryos has successfully been used in cows, sheep, goats, and horses. Pig embryos have not yet been successfully frozen. The entire genetic information is stored in one diploid embryo and no complicated backcrossing programmes are necessary. Once the embryos are obtained storage costs

are low. However it is still relatively expensive to obtain the embryos. Brem (1988), taking various parameters into account, has estimated the number of frozen embryos needed for preservation in cattle - Table 3:

TABLE 3: Number of embryos to be stored in an embryo bank with the objective of producing 25 breedable heifers after medication for various combinations of survival rates and pregnancy rates (Brem, 1988).

Survival rate of	Pregnancy rate (%)				
embryos *(%)*	20	30	40	50	60
50	616	411	308	247	206
60	513	342	257	206	171
70	440	293	220	176	147
80	385	257	193	154	129
90	342	228	171	137	114

31. The embryo preservation would be even more useful if there is an easy and accurate technique of sexing embryos before freezing.

- **Genes**

32. In the next decades a new method of preservation may be available. It may then be possible to preserve sequences of catalogued DNA in perpetuity. Storage of uncatalogued DNA is already possible but there are at least two problems which prevent it from becoming the normal method of preservation at present. One is the fact that genome maps are not yet available to identify which sequences of DNA are responsible for specific traits in the live animal; second, the use of stored DNA to recreate an animal with specific traits is not yet possible as DNA reinsertion techniques with animal cells still produce random results. Nevertheless, in planning such a long term project as preserving endangered breeds, the prospects of DNA storage as a method for the future must be taken seriously. DNA also has the advantage that it is a chemical and is not viewed as biological material by quarantine authorities. Thus DNA may be moved freely round the world whereas there are restrictions on the movement of animals and germplasm because of disease risks.

(iii) Comparison of Costs of Different Techniques

33. Besides the technical feasibility costs have to be assessed. Cryogenic banks generally imply both initial investment of storage equipment and relatively high collection costs which are largely compensated by subsequent low annual storage costs. Ollivier and Lauvergne (1988) have summarized the costs - Table 4:

TABLE 4: Relative costs of collection and annual storage for cryogenic banks in cattle and sheep assuming that the annual cost of maintaining a breeding unit = 100 (adapted from Ollivier and Lauvergne, 1988).

Gene bank	Costs	Cattle (a)	Cattle (b)	Cattle (c)	Sheep (a)
Frozen semen	Collection	184	83	375	290
(2500 doses)	Annual storage	4	17	8	7
Frozen embryos	Collection	1500	1770	1750	1667
(625 embryos)	Annual storage	10	42	12	17

(a) Smith, 1984b: in breeding rate of 0.2 percent per year assumed in breeding unit (e.g. 10 bulls - 26 cows).

(b) Brem, *et. al.*, 1984: breeding unit of 5 bulls and 25 cows.

(c) Parez, 1984: costs of breeding unit assumed as in (a) conditions of developing countries considered for collection and storage.

V. STRATEGIES FOR PRESERVATION IN DEVELOPING COUNTRIES

34. Some developing countries have established animal genetic resource preservation programmes in the last ten years. These are generally large countries with many indigenous breeds, a well developed administrative and scientific infrastructure, trained nationals and laboratory resources. For example, Argentina, Brazil, China and India have a national strategy both for live animal and cryogenic preservation of endangered breeds and good progress is being made. These national efforts have been supported by the activities of FAO and UNEP who, together from 1973 onwards, have developed methodologies, training courses, publications and held expert meetings which focus on the needs and opportunities of developing countries for the improved conservation and management of animal genetic resources.

35. Some examples of these various activities are cited:

(i) Surveys

36. Surveys concentrated first upon special categories of animals which are known to be declining, and which have unique genetic qualities. These surveys include Mediterranean breeds of sheep, prolific tropical sheep and trypanotolerant livestock. Also surveyed were sheep breeds of Afghanistan, Iran and Turkey where specially adapted sheep play an important role in the survival of large numbers of people. The special value of traditional dairy cattle breeds in India was also recognized and a review of their potential and declining status was completed.

37. An inventory of special herds was carried out. It listed, supported with essential statistics and brief comments, the status of flocks and herds of rare breeds kept by individuals or public institutions for scientific, cultural, historic or tourist reasons. It included ass, banteng, buffalo, cattle, goat, horse, pig and sheep. It also included free living, unmanaged feral populations formed from domestic animals formerly kept under control. Domestic animals kept in zoological gardens and experimental and selected strains developed in research institutes were also included. FAO and UNEP also surveyed the Przewalski Horse, the wild forerunner of the Asian domestic horse, and designed an action programme for its preservation in Mongolia.

38. In addition to surveys on special categories of animals which were thought to be declining, a different approach has been followed by cataloguing the animal genetic resources of countries whose breeds are little known in the world at large. The People's

Republic of China and the USSR have been surveyed in this way. As a consequence not only are the rare and declining breeds identified, but also major local breeds of current commercial value are identified and catalogued.

39. In Latin America, where there are many countries having similar types of Criollo cattle a review of the state of knowlege was carried out. This covered Criollo breeds and at the same time information was gathered on the llama and alpaca, on guinea pig and chinchilla and on sheep and goats of the region.

(ii) Expert Consultations and Meetings

40. These have been held since the mid 1970s to design action programmes and to develop policies and strategies. In 1980 a Joint Technical Consultation was held with UNEP, following which a Joint FAO/UNEP Expert Panel on Animal Genetic Resources was established with 36 members drawn from all regions and representing professional interests in all domestic species. The Terms of Reference of the Expert Panel are given in Annex 1. Meetings of the Expert Panel were held in 1983 (paid by FAO) and 1986 (paid by UNEP). No further meeting is currently planned due to financial constraints.

(iii) Publications

41. The results of the surveys and expert meetings have been published regularly by FAO and where appropriate, jointly with UNEP. A separate publication, started in 1983, is the FAO/UNEP Newsletter - Animal Genetic Resource Information (AGRI) - drawing special attention to preservation activities. The aim has been to publish the newsletter twice per year, subject to available resources. It has a specialist readership of about 1 500 throughout the world.

(iv) Training

42. An FAO/UNEP training course on the preservation of endangered breeds was held in 1983 and included identification of endangered breeds; methods of estimating desired numbers of semen samples, embryos or live animals to ensure genetic diversity; methods for collection, processing, freezing and long-term storage of samples; health regulations; techniques to avoid disease contamination; record keeping systems for storage and preservation centres; maintenance of liquid nitrogen facilities.

(v) Genetic Characterization

43. A large-scale pilot project in several countries in Africa, Asia and Latin America was carried out from 1983–86 to develop a new system of Animal Descriptors. These had never been available before. The pilot trial was able to develop both the Animal Descriptors and the methodology for their use. The output from such a system is an orderly genetic characterization of the breeds and of the environments to which they are adapted. It is suitable for use in a computerized system known as an Animal Genetic Resource Data Bank, where it is valuable for identifying which breeds are endangered and also for documenting standard genetic characterizations for the preserved breeds.

(vi) Promotion of Research

44. FAO and UNEP have promoted an international research project into the genetic structure of the Sahiwal cattle. This breed which originated in Pakistan, has many attractive traits for continued use for milk production under tropical conditions. It is well adapted and has higher milk production than most indigenous dairy cattle breeds in tropical countries. It is therefore an attractive exotic breed to introduce to other developing countries especially for crossbreeding. Unfortunately numbers of Sahiwal have been declining. It is now estimated that only about 17 000 purebred animals

remain, principally in India, Kenya and Pakistan. The decline is due to crossbreeding, especially with temperate breeds of dairy cattle. However, purebred animals remain important. The current phase of the study of the genetic structure of the Sahiwal breed is being carried out cooperatively by the national governments, by FAO and with additional trust funds from Sweden. It is expected that at the conclusion, it will be possible to formulate a programme for the increased use of the breed and also to preserve for posterity germplasm with known performance levels under defined conditions.

(vii) Regional Animal Gene Banks

45. The most recent activity is the formulation of a programme to establish Regional Animal Gene Banks in Latin America, Africa and Asia for the cryogenic storage of semen and embryos of endangered breeds in the countries within each region. Two centres are located in each region for storing split samples of each breed to safeguard against accidental loss. The locations of the centres in the different regions and the next phase of the programme including training of national staff in the methodology of cryopreservation and documentation are given in Annex 2.

(viii) Some Concurrent Strategies in Developed Countries

46. The European Association of Animal Production (EAAP) undertook a survey in 1984 of 22 countries in Europe to identify which breeds are endangered and which countries have programmes for preservation (Maijala et al., 1984). The results show that in Europe there are nearly 1 300 indigenous breeds of cattle, horses, pigs, sheep and goats. Of these 81 cattle, 67 sheep, 51 horse, 31 pig and 12 goat breeds are considered to be endangered. A comparable exercise for a developing region, namely Asia and the Pacific was planned by a similar professional society (Society for the Advancement of Breeding Research in Asia and Oceania - SABRAO). However, it was not possible to carry it out successfully due to the meagre national records and the absence of sufficiently well developed infrastructures needed for surveys.

47. Preservation activities in developed countries also highlight the need for central documentation facilities. The EAAP has established an Animal Genetic Resource Data Bank to store information on the size and changes of animal populations and also on the genetic characterizations of breeds. FAO arranged in 1988 with EAAP for the European Animal Data Bank to include similar information from developing countries. For this purpose the Animal Descriptors developed by FAO and UNEP and published in 1986 for five species of mammals and seven avian species are being used.

48. The US National Academy of Sciences is currently engaged in a comprehensive study of the need to preserve and manage genetic resources globally as well as in the USA. FAO is actively **participating** in the study group on animal genetic resources.

VI. SUMMARY OF PRESENT POSITION

49. There are many breeds of indigenous livestock which are declining. The rate of decline, the current numbers of animals, the distribution and likely date to reach extinction are usually not documented. Some breeds have already been lost and many are now threatened. The trend is accelerating.

50. The genetic characteristics of endangered breeds are rarely documented. Although production may be relatively poor, resulting in declining economic interest, breeds often have unique adaptive qualities which are also not documented.

51. Attempts to document the status of breeds by mail surveys have generally not been successful. It is most difficult to obtain accurate information in many countries and sub-regions where breeds are most at risk.

52. If efforts are focussed upon accurate documentation before preservation starts, then many breeds will be lost. Priority must be given to preservation which can be accompanied by limited documentation. The cost of preserving some breeds which may not be endangered is part of the price of ensuring that truly endangered breeds are not totally lost. It is a relatively small price.

53. National boundaries are poor indicators of breed distribution. Breeds frequently exist in several countries, although known by different names. A regional approach to preservation will be, for a number of reasons, the most economic.

54. Cryogenic storage should be the preferred method. Regional Animal Gene Banks with several centres holding split samples are ideal from the point of view of low cost and long term security.

55. Regional Animal Gene Banks are well placed to serve the interests of the smaller countries, whose national resources are most limited and for which national animal gene banks would be extravagent.

56. Regional Animal Gene Banks, organized on TCDC principles, would provide uniform methodology for the identification and evaluation of breeds to be preserved, the collection, freezing, shipping and storage of germplasm and the long term care, documentation and security of the samples.

57. Legal protocols are needed to ensure that the samples in a Regional Animal Gene Bank remain in the ownership of the country of origin.

58. Animal Health protocols are needed to ensure that animal diseases are not spread via Regional Animal Gene Banks and that accurate comprehensive records are established of the health status of the animals from which the samples are taken.

59. Live animal preservation programmes should be encouraged on a national basis, wherever possible, by drawing international attention to the declining and endangered breeds, seeking financial resources and emphasizing the opportunity for individuals to contribute to preservation. Such in situ preservation is particularly important for poultry where the costs of keeping individual live birds is modest.

VII. RECOMMENDATIONS FOR ACTION BY FAO

60. Establishment of a World Watch system on indigenous livestock breeds to identify need and to promote action when valuable or unique breeds are approaching risk. This system is to consist of a census information collection programme for developing countries with a central documentation centre serving both developing and developed countries. Data on the status of indigenous breeds in developing countries is to be regularly collected in prescribed format and trends monitored. This is to include the actual or estimated numbers of animals, the effective breeding population size, geographic distribution and indications of the changes predicted for the size of the breed based on recent trends. Critical changes are to be reported. National governments will be alerted to the need either for more detailed study or for preservation actions. Technical advice and facilities are to be available for cryogenic storage at Regional Animal Gene Banks. Studies are to be suggested on the status of indigenous breeds not currently at risk, with the aim of avoiding an emergency situation later.

61. In association with the World Watch system there is to be an up-to-date list of breeds and populations of indigenous livestock in developing countries, with a genetic characterization of each breed. An advantage of a global animal data bank for genetic characterizations is that breeds having the same genetic value but which are known by different names, are then assessed together for preservation purposes.

62. The recently established Animal Genetic Resources Data Bank set up by the European Association of Animal Production in the Federal Republic of Germany, with which FAO closely cooperates, is to be strengthened so that it will become a global information centre for international use, both for the improved use and for the preservation of indigenous breeds in the developing regions of the world.

63. Rapid completion of the programme for the establishment of Regional Animal Gene Banks for Africa, Asia and Latin America and early establishment of a comparable Regional Animal Gene Bank for the Near East region.

64. Priority in the use of the Regional Animal Gene Bank to be given to the storage of semen, while embryos should also be collected as additional germplasm wherever possible.

65. The manual for the operation of the Regional Animal Gene Banks, already prepared by FAO, is to be published and made available to all member countries.

66. Special attention is to be given to technical support for developing countries wishing to establish live animal herds for the preservation of endangered breeds of livestock. A manual is to be prepared for this purpose.

67. The possibilities of private individuals, villages and other communities or groups being able to participate and contribute to in situ preservation activities by keeping animals and birds is to be explored and encouraged. Public and private financial resources for the support of this type of activity are to be encouraged and a mechanism established to capture such contributions and channel them into live animal preservation programmes.

68. Training programmes are to be organized regionally or globally as appropriate for training national scientists and administrators in the operation, management and participation of Regional Animal Gene Banks and national animal herds and flocks for preservation purposes.

69. Studies into the genetic relationships of breeds of the same species are to be encouraged and research sponsored with the aim of measuring genetic distance (differences) between indigenous breeds. This would provide more information on which traits in a breed are unique and therefore worthy of preservation and those traits which are also found in other not endangered breeds.

70. Close technical contact is to be maintained with those rapidly developing fields of biotechnology which are closely related to preservation techniques, with the aim of ensuring that animal tissues stored in Regional Animal Gene Banks are suited to likely future developments.

71. When supporting national and regional programmes that involve crossbreeding the indigenous with exotic breeds, FAO is to provide technical advice to governments to avoid the depletion of indigenous stock below critical levels

VIII. RECOMMENDATIONS FOR ACTION BY NATIONAL GOVERNMENTS

72. Recognizing the ecological, cultural and possible future economic value of endangered domestic breeds and the need for active national involvement to stimulate external assistance, governments to give higher priority than hitherto to the preservation of endangered breeds by making financial provisions in their livestock plans and programmes.

73. Formulate a practical programme of identification and data collection for the characterization and evaluation of indigenous breeds, participate in the Global Animal Genetic Resources Data Bank, and rapidly implement a programme of cryopreservation of semen and embryos of endangered breeds by taking part in the Regional Animal Gene Bank programme.

74. Realizing the danger to indigenous animal genetic resources by programmes that involve introduction of exotic germ plasm, continuously monitor genetic change in the indigenous breeds included in such programmes and participate in the proposed FAO World Watch system. Maintenance of purebred herds of indigenous breeds is to be an integral part of programmes involving crossbreeding. It may be feasible under certain circumstances, to designate small areas under national control which are unsuited to intensive animal production, where the policy will be never to replace or crossbreed the locally adapted indigenous animals.

75. Governments to be encouraged and assisted to make available bulls of local indigenous breeds in national AI centers.

76. Create public awareness of the genetic, scientific and cultural value of endangered breeds and actively support the creation of breed societies, and registration and genetic characterization of animals.

77. Encourage universities, research organizations and other technically-oriented government institutes to create and maintain live animal units of endangered breeds.

78. Stimulate public interest and mobilize support for conservation programmes by publicising endangered breeds at agricultural shows and exhibitions, and establishing live animal units in zoos and parks.

79. All interested organizations, institutes and individuals are to be encouraged to provide financial support for the safeguarding of animal genetic resources.

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ANNEX 1

FAO/UNEP JOINT EXPERT PANEL ON ANIMAL GENETIC RESOURCES CONSERVATION AND MANAGEMENT

TERMS OF REFERENCE

I. Background and Justification

In the 1930s and 40s the scientific basis for the genetic selection of animals was worked out in institutions in Europe and the United States of America. The application of these findings to practical animal breeding improvement programmes has made possible an unprecedented rate of increase in the production of food and fibre per animal. A few high performance breeds have emerged which are gradually displacing the local breeds in temperate regions. As a result there is growing concern that that the latter may disappear altogether unless special efforts are made to conserve them.

The developing countries are likewise increasingly concerned about their livestock resources, especially after the many large scale introductions of high-yielding breeds from the temperate zones which often caused a decline in the numbers of local livestock types. The latter have, through natural and man-selection, developed characteristics which make them well adapted to the often harsh environmental conditions under which livestock have to live and produce in these areas. This valuable genetic material needs to be maintained and improved as the basis for national livestock breeding programmes and policies.

The problems facing the world's animal genetic resources were identified by a high level FAO/ UNEP Technical Consultation held in 1980 as being principally of three kinds. The first is a decrease in genetic variability within breeds; this is mainly a problem of the high-yielding breeds maintained in temperate zones and employed in intensive production systems. The second is the rapid disappearance of indigenous breeds and strains of domestic animals through the indiscriminate introduction of exotic breeds. The third concerns the special problem of hot, humid climates and other harsh environments common to the developing countries. Only in restricted areas within these environments is it possible to improve animal health protection measures and feeding and management practices to levels that would allow high-yielding animals from the temperate zones to be used. In these circumstances the need is to design and implement appropriate selective breeding programmes based on existing populations of animals adapted to harsh environments.

The emerging awareness of the need for urgent action to conserve and develop the world's animal genetic resources has resulted in a number of limited and mostly uncoordinated efforts in this direction. Regional agricultural and/or animal husbandry organizations in Africa (IBAR of OAU), Europe (EAAP), Asia and the Pacific (SABRAO) and Latin America (ALPA) have set up committees on animal genetic resources and initiated studies on their management. However, there is an obvious need for the coordination of these activities as well as for the continuous exchange of information on experiences, achievements and methodologies for the efficient management and conservation of animal genetic resources for future needs. The future potential use of a specific animal genetic resource may not necessarily be confined to the country or area where it is at present threatened. Instead, it may well prove its usefulness in some other part of the world. This fact underlines the need for a strong involvement of international bodies like FAO and UNEP.

In recent years techniques for the recovery of embryos of animals and their long term conservation at supra-low temperatures have been developed and the scientific research in this field is at present in a very intensive phase of development. In consequence, new knowledge is being continuously generated on animal genetic resources conservation invitro, for both short and longer term periods. At present, of course, the development of the embryo transfer/storage techniques is geared mainly toward its immediate use for commercial purposes. But the potential for its use in connection with the conservation of animal genetic resources is great. This would require its continuous study at the global level. There is already information available that embryo banks are being established in some of the industralized countries.

In the light of the above considerations, an FAO/UNEP Panel of Experts on Animal Genetic Resources Conservation and Management was established in 1983, consistent with the recommendations of the FAO/UNEP Technical Consultation (1980) that FAO and UNEP establish an appropriate coordinating mechanism for the conservation and management of the world's farm animal genetic resources at national, regional and international levels.

II. Objectives and fields of activity

The objectives of the Panel are to:

– Review periodically ongoing work on animal genetic resources conservation and management in the different parts of the world and delineate future work programmes on a priority basis.

– Identify the principal problems hampering the exploitation and improvement of animal genetic resources at national and regional levels.

– Determine how these problems may be solved, what action programmes and projects may be developed in given situations, and how existing national and regional organizations may be strengthened for this purpose.

– Formulate ways and means of stimulating regional and global cooperation in programmes for promoting animal genetic resources development with special emphasis on mutual assistance among national and regional institutions.

– Advise the Director-General of FAO and the Executive Director of UNEP on critical issues relating to the conservation and management of animal genetic resources.

The Panel activities cover the following fields:

(i) Genetic resources conservation and management activities at global, regional and subregional levels.

(ii) The design and implementation of selective breeding programmes for animal populations in harsh environments.

(iii) The establishment and operation of data banks on animal genetic resources.

(iv) The development and application of an in situ animal genetic resources conservation methodology.

(v) Public relations and collection and dissemination of information programmes for animal genetic resources conservation in developing countries.

(vi) The development and application of an in vitro conservation methodology of animal genetic material, including disease control aspects.

(vii) The development and maintenance of inventories of animal genetic resources and of a global register of such resources.

ANNEX 2

REGIONAL ANIMAL GENE BANKS: ACTION PLAN

(i) FAO started the organization of Regional Animal Gene Banks for the cryogenic storage of semen and embryos in 1987 in the Africa, Asia and Pacific, and Latin America and Caribbean regions. It is hoped to start a similar Regional Gene Bank in the Near East Region in 1989.

(ii) Each Regional Animal Gene Bank is organized as a cooperative programme between the countries which wish to participate by storing semen and/or embryos of their endangered breeds. In each region two centres have been identified where national facilities can easily be expanded to serve the needs of the region. Two centres are needed in each region to hold split samples, thus providing security against accidental loss. The countries in each region are: Ethiopia and Senegal (Africa), People's Republic of China and India (Asia and the Pacific), Argentina, Brazil and Mexico (Latin America and the Caribbean). The separate centre is needed in Mexico to serve the needs of Central America and the Caribbean, which are an animal disease-free zone separate from South America.

(iii) The first phase of the programme was completed in 1988 and consisted of a desk study by the centres in each region covering all topics, including standards for the handling of samples, animal health aspects, recording system for operation of the centre, documentation of genetic characteristics of breeds, estimated operating costs and needed training programmes for nationals of member countries. The output from these studies have been incorporated into a new Operating Manual for Regional Animal Gene Banks.

(iv) The next phase of the programme to permit immediate action during 1988 based upon cooperation between countries, is the provision of TCP projects. These are expected to provide training in necessary methods for identifying endangered breeds, sampling techniques, documentation and collection, processing and shipping of samples, and also to provide supplementary equipment and expert advice.

(v) The operation of the Regional Animal Gene Banks during the following three years during which most of the currently endangered breeds will be collected, is expected to be supported financially by trust funds. The permanent long-term maintenance of the Regional Animal Gene Banks will need simply regular supplies of liquid nitrogen and an up-to-date recording system. It is expected that the costs of operating these will be provided by the cooperating countries in the region.

(vi) The contributions of each participating country to Regional Animal Gene Banks will include necessary equipment and staff for the identification of endangered breeds and collection and shipment of semen and embryos to the regional centres. The contributions of the countries operating the regional centres will be the needed laboratories for handling the samples, physical facilities for housing the storage containers and provision of staff and office facilities for recording systems. It is expected that the special equipment specifically needed for operating an animal gene bank, such as liquid nitrogen plant and storage and shipping containers, will be provided under the TCP projects.

(vii) No payments for the value of the samples or the animals from which they are derived will be made to the countries sending samples to the Regional Animal Gene Bank. Ownership of the samples will remain with the country of origin. It is expected that protocols will be worked out in each region by representatives of the participating countries for safeguards to prevent valuable germplasm being released from the centres for purposes inconsistent with the agreed aims for preserving unique genetic material.

(viii) The commitments of FAO are the initial organization which was carried out using Regular Programme Funds in 1986–87, followed by seed money from TCP for the needed training, expert advice and essential equipment in 1988.

(ix) The estimated budget for the establishment of each regional animal gene bank centre is as follows:

	US$
Equipment (once only)	150 000
Operation during establishment (per annum)	20 000
Training/Expert Advice (depending upon the number of countries (once only)	75–150 000
Long-term operation (per annum)	5000

(x) Blood samples to be used for blood typing and for DNA extraction and permanent storage, will be taken from each animal whose semen or embryos are stored.

(xi) The contents of the recently produced FAO Manual on the Operation of Regional Animal Gene Banks follow.

MANUAL ON ESTABLISHMENT AND OPERATION OF ANIMAL GENE BANKS

Contents

4.0 ANIMAL HEALTH REQUIREMENTS

4.1 Semen
4.1.1 Disease-free semen
4.1.2 Health tests
4.1.3 Special requirements for animals originating from private herds
4.1.4 Precautions
4.1.5 Certification
4.2 Embryos
4.2.1 Health status of donor
4.2.2. Embryo collection unit
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5.0 COLLECTION AND PROCESSING

5.1 Semen
5.1.1 Animals
5.1.2 Semen quality
5.1.3 Recording
5.2 Embryos
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5.2.3 Fertilization, recovery, evaluation, freezing
5.3 Requirements
5.4 Samples for genetic studies
5.4.1 Collection and storage of blood samples

6.0 PROCEDURES AT REGIONAL ANIMAL GENE BANK

6.1 Receipt and storage
6.2 Release of material
6.3 Checks and security

7.0 DESCRIPTION OF POPULATIONS CONSERVED

Annex Ia Animal Health Certificate for Semen
Annex Ib Animal Health Certificate for Embryos
Annex 2 Description of materials sent to regional animal gene bank
Annex 3 Description of materials released by regional animal gene bank
Annex 4 Monthly record book at regional animal gene bank
Annex 5 Annual summary by regional animal gene bank
Annex 6 Description of livestock populations stored at regional animal gene bank

APPENDIX 2:

EXTRACT FROM THE REPORT TO THE 95th COUNCIL MEETING OF THE COAG MEETING HELD IN APRIL 1989 (CL/95/9)

Selected Development Problems

Preservation of Animal Genetic Resources

121. This subject was presented as a selected development issue and the discussion was based on document COAG/89/6 “Preservation of Animal Genetic Resources” which examined the background, analysed the current position and presented proposals for an enlarged global strategy. In appraising the background, the paper reviewed the activities initiated by FAO in recent years

which have been components of the FAO Regular Programme of Work and Budget, supported by UNEP funding. The paper indicated that the proposed global strategy would require an enlarged programme.

122. The Committee commended the quality of the paper and its timeliness. It confirmed its view that the topic is of growing importance at national, regional and global levels and recognized that the topic merits the development of an international strategy, programme and agreement in order to ensure the availability of animal genetic resources for present and especially to future generations.

123. The Committee recognized that growing pressures upon the world's animal genetic resources, arising mainly from short-term economic interests, are threatening and depleting animal genetic variation. Consequently, in the interests of economics, science and human heritage, a programme of preservation and improved use is fully justified. The Committee further recognized that to be effective such a programme should have international acceptance and support.

124. The Committee recognized that the current use of animal genetic resources is closely linked with the need for preservation for possible future use. However, it is difficult to anticipate the precise economic value of such preserved resources in the more distant future. The Committee affirmed its view that the present generation has a responsibility for ensuring that future generations are not denied access to animal genetic resources through either neglect or wilful misuse of this human heritage.

125. The Committee expressed its view that although it is often impossible to justify the preservation of animal genetic resources in quantified enconomic terms, preservation programmes should be developed on the concept of availability if and when required.

126. The Committee urged FAO to expand the programme of animal genetic resource preservation and improved use as a matter of urgency, in order to stem the current loss of indigenous breeds of animals, The Committee recognized that this situation is becoming critical especially in some developing countries.

127. The Committee recognized the lack of information on the status of many animal genetic populations in some developing countries and urged FAO to devote new activities and technical support for accurate surveys, genetic classifications and risk status assessment as well as censuses. The Committee also strongly urged FAO to develop a World Watch List of endangered animal breeds as a support mechanism and early warning for member countries and encouraged FAO to update and publish this list regularly.

128. The Committee recongnized that it would be neither feasible nor responsible to await completion of genetic characterizations for all indigenous animal breeds, especially in developing countries, before taking up preservation intitiatives without running the risk of genetic resources being endangered and possibly lost. The Committee therefore recommended that, due to the accelerating threat to indigenous breeds, with unique genetic qualities, especially those which enable animals to live and produce in hostile environments, FAO should develop documentation and preservation programmes concurrently.

129. The Committee affirmed its support for the technical methodology already developed by FAO for the preservation of animal genetic resources and

recognized that there is now an urgent need to apply these proven techniques on a global scale so that they may be available to all countries who wish to use them. In this regard, the Committee affirmed its view that the organization of animal genetic gene banks and data banls is often not feasible on a national basis and supported FAO's initiatives to establish methodologies suitable for regional and global use. The Committee also supported the wish of those countries with national programmes to link them to the global programmes.

130. The Committee commended FAO for the development of Animal Descriptors and for the establishment of the EAAP/FAO Global Animal Genetic Data Bank. The Committee emphasized the importance of training, technical and financial support to enable all developing countries to document their indigenous animal breeds, to enter them into the global system and to be encouraged to access this information for decision-making.

131. The Committee supported the approach of FAO in placing primary emphasis on the cryogenic storage of germplasm.

132. The Committee recommended that FAO should develop appropriate methodologies for the establishment of live animal reserves for those countries and in those circumstances where the system is appropriate. The Committee recognized the importance of such in situ preservation being integrated with the preservation of plant genetic resources in natural habitats and supported the joint approach.

133. The Committe suggested that FAO should pay particular attention to certain topics in the development of the global programme. Some members felt these were animal health and disease control in the movement and storage of germsplasm and animals preserved in situ, relationships with wildlife genetic resources; the possibility of mobile teams to provide technical services to developing countries in the identification of endangered breeds and the collection of germsplasm; the need for standards for evaluating genetic merit in donor animals; the question of price and payment for preserved semen and matters of ownership/trust/access and replinishment of germplasm in regional gene banks; and finally costs of operating programmes especially in developing countries where resources are extremely limited.

134. The Committee encouraged FAO to continue its work in exploring the use of new biotechnology methods applicable to animal genetic resources. In particular, FAO should continue to study new developments concerning the use of DNA as a supplement to the storage of semen, embryos and oocytes.

135. The Committee recognized the close association between domestic animal genetic resources and wildlife due not only to the genetic relationships between domestic species and their wild ancestors but also because of the growing practice of farming wild species for food and fibre production. The Committee therefore urged FAO to study more closely the possibilities of joint programmes and cooperation with other bodies whose prime interest lies in wildlife.

136. The Committee urged FAO to develop further the training programmes for developing country nationals to equip them for participation in the Regional Animal Gene Banks and the Global Animal Genetic Data Bank programmes. The Committee emphasized the importance of immediate financial support to avoid a

period of inactivity while longer term financial support for a global and genetic resources programme is being developed.

137. The Committee endorsed the priority being given by FAO to the importance of biotechnology in relation to animal genetic resources and recognized the impact which it will have in future upon techniques both for improved use and for preservation of animals.

138. The Committee recognized that animal genetic resources are a part of the larger field of biological diversity and encourage FAO to continue its close liaison and, where appropriate, it's collaboration with other organizations, both inter-governmental and NGOs, which are active in this field, with the aim of developing a unified and comprehensive approach to this subject.

139. The Committee encouraged FAO to continue to work in close contact with other bodies currently involved in the development of animal genetic resources, especially those with representation from developing and developed countries so as to ensure that FAO's global programme is comprehensive and represents the interests of all countries and regions.

140. The Committee approved the proposal that, in addition to the continued development and enlargement of the existing programme, FAO should consider further the many technical, legal, financial and institutional aspects of a global programme for animal genetic resources. The proposal for an Expert Consultation to examine these topics was supported. Furthermore, approval was given for the Working Group of the FAO Commission on Plant Genetic Resources, based on its experience, to study the possibility for FAO to establish a global system of genetic resources, including animal genetic resources. Confidence was expressed that FAO will be able to attract extra-budgetary resources for these important tasks.

APPENDIX 3

EXTRACT FROM THE REPORT OF THE 95TH COUNCIL MEETING (CL/REP/1)

Preservation of Animal Genetic Resources

52. The Council recognized the importance of Animal Genetic Resources both for the future of animal production and also as a component of global genetic resources. The Council accepted the view of COAG that the FAO programme on the Preservation of Animal Genetic Resources had a sound technical base and was organized effectively. The Council called for the programme to be expanded and further developed as proposed in the Report of COAG, and recommended that lack of funding should not be the cause of delay in implementation nor lessen the impetus already achieved.

53. The Council recognized that animal genetic resources was part of the larger topic of biological diversity. Many members felt that the Working Group of the Commission on Plant Genetic Resources should review in October 1989 the various aspects and possibilities of expanding FAO's Global System on Plant Genetic Resources to include animal genetic resources. Some members stressed the technical differences existing between the preservation of plant and animal genetic resources and requested a technical consultation.

54. The Council requested the Director-General to examine the many technical institutional and policy aspects of FAO's future role and programme in the important field of animal genetic resources including the possibilities of integrating the institutional infrastructures for animal and plant genetic resources within one system, while at the same Lime taking account of the relationships and needs of fisheries and wildlife.

55. The Council affirmed its support for the Director-General's intention subject to availability of turds, to hold an Expert Consultation in September 1989 and a meeting of the Working Group of ihe Commission on Plant Genetic Resources in October 1989. It noted the Director-General's request for extra-budgetary resources to implement these unforeseen and important activities and his intention to report to the Council and Conference in November 1989 on progress achieved.

APPENDIX 4

INTRODUCTORY STATEMENT

Dr H.A. Jasiorowski

Director, Animal Production and Health Division

Ladies and Gentleman,

The main ask of FAO is to assist developing countries to produce more food, so that hunger and malnutrition can be eliminated

We all know that livestock plays an important role in this respect. It is sufficient to say that, on an average, people in developing countries consume only 13 grams per day of animal protein while people in developed countries consume 58 per day. The recognized minimum is ca 30 grams per day. But these figures may be misleading since millions of people in developing countries consume not more than 4 grams of animal protein average per caput and day.

Under these circumstances, it is obvious that FAO has to concentrate its efforts on the increase of production of food of animal origin in developing countries. As known, this can be done either by increasing the number of animals or by increasing their productvity or by both. By looking at related statistics, it becomes clear that until now in the developing world the total increase of milk and meat production was mainly due to the increase in the number of animals, and only this phenomena allowed during the last decades the provision of more or less constant supply of these products per caput (however low) in spite of the rapidly growing number of the human population. Unfortunately, this cannot last forever. Therefore, FAO's main efforts have been directed towards an increase of livestock productivity by improvement of feeding and genetic potential.

For the purpose of this meeting, let us leave out the important problems of feeds and feeding of animals in the developing countries and to deal with the problem of genetic improvement of productivity traits in livestock of the third world.

It is well-known that genetic potential for productivity traits of indigenous livestock breeds in developing countries is generally low. The improvement by within-breed selection methods has proved to be a very long process and in most cases not justified economically. Therefore, the importation of exotic, more productive genotypes became an almost universal method of improving or replacing local livestock populations. The method of livestock genetic improvement has varied between countries, between species and the different methods have changed genotypes at different rates. The use of “superior'' imported genetic material has been by direct breeds substitution - particularly for pigs and poultry (in some cases, accompanied by a direct substitution of environment), by crossbreeding, upgrading, continuous back crossing and recently even the formation of synthetic breeds. Some programmes use animals directly, others use AI and, more recently, Embryo Transfer. The magnitude of this process can be judged by the fact that there is not even one developing country which to date has not imported exotic genotypes for the improvement of local livestock populations.

The impact of exotic genotypes on local livestock populations varies depending on countries and species. While sheep and goats were left less affected, genetic upgrading through crossbreeding became very popular in dairy cattle in developing countries and native breeds of poultry and pigs are rapidly being replaced by imported exotic breeds. This process, in general is leading to the reduction of some of the indigenous animal populations which in turn can cause the extinction of some of them. If this process continues, the livestock genetic diversity in developing countries would become reduced as has happened in the developed part of the world.

Throughout the history of FAO, we have had to deal with the dilemma of the rapid improvement of livestock in developing countries and the necessity for the preservation of genetic diversity. FAO has been well aware that genetic changes particularly the more rapid ones, will lead to some loss of genetic diversity. Wherever possible we have advised the developing countries to improve their indigenous breeds by selection, avoiding crossbreeding. However, the majority of the developing countries do not have enough infrastructure. With the new developments in breeding methodology, the use of the open nucleus breeding system gives new possibilities and is being encouraged. The system is being introduced by FAO to dairy sheep in the Middle East, and to indigenous pigs in China, Philippines and Viet Nam. In all our activities related to genetic changes we have tried to combine them with the idea of preservation. However, such activities are not easily achieved in developing countries where nations are, quite rightly, mainly concerned with efficient food production and, where pressures to feed people are great, so is the desire to use any material which promises to change production levels. In such circumstances the expense of the loss of a genetic resource which, at that moment, appears to be of low value is of no political importance. In addition, we should not expect to achieve in the developing countries a quick response to the idea of genetic resources preservation if it has taken decades for developed countries to realize the magnitude of losses and take steps to prevent them. FAO therefore has attempted to use all possible channels to ensure that genetic diversity is at least maintained. The organization has actively developed links with all interest parties - whether governments, NGOs or private groups. FAO has worked closely with UNEP which, in turn, has provided funding to assist FAO in achieving its objective of making countries more aware of the long term need to maintain a broad genetic resource.

FAO from its inception has considered the use of genetic resources in its widest sense - some 50 percent of its 76 publications on animal production directly concern the thorough utilization of genetic resources and preservation. However, FAO has been more actively involved in considering the preservation/maintenance of animal genetic resources for some 20 years.

The milestone in this respect was a joint FAO project from 1974 to 1980 whose aim was to monitor endangered livestock breeds and which was summarized during a Technical Consultation (1980) on Animal Genetic Resources, Conservation and Management. The valuable Proceedings were published and a Panel of Experts was formed. In 1983, as a result of the Expert Panel meeting - proceedings were published on “Animal Genetic Resources, Conservation by Management, Data Bank and Training”. In 1986 another meeting was held on “Animal Genetic Resources - strategies for improvement and conservation”. In the meantime, FAO partly in collaboration with UNEP, published several publications dealing with the characterization of animal genetic resources in developing countries. I want only to mention here, for example, publications on declining breeds of Mediterranean sheep, on sheep and goat breeds in Pakistan, India and Turkey, Prewalski Horse, Animal Genetic Resources in China and the USSR and others. These publications and previously mentioned meetings have provided the necessary background and guidance for the organization by FAO, jointly with EAAP, of the Animal Genetic Data Bank in Hannover and 8 regional animal gene banks in different regions of the developing world. Later special papers will deal with this subject.

Recently, (1989) FAO's activities in the field of animal genetic resources preservation were presented to our main technical Governing Body Committee on Agriculture (COAG). The FAO Committee of Agriculture clearly recognized the need to act urgently to ensure that animal genetic diversity is maintained. The recommendations covered documentation and concurrent preservation, urging FAO to develop training programmes. During this Session of the Committee on Agriculture, developed countries like Australia, Canada, West Germany and the UK, indicated their willingness to offer expertise as well as financial and institutional assistance for the data bank and the gene banks. Seven developing countries (Argentina, Brazil, China, Ethiopia, India, Mexico and Senegal) had undertaken to establish the regional animal gene banks. There is at present a favourable climate for formulating and implementing appropriate projects for the preservation of endangered breeds and strains. FAO Council backed COAG's view by unequivocally recommending “that the lack of funding should not be the cause of delay in implementation nor lessen the impetus already achieved”.

Given the present support for activities to ensure that more genetic diversity is not lost in developing countries, our Governing Bodies stressed that greater resources are needed. Preservation of animal genetic diversity is in the interest of the whole of humanity and, for this purpose, financial resources have to come from the developed part of the world.

COAG, when discussing the Animal Genetic Resources Preservation Programme, found that several technical, biological and legal questions still have to be answered and for this purpose asked FAO to call an Expert Consultation within this year. Your meeting is in response to this request. More specifically, the COAG questions will be presented to you in one of the following papers. Here I would like only to summarize what FAO expects in general terms from this meeting.

1. There is no doubt that the Animal Genetic Resources Preservation Programme should be organized on a global basis which means including developed and developing countries. What should be the modality of such a programme? Since there is probably no doubt that FAO is the Organization which should take lead in such a programme, in cooperation with UNEP and other organizations, the question still remains as to how it can best be accomplished.

   The first part of this Consultation is designed to deliberate on the institutional, legal and financial aspects. A working group is expected to draft conclusions and recommendations on these issues. Your recommendations on the appropriate nature of inter-governmental forum, legal instrument and financial arrangements will be of particular interest to FAO in developing it's programme not only on animal genetic resources but also on biodiversity in general.

2. Global animal genetic resources preservation calls for strong international cooperation and support. Should we not, establish therefore an International Undertaking as has been done for plant genetic resources?

   The objective of such an undertaking would be to ensure that animal genetic resources of interest, particularly for agriculture, will be explored, preserved, evaluated and made available for breeding and scientific purposes. It would be based on the principle that such resources are a heritage of mankind.

   Such an undertaking probably should include definitions of terms and cover:

   - Governments adhering to the Undertaking organising or arranging for missions of scientific exploration to identify resources in danger.

- Appropriate legislation and other measures being developed and maintained to protect and preserve resources - both *in situ* and in gene banks.
- International Cooperation aiming to strengthen the capabilities of developing countries, intensify activities in all aspects of animal genetic resources.

International arrangements being developed further to ensure a coordinated network of gene banks, to increase the activities and to provide adequate training and funding for these tasks.

FAO's role might be, for example, to keep the international situation under review, to establish an intergovernmental body to monitor the Undertaking (Commission), to recommend further activities and to act in consultation with those governments which are signatories to the Undertaking.

It is clear that the preservation of plant and animal genetic resources have the same objectives-preservation of biodiversity. But are the biological and technical differences not big enough to maintain this programme seperately within FAO, at least for the time being? In particular, because of the considerable political and economic differences which derive from the fact that with animals the gene flow comes from the north to the south while - with plants - from the south to the north. This fact cannot be underestimated in our plans.

3. What resources, including funds, FAO infrastructure, and staffing is needed to make such programme viable?

How can we get support for such a programme from the member countries, donor agencies and interested companies?

Animal genetic resource preservation has one distinct advantage which all those involved must learn to exploit - public perception of animal preservation appears to be even more favourable than the general support given to all matters “green”. This should provide a useful basis on which to press for the resources necessary to carry out the work involved.

4. The future course of action for the preservation and utilization of animal genetic resources should be considered together with the institutional, legal and financial requirements for implementing the necessary programmes. The FAO programme on animal genetic resources is well defined and, at present, there is a need to develop projects for implementing the programme in developing countries. Whenever institutions in member countries have shown interest in developing a preservation programme, appropriate projects are being prepared in order to establish donor trust funds to support these projects. The recommendations of this Expert Consultation will be particularly useful in preparing these projects and finding donor funds.

5. Coupled to the question of funding are inevitably the legal and institutional aspects - these are crucial to the successful operation of data and gene banks whether in live animal form or by cryogenic means. The legal means of ensuring that genetic stock are preserved and can be used properly is itself a difficult area and one which needs to be resolved urgently. Lessons must be learnt from the experiences of those involved in plant resources - new biotechnology offers greater opportunities for the use of genetic engineering - these possibilities must not stand in the way of the initial preservation of the resource. It is this reasoning which leads the AGA secretariat to work on the basis that the donor country

retains ownership of all material stored. Because of the complexity of this area, we propose establishing a working group as part of this Consultation meeting which has a most important role in recommending ways in which animal genetic resources preservation can take place quickly and can ensure that genetic diversity is available on a global basis.

6. How broad should be the animal genetic resources preservation programme? Should it include only the so-called farm animals or also some wildlife?

7. What should be the time scale of activities? This has major implications for funding and its timing.

What should be the role of preservation *in situ* and *ex situ*? How far can the new developments of biotechnology (molecular genetics) alter the methods of genetic resources preservation?

There are many other questions and problems which will emerge from the papers presented and from the discussions.

I am convinced that, with the expertise gathered here, this Consultation will greatly contribute to the future development of programmes and projects in the preservation of animal genetic resources not only by FAO and its Member Governments, but also by other institutions and organizations throughout the world. I wish you every success in your deliberations and look forward to a useful outcome.

APPENDIX 5

AGENDA

Tuesday, 26 September 1989

0830		Registration
SESSION I		**Opening of the Expert Consultation**
0900	1.	Opening Statement: Assistant Director-General, Agriculture Department
0920	2.	Introductory Statement: Director, Animal Production and Health Division
0940	3.	Statement by UNEP
1000	4.	Election of Chairman and Vice-Chairman
1005		Break
SESSION II		
Rapporteur :		*HA. Fitzhugh*
1045	5.	Requirements for animal genetic resources, recent developments and future prospects (H.A.Fitzhugh)
1115	6.	Legal questions relating to the preservation and use of animal genetic resources (M. A.Hermitte)
1200	7.	Existing legal and institutional arrangements for conservation of genetic resources (Secretariat LEG)
1230	8.	Programme and Finance aspects of FAO Workplan for Animal Genetic Resources (Secretariat AGA)
1245	9.	Resumé by the Rapporteur.
1300		Lunch
SESSION III		**Technical Problems Associated with the Preservation of Animal Genetic Resources**
Rapporteur :		*D. Simon*
1400	10.	Review of Regional Animal Gene Banks and questions raised by the Tenth COAG with recommendations on these topics from the Hannover Workshop held in June 1989 (J. Hodges)
	11.	Discussion and approval of the report of the Hannover Workshop
1500	12.	Future biotechnological possibilities in preserving animal germplasm (G. Brem)
1545		Break
1615	13.	Cryogenic preservation of wildlife germplasm. (M.H. Woodford)
1700	14.	Resume by the Rapporteur
		The Working Group on Institutional, Legal and Financial Aspects will meet in the evening (Chairman H.A. Fitzhugh)

Wednesday, 27 September 1989

SESSION IV		**Live Animal Preservation**
Rapporteur : EL. Henson		
0900	15.	A review of live animal preservation (I. Bod6)
0930	16.	The organization of live animal preservation programmes (E.L. Henson)
1000	17.	Principles and programmes for live animal preservation in developing countries (A. Mariante)
1020		Break
1050	18.	Programme for preservation of livestock breeds in Europe (S. Wezyk)
1110	19.	Live animal preservation programmes in Africa (L. Setswaelo)
1130	20.	Experience with *in situ* preservation of poultry breeds (R.D. Crawford)
1200	21.	Discussion
1245	22.	Resume by the Rapporteur
1300		Lunch
SESSION V		**World Watch on Endangered Breeds**
Rapporteur :		*RD. Crawford*
1400	23.	The Global Animal Genetic Data Bank (D. Simon)
1440	24.	A World Watch List for Endangered Breeds of Livestock (K. Maijala)
		Endangered Livestock Breeds in developing world
1510	25.	East Africa (K.O. Adeniji)
1525	26.	West Africa (L.O. Ngere)
1540		Break
1610	27.	South Asia (R.M. Acharya)
1625	28.	East Asia (Y. Chen)
1640	29.	Latin America I. (A. Mariante)
1655	30.	Latin America II. (G.E. Joandet)
1710	31.	Endangered breeds of sheep (J. Lauvergne)
1725	32.	Endangered breeds of Poultry and Ducks (B. Gunawan)
1740	33.	Endangered Camelidae breeds (C. Novoa)
1755	34.	Resume by the Rapporteur

Thursday, 28 September 1989

SESSION VI

0900	35.	Report of Working Group on Institutional Legal and Financial Aspects (by Chairman H. A. Fitzhugh)
0930	36.	Discussion on Report and formulation of recommendations
1030		Break
1100	37.	Presentation of draft technical recommendations (by Rapporteurs)
1130	38.	Discussion of draft technical recommendations
1230		Lunch

1400		Discussion (continued)
1530	39.	Adoption of Recommendations
		Closing of the Expert Consultation.

APPENDIX 6

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APPENDIX 7

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Prof. D. Simon, Institute for Animal Breeding and Genetics, Tierärztliche Hochschule, Hannover (FRG) institutions, breeding associations and animal producers in those countries. Also there are described examples of financing and support of agricultural producers and farmers, who keep rare and disappearing breeds of farm animals and poultry. There is underlined, that the goal of such support is not only preservation of gene pools as elements of commercial animal production, but also as element of historical and cultural heritage and ecological balance. The article discusses actual tasks of GPP preservation in Russian Federation, mentions the institutions and organizations in charge for this to Ex situ conservation: captive breeding, gene and seed banks, zoos and aquaria and all other forms of maintaining species artificially and off-site. Contrasts with in situ methods such as parks and habitat management. Introductions: releasing animals (captive or wild born) where they never existed. Usually because old habitat is gone or degraded, not available, but the new habitat is considered suitable.