CONSERVATION BY MANAGEMENT

AN EXAMPLE OF A NATIONAL PROJECT ON MANAGEMENT OF ANIMAL GENETIC RESOURCES (N'DAMA CATTLE BREED): A CENTRE AT BOKE FOR SELECTION, MULTIPLICATION AND IMPROVEMENT OF N'DAMA CATTLE IN THE REPUBLIC OF GUINEA

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This short-term mission was achieved for an FAO/UNDP Project, in the Republic of Guinea (République Populaire et Révolutionnaire de Guinée). This is a national project. Its title is "Centre de Sélection, multiplication et amélioration du troupeau N'Dama", i.e. Centre for Selection, Multiplication and Improvement of N'Dama Cattle.

One third of the total N'Dama cattle population is located in the Republic of Guinea (1 154 000 head on 3 423 000) (FAO 1980). The Futa Djalon mountainous region in Guinea is considered as the original territory of the breed, from which it spread progressively to Senegal, Mali, Sierra Leone, Ivory Coast, Liberia and, more recently, to Zaire, Congo, Ghana and Nigeria.

This regional breed, considered as trypanotolerant, is widespread (12 countries).

FAO and UNDP accepted to fund a "Centre for Selection, Multiplication and Improvement of N'Dama Cattle" located in Guinea. Until new, not much selection has been done in the N'Dama population. The evaluation of this breed, in rather improved or fairly improved conditions, has been partly achieved.

1. THE GOALS OF THE PROJECT

- Setting up of a 300 head herd with animals bought from farmers.
- Selection of the criteria of trypanotolerance, adaptability and meat productivity.
- Multiplication to provide African foreign countries with improved N'Dama.
- Evaluation of the N'Dama breed in slightly improved conditions.

2. THE TRAITS TO BE SELECTED

2.1 Trypanotolerance

The genetic determination of trypanotolerance and the biochemical aspects are not perfectly known:

The certitudes:

i. Trypanotolerance partly depends on genetic factors, but the genetic determination involved is probably complex (several loci, some of which responsible for the immunity response).
ii. Trypanotolerance of an animal also depends on its conditions (nutrition, stress, etc.) and on the challenge (intensity of exposure to infected tsetse flies).
iii. There is a great range of sensibility, to trypanosomiasis (or of trypano tolerance) in the N'Dama breed.

iv. As a matter of fact, the N'Dama trypanotolerance is not absolute. Trypanoso-miasis is responsible for mortality (calves, stressed animals), morbidity (persistent anaemia, etc.) and for lowered performances (growth, milk production, reproduction1).
v. The high trypanotolerance of the N'Dama population considered as a whole is due to its ability to control and limit the parasitaemia.

The uncertainties

i. Quantitative measure of phenotypic trypanotolerance has not yet been described and practised
ii. The heritability of the trypanotolerance trait is not known.
iii. Safe genetic markers, indicators of trypanotolerance, are not yet known, though studies on enzyme Erythrocyte glucose 6 phosphate dehydrogenase are being done.

2.2 Adaptability to Hard Conditions

The N'Dama breed shows a real ability to survive in difficult conditions2. One will consider that the level of performance of an animal of the Centre is an indicator of its resistance and its adaptability. The traits taken into account will be morbidity, longevity and, in general, the level of performance.

For this reason, the animals of the Centre must not be reared under too improved conditions.

2.3 Meat Performance

A moderate selection on meat performance can be done. The mean daily gain between 1 and 3 years will be used for this purpose. There are also large differences in the body construction (animals more or less bulky), which are partly genetic.

3. TECHNIQUES OF COLLECTING AND STORING DATA

3.1 In the Centre

Identification of the animals and setting up of a card index: 1 card per animal with information (pedigree, mother line only, growth (3 months to 3 months), reproductive career of the cows, sanitary information (diagnosed diseases, symptoms, analysis, health events).

3.2 In Traditional Herds

Data will be collected in traditional herds (for each cow: how many calves, how many weaned calves).

4. RECOMMENDATIONS FOR THE ORGANIZATION OF THE CENTRE

4.1

The animals to be bought now in traditional herds will have to be chosen more carefully (the average quality of the 100 animals in the Centre is not higher than the average quality of the animals in the traditional herds).

There are great difficulties to get very good animals from the farmers, who do not want to be paid in national currency and are very reluctant to sell females, either heifers or cows.

4.2 Is the Location of the Centre Suitable?

The pressure of infected flies must be at least medium on the territory of the Centre. If this was not true, selection on trypanotolerance could not take place. Capture of flies and dissections must be done, and should have been done before the location of the Centre was decided (in 1981, 150 flies captured, 30 dissected, none of which infected).

4.3 Recommendations for the Rearing of the Herd

- To recruit a skilful Fulani herdsman, who must not be allowed to milk the cows (difficult to check).
- Heifers must not be mated before 30-32 months (160-170 kg). Elimination of some animals of the present, herd (approximately 1/10).
- Purchase of new animals, from traditional breeders (20 to 40 percent of the animals are satisfactory from the point of view of morphology), in areas where the challenge is medium or high, chosen on different criteria: age (female 2.5

years, male 3.5 years), morphology, reproductive performance of their mothers, etc.

4.4 Recommendations about Selection

A 300 head herd (number of reproductive animals) is not enough to do serious selection. The size of the reproductive herd should be at least 1000 head. Figure 1 indicates the career of one generation of calves1. The renewal of the reproductive herd is both internal (selected animals born in the Centre) and external (animals chosen in herds reared by cooperating or non cooperating traditional farmers). The animals born in the Centre are selected on their performance or characteristics, thanks to a simple index combining:

-	the mean daily growth (between 1 and 3 years)	50%
-	a morphology mark	25%
-	a trypanotolerance mark2	25%

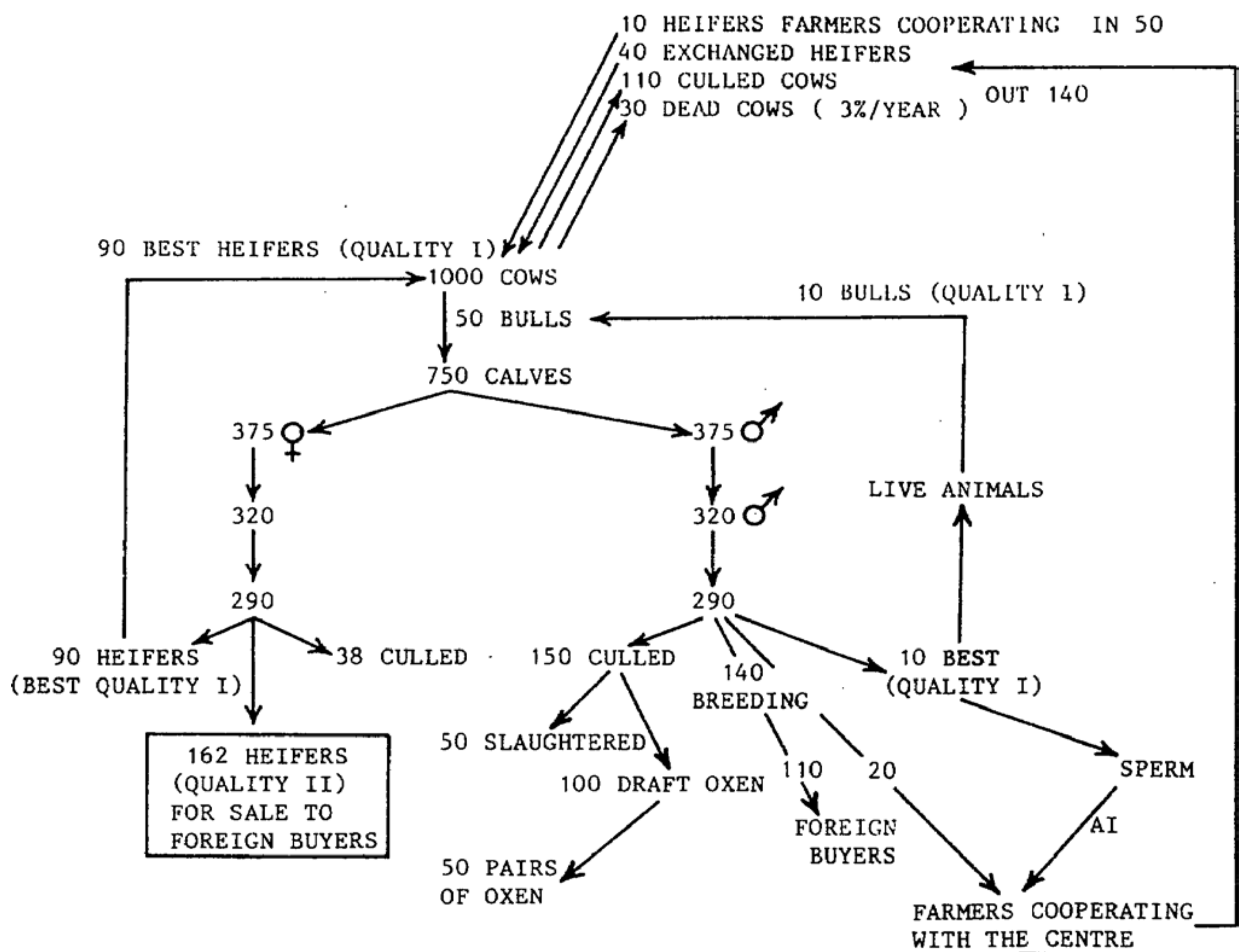

Fig. 1 The use of one year's crop of 1000 cows in a nucleus herd

Table 1 EFFECTS OF THE PROJECT ON DIFFERENT REGIONAL LEVELS

Level	Genetic progress				Progress by improvement
	Time needed (years)	Increase of daily growth gain after this time	Genetic increase of adult weight (kg)	Supplementary weight of meat from each adult animal (kg)	Improvement of meat productivity per cow, by deworming of calves
Herd of the Centre	10	22 % 183 g*	30	14	
Traditional herds cooperating with the Centre (1/3 of the herds of the project area)	25	9.3% 165.6 g	13	6	60 kg meat/year of reproductive life of the cow (calf mortality: 40%) ↓ 80 kg meat/year of reproductive life of the cow (calf mortality: 20%) i.e. + 25%, in 3-4 years
Traditional herds of the project area	25	2.6% 154 g	3	1.4	
All traditional herds in Guinea (with AI in some cooperating	25-30	2 %	2	1	

- Mean daily growth gain

Table 2 STATISTICS OF GEOGRAPHIC REPARTITION OF N'DAMA CATTLE (PER COUNTRY)

			Thousands of heads of N'Dama	%
Zone d'extension naturelle	Guinea		1 154	33.7
	Senegal		746	21.8
	Mali		465	13.6
	Gambia		296	8.7
	Sierra Leone		207	
	Guinea Bissau		166	
	Ivory Coast		70	
	Liberia		11	
		Sub-total	3 115	
Zone d'implantation	Zaire		240	7.0
	Congo		33	1.0
	Ghana		17	0.5
	Nigeria		15	
		Sub-total	308	
		TOTAL	3 423	100

Source: Bétail trypanotolérant en Afrique de l'Ouest et en Afrique Centrale. Vol. 1. Etude générale. OAA, Rome (1980).

The performance of the mother (reproductive performance, growth) is also taken into account to discriminate between the candidates for reproduction.

5. GENETIC EFFECTS OF THE CENTRE ON THE REGIONAL AND NATIONAL N'DAMA POPULATION

It is possible to evaluate1 the genetic gain on mean daily growth which will be obtained if the herd of the Centre is reared according to Figure 1. The genetic improvement on growth and size is very low compared to the progress which can be done in 3-4 years, only by deworming campaigns (see Table 1).

It is obvious that such a project requires the confidence of the farmers. For different reasons, it may be difficult to get this confidence back.

6. A REGIONAL COORDINATION OF THE SELECTION, MULTIPLICATION AND EVALUATION ACTIVITIES OF THE N'DAMA BREED MUST BE SET UP

This breed can be found in 12 African countries. Nine of these countries represent 98.6 percent of the whole N'Dama population (see Table 2). The Boké Guinean project for selection and multiplication of the N'Dama could play an important part in the set up of this regional coordination, if it is a success. Technical institutes such as ILCA, economic and political organizations such as the Commission Economique des Etats de l'Afrique de l'Ouest have a part to play, too.

IMPROVEMENT, MULTIPLICATION AND CONSERVATION OF TRYPANOTOLERANT CATTLE BREEDS

C. Hoste1

1. INTRODUCTION

The trypanotolerant cattle can be divided into two main groups: the N'Dama and the West African Shorthorns. The latter group can be subdivided in terms of overall size into Savanna and Dwarf Shorthorns. The N'Dama can be considered as a single breed but in each group of the Shorthorns different breeds can be found.

The ILCA/FAO/UNEP study (ILCA 1979) has estimated the numbers in these groups as: 3.4 million head for the N'Dama; 1.7 million head for the Savanna Shorthorn and 0.1 million head for the Dwarf Shorthorn. Numbers and economic interests are quite different for each group. Therefore even if the improvement and the multiplication of each breed is desirable, present priorities for breeding plans are (or should be):

- improvement and multiplication for the N'Dama
- multiplication and conservation for the Savanna Shorthorn
- conservation for the Dwarf Shorthorn.

2. IMPROVEMENT AND MULTIPLICATION FOR THE N'DAMA

Improvement of the productivity of a breed can be undertaken either within the breed through selection or by crossbreeding operations with "improved" breeds. But even in that case, it is necessary to start with a good basic herd, which also implies selection of the pure breed. Results of both policies will successively be reviewed and some proposals made for the N'Dama breed.

2.1 <u>Selection</u>

Selection of the N'Dama can be done with two rather different approaches: the improvement of productivity at the national level or the production of breeding groups which are representative of a certain phenotype for export. Undoubtedly the first objective should be the priority because it leads in the long-term to food self-sufficiency. In reality an inversion of priorities is seen with the implementation of improvement and multiplication centres for a certain type of N'Dama rather than for the N'Dama breed as a whole.

Selection for the "typical" N'Dama is usually the responsibility of research stations. This choice should be reconsidered for several reasons:

- Research stations have rather small areas (a few hundred hectares at the best) and numbers of cattle for breeding are rather small (a few hundred head). Genetic variability and consequently selection efficiency are limited.
- Research stations tend to intensify the environment (fodder crops) to increase their cattle population. In addition, stations are usually considered as show-windows of the country and animals must be in good condition. Therefore they are bred more and more artificially. Results are apparently satisfactory but miss the main objective, because improved animals become totally unadapted to the commercial environmental conditions in which they will have to live and reproduce.

Therefore selection cannot be efficiently done in stations but should be carried out by large multiplication units using a breeding system which is much closer to the natural conditions. To be viable and efficient these units should have a minimum of 3 to 5 thousand head.

It is essential and crucial to implement a selection programme which can be applied by all the multiplication units. This programme must be simple, efficient and easy to implement. Several organizations (such as FAO, ILCA, IEMVT) have certain experience in this field, but they used different schemes. As no irreversible choice has yet been taken, it is vital to plan a meeting to present and discuss the different selection programmes. The final result should be a united decision on the scheme to be adopted; or at least to agree on a minimum package of information to be collected in each situation. That will lead at a later stage to the definition of a standard of the N'Dama breed.

The management of these multiplication units should be based on extensive grazing with natural pastures. This is vital. The success of ranches is directly linked to bush control, the increase of good natural fodder species, the availability of good pastures all the year round, etc. All of this implies a strict fire policy and rotation of herds on the different pastures. A workshop on this subject should also be organized or could be joined with the one on selection programmes.

2.2 Crossbreeding

Nearly all research stations or national organizations which were in charge of the improvement of the N'Dama breed were tempted into crossbreeding with exotic and mainly Euopean breeds. N'Dama crossbreds have been produced with:

- Charolais and Friesian in Bissau Station in Guinea Bissau,
- Krasnaya Steppnaya, Jersey, Ayrshire and Holstein in Guinea,
- Sahiwal in Teko Station in Sierra Leone,
- Brown Swiss in Liberia,
- Jersey, Krasnaya Steppnaya and Brahman in Sotuba in Mali,
- Jersey in Bouake and Abondance and Fleckvieh in the North of Ivory Coast.

Most of these programmes have stopped because, while crossbreds usually survive on stations (usually with many problems), they have never been successfully distributed outside these favourable environments. Crossbreeding programmes cannot be encouraged, but on-going operations should be carefully monitored.

2.3 Role of Research Stations

If the research stations were no longer in charge of selection programmes they would still have a preponderant role to play in the improvement of the N'Dama breed.

In traditional environments they have to work out the methodology of data collection and to study with a multidisciplinary approach all the constraints to the livestock development systems; they can also participate in data recording and assist in data analyses.

Within stations, with their own cattle, scientists should study the different parameters which can increase productivity in different environments, such as weaning time, dipping and/or deworming frequencies, feeding regimes, reproduction cycles, sperm collection, dilution and conservation, etc.

3. MULTIPLICATION AND CONSERVATION FOR THE SAVANNA SHORTHORN

Substantial populations of the Savanna Shorthorn are still found in Ghana (616 000 head), Upper Volta (484 000 head) and Ivory Coast (250 000 head). These three countries have more than 80 percent of the total Savanna Shorthorn population.

The main problem for these breeds is crossbreeding with zebu which is widespread. Measures must be taken urgently of substantial numbers of pure breeds are to be preserved. The best justification for doing this lies in the high productivity figures shown in the ILCA/FAO/UNEP study (1LCA 1979).

Two different types of action can be undertaken to face the problem:

- to convince national governments of the value of the local breeds kept as pure breeds. Then, when they are convinced, to assist them in the implementation of breeding policies to limit anarchistic crossbreeding;

- FAO and UNEP should start immediately an appraisal study for a livestock development project through inter-country (Ghana, Upper Volta, Ivory Coast) cooperation, based on local breeds and including a multiplication centre of the pure Savanna Shorthorn (named Ghanaian Shorthorn in Ghana, Lobi in Upper Volta and Baoulé in Ivory Coast).

In this group, only two breeds are in real danger of extinction or absorption: the /?/oayo and Kapsiki breeds in Cameroon. In spite of recommendations made since 1978 no conservation measures have been taken and it seems that at present it is too late to take action. Including the Bakosi breed, this makes a total of three breeds extinguished in Cameroon in the last ten years. Certainly, these places should be visited in the near future to decide if these names have to be finally scratched from the maps.

4. CONSERVATION FOR THE DWARF SHORTHORN

With only 1 percent of the total trypanotolerant population, the Dwarf Shorthorn group is the one most in need of conservation measures.

Fairly large populations still remain in Nigeria (38 000 head), Benin (20 000 head) and Liberia (15 000 head) but are under heavy pressure from both N'Dama and zebu. Conservation measures, combined with improved utilization, should be directed towards these larger groups.

However, as these populations live in small and relatively isolated pockets, it is much more difficult to propose inter-country cooperation for the conservation of these breeds than for the Savanna Shorthorns.

In Nigeria many state farms exist and one of them could easily be devoted to the Dwarf Shorthorn (named Forest Muturu). The Pota ranch in Lagos State which is located in the Forest Muturu area would be the ideal place. If the purebred Muturu herd could be kept under the same management conditions as the N'Dama or crossbreeds and individual recording reinstated, that would permit good and very interesting comparative studies.

In Benin a case study has been undertaken by ILCA (Lazic 1978) and results indicate that in terms of productivity, the Lagune breed (Dwarf Shorthorn) is superior to the Borgou (stabilized cross between Savanna Shorthorn and zebu). This should encourage the livestock development projects in that area to keep a large herd of pure Lagune.

In Liberia, like in Nigeria, a state farm should be devoted to the breeding of the Liberian Dwarf and the N'Dama to allow comparative studies and preserve large numbers of the Dwarf Shorthorn. A ranch has already been identified by Mason (1982).

5. CONCLUSION

Actions for the improvement, multiplication and conservation of trypanotolerant cattle breeds are rather well defined.

The problem is that most of them are urgent and have already been mentioned in the ILCA/FAO/UNEP study in 1979, but nothing has yet been undertaken in these lines. Consequently, the extinction of two additional breeds has occurred; also more and more difficulties will be encountered to initiate conservation measures for the others.

The recommendations of this meeting should be strong enough to be followed by programmes in the field.

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SUDANESE INDIGENOUS CATTLE BREEDS AND THE STRATEGY FOR THEIR CONSERVATION AND IMPROVEMENT

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1. INTRODUCTION

1.1 Sudan Animal Wealth

The Sudan is predominantly an agricultural country with a large livestock fund estimated at about 18 million head of cattle, 30 million sheep and goats and 2.6 million head of camels. The livestock population compared to the human population is as follows:

Year	Total animal units thousands	AU/Human
1977/78	25 044	1.51
1978/79	26 332	1.55
1979/80	27 961	1.58

Animal Unit (AU) equals one cow or its equivalent.

In spite of this large animal population there is a shortage of milk and dairy products in many parts of the country. The *per capita* consumption of milk and dairy products is estimated at about 38.8 kg liquid milk, 3.8 kg cheese and 0.8 kg (clarified) butter. The total amount of meat produced annually is 700 thousand tons. Though lamb and mutton is the meat of choice for most Sudanese and represents 20 percent, beef represents about 70 percent and goats and camel meat represent about 10 percent of the total meat consumption. The Sudan exports annually about half a million head of sheep to the Middle East countries.

1.2 Physical Environment and Climate

The Sudan is a vast country with an area of about 2.5 million square kilometres extending over 18 degrees of latitude (4^0 N to 22^0 N) and hence displays a great diversity of climatic conditions. Parallel to this, the country also exhibits great variation in soil types. The interaction of these two factors created various ecological niches which affected in many ways the people and their animals. The flow of the Nile and its tributaries throughout the entire length of the Sudan from south to north adds further variation and amelioration of the environment.

According to the annual precipitation, which is the most important single factor, the Sudan may be divided into three main ecological zones: the arid (north of 16^0 N), savannah (10° - 16°N) and the tropical forest swamps south of the 10th parallel.

For most parts of the country (except the extreme north and extreme south), the climate is characterized by long dry summers and a very short rainy season (July-September). Summers are very hot with mean maximum temperatures rising several degrees above mammalian body temperature. The rains are erratic and consequently there is tremendous fluctuation in the feeding and nutrition of livestock in the different seasons and years. Livestock depend on natural grazing and crop residues. The pattern of animal husbandry is mainly nomadic.

The animal health situation is far from satisfactory. Besides nutritional diseases resulting from seasonal malnutrition, many endemic diseases affect both cattle and sheep. Tick-borne diseases like theileriasis, cattle infectious diseases and trypanosomiasis still prevail in some parts of the country.

2. CATTLE BREED TYPES

According to origin and physical characteristics, the cattle of the Sudan can be classified into two main groups viz. Northern Sudan Shorthorn Zebu and Nilotic cattle in southern Sudan. The older of the two main groups is undoubtedly the Nilotic which is to be classified as "Sanga", a cross mainly derived from the longhorn humpless and the longhorn zebu which infiltrated from Asia into Africa in dynastic times.

2.1 Northern Sudan Shorthorned Zebu

This group includes the following distinguishable breeds: Kenana, Butana, Baggara. All of these breeds are predominantly raised by nomadic tribes in central Sudan. Because of some common grazing areas some admixture of blood is seen in some herds.

Kenana:

This breed is named after the Kena tribe who inhabit the western bank of the Blue Nile. Kenana and Rufaa El Hoi are both semi-nomadic tribes who raise Kenana cattle. The colour of the breed- is light grey on the body, while the head, neck, shoulders, legs and tails are usually black. The calves are born red and change colour gradually to light grey at three months of age. The hump is large, the dewlap is pendulous and the horns are short. The home of the breed is mainly between the White and Blue Nile almost up to Khartoum. For details of production traits see Appendix.

Butana:

This breed is named after its homeland, the Butana plain of central Sudan which lies between the Nile, River Atbara and the Blue Nile. The area is composed mainly of non-cracking clay with few seasonal rivers some of which drain into the Nile. It is mainly grazing land for sheep, camel and cattle nomadic tribes.

The colour of the breed is solid red, with some black on the mouth, eyes and some joints. Both in size and production characteristics, it resembles the Kenana breed (Appendix).

Baggara:

The name of the breed "Baggara" means cattle herders. This breed is found in western Sudan and is raised by nomadic tribes in Darfur and Kordofan. Its homeland is the savannah belt of central Sudan.

It represents the majority (about 80 percent) of the northern Sudan shorthorn zebu cattle. The breed shows great diversity of colour but has mainly dark colours. The horns are short and the dewlap is large. For production see Appendix.

2.2 Nilotic Cattle

These are the cattle of southern Sudan. The whole area is a flat clay plain sloping very gently from southeast and southwest towards the main river channels. During river flood the whole area is inundated for about six months annually. The area is infested with biting flies which necessitate cattle housing at night.

Nilotic cattle are nondescript, with medium body size, large horns and the hump is muscular and cervical to cervico-thoracic in position. These cattle have very low milk production potential.

3. GENETIC IMPROVEMENT PLANS

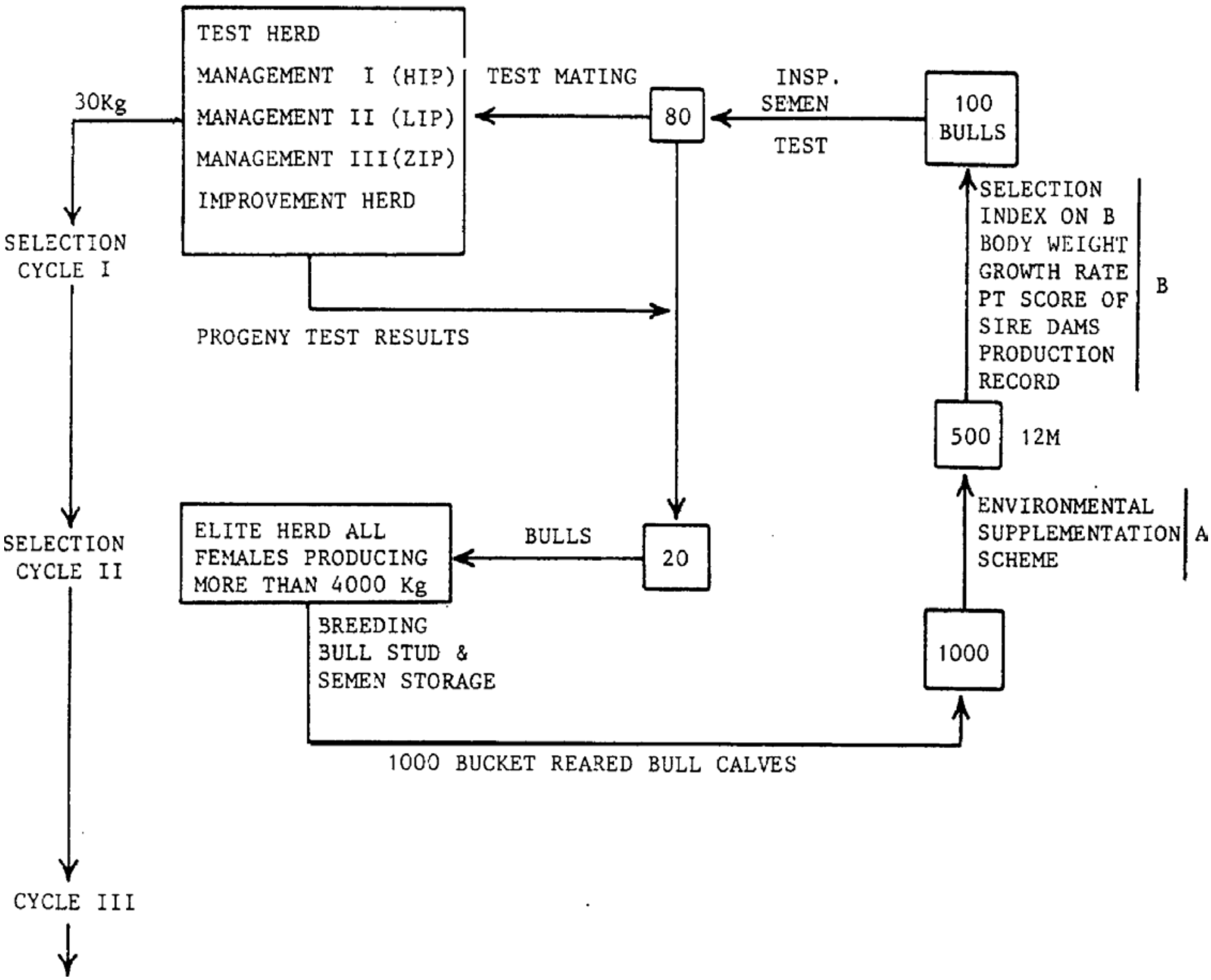
3.1 Conservation and Within Breed Selection

Early attempts at conservation and improvement of indigenous cattle breeds were conducted in 1940 (Boyns 1947) when a total of 223 Butana cattle were purchased from nomads and put in a government farm where good feeding, management and selection were practised. The results of this endeavour were very encouraging: thirty-two cows of this herd averaged more than 2000 kg in such a short period.

A similar herd of Kenana cattle was established in Medani Agricultural Experiment Station.

Shortly after independence in 1956, the Sudan Government established two more livestock experiment stations viz. Urn Benein for Kenana cattle and Ghazal Gawazat for Baggara cattle. While Kenana and Butana cattle were recognized as dairy breeds and selected mainly for this purpose, Baggara were selected mainly for growth rate and beef production.

A further development in animal breeding is the establishment of Kuku Research Centre in Khartoum North, with relatively good feedlot and meat laboratory facilities as well as a nutrition laboratory and poultry unit.



The results of selection for milk yield in institutional herds were as follows:

Farm	Breed	Milk yield genetic gain/year	h2
Medani1	Kenana	0.74	24
Atbara2	Butana	0.70	30
University3	Mixed (indig)	0.58	36

References:

1 Alim (1960);
2 (1962);
3 Osman (1970).

The institutional herds succeeded in preserving and maintaining few purebred Kenana and Butana herds, but due to their small size (about 200-300 cows) not much selection progress can be attained. In addition due to the lack of effective Al and extension services these herds had but little impact on the national herds.

3.2 Using Foreign Breed Resources

Early importations to the Sudan of exotic cattle and their frozen semen are shown in the following tables:

EARLY IMPORTATIONS OF EXOTIC CATTLE TO SUDAN

Year	Imported bulls	Breed	Origin
1925	1	Shorthorn	UK
1927	1	Friesian	USA
1929	1	Ayrshire	UK
1950	2	"	"
1960/61	3	Friesian	"
"	1	Guernsey	"
"	2	Ayrshire	"
1970	2	Friesian	"

IMPORTED FROZEN SEMEN

Year	Doses	Breed	Origin
1976/80	10 500	Holstein/Friesian/Jersey	UK
1981	3 000	Friesian	UK
1981	2 500	Friesian	Finland
1982	10 000	Friesian	Switzerland

The only reliable data on the performance of crossbred cattle is with the Belgravia Dairy in Khartoum. The results of crossbreeding in this farm over a period of about forty years were analysed (Osman and Russell 1974). The reproductive performance of crossbred cattle was satisfactory though inferior to that of indigenous contemporaries. Total lifetime milk yield increased with percentage of European blood to a maximum at 75 percent. High grade cows also had high milk yield per year of productive life, but a shorter productive life and higher death rates and infertility problems.

4. ORGANIZATION OF GENETIC IMPROVEMENT AND CONSERVATION

4.1 Ministry of Agriculture

By and large the Ministry of Agriculture is the main site of animal breeding and development activities. For this purpose, it has established four experimental stations and two AI centres for cattle breeding and development.

Experimental station	Breed	Herd cows	Feeding	Breeding plan
Um Benein	Kenana	250-300	irrigated pastures	selection for milk production
Atbara	Butana	100-150	"	"
Ghazal Gawazat	Baggara	400-500	range	selection for beef production
Shukaba	Crossbred	just starting	irrigated pastures	crossbreeding for milk production

4.2 Other Institutional Herds

4.2.1 University herds

The University of Khartoum has the largest and oldest herd. A foundation herd of about 200 North Sudan Shorthorn Zebu was selected for milk production for about forty years (Osman 1970). More recent development included establishment of a nucleus of purebred Kenana and Butana cattle as well as crossbreeding with dairy European cattle.

The University of Gezira Farm is keeping a herd of Kenana cattle as well as some crossbred cattle.

4.2.2 Belgravia Dairy

The largest farm in the country with European x zebu crossbred cattle is still continuing its upgrading programme which includes the use of other European dairy breeds (Ayrshire, Guernsey) besides Friesians.

4.2.3 Dairy Project in Khartoum

A new development which will have a great impact, at least in Khartoum province, is the newly established Dairy Project in Khartoum with an expected target of about 5000 dairy cows mainly of the Holstein/Friesian, Brown Swiss and Jersey. This project will provide an excellent opportunity for the study of the performance of purebred European cattle and their relative efficiency when compared to the indigenous breeds.

5. STRATEGY FOR UTILIZATION OF INDIGENOUS BREEDS

It is admitted that the indigenous cattle are low producers in terms of milk and meat yield. However, this low production is part of their adaptation to the local environment. In many instances indigenous cattle are also used in farm work and at times walk for several hundred kilometres in nomadic herds. Moreover, indigenous cattle have better resistance against endemic diseases such as tick-borne.

It is to be noted however that the indigenous cattle in view of their number produce the largest portion of milk and meat, therefore any genetic improvement programme, involving crossbreeding or importation of purebred European cattle to the country for replacement of the indigenous cattle, is not only impracticable but also undesirable. The use of exotic stock is at best a restricted activity in certain farms that can afford provision of improved feeding and management conditions not at present available in small farms and nomadic/transhumant herds.

Therefore genetic improvement of the indigenous cattle by selection continues to be the most advisable policy. However, due to the lack of scientific recording resulting from the mobility of herds (nomadic) or the small size of most herds and the magnitude of the expenses incurred under these conditions, the traditional methods of selection involving progeny testing of bulls must be modified to suit the prevailing conditions. The establishment of "nucleus" herds for the Kenana and Butana breeds through the purchase of very high milking cows and the application of embryo transfer may be a worthwhile effort in this connection.

Even though Kenana and Butana are the best milking breeds, while Baggara are mainly for beef production, selection for both milk and growth rates is important in all these breeds. In the former two (Kenana and Butana) a selection index, giving more emphasis to milk and less to growth rate should be applied. In the latter (Baggara) the reverse situation should be applied.

In order to encourage genetic improvement and conservation of the indigenous breeds, the Universities and agricultural and veterinary schools should be encouraged to maintain purebred herds of the indigenous breed of the locality-Genetic improvement and conservation require development of the AI, recording and extension services.

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APPENDIX

PRODUCTION TRAITS OF SUDANESE INDIGENOUS CATTLE

Table 1 REPRODUCTIVE RATES OF SUDANESE INDIGENOUS CATTLE IN INSTITUTIONAL HERDS

Trait	Kenana*	Butana*	Baggara**
Age at first calving, months	42±8	47±11	66±7
Calving interval, months	13.1+3	13.2±2.5	14.9±0.3
No. of services per conception	1.17±3	1.27+0.6	1.25±0.04
Gestation, days	286	290	287

* Kenana and Butana raised on irrigated pastures

** Baggara raised on natural range

Table 2 BIRTH WEIGHTS AND ONE YEAR OLD WEIGHT (kg)

Breed type	Birth weight		One year weight	
	Males	Females	Males	Females
Kenana	23.6	22.1	148.0	138.6
Butana	24.6	23.4	160.0	140.4
Baggara	22.2	20.6	148.4	NA

Table 3 FEEDLOT PERFORMANCE

Trait	Kenana	Butana	Baggara
Daily gain, kg	0.78±0.28	0.8910.20	1.00±0.23
Age at slaughter, months	17.8	11.5	21.8
Weight at slaughter, months	231.8	159.6	274.3
Feed conversion (kg feed/ kg gain)	8.15	6.2	6.44

Table 4 FIRST LACTATION MILK YIELD AND LACTATION LENGTH

Breed type	Farm	Lact. (days)	Milk yield (kg)
Kenana*	Um Benein	251	1 423
Kenana*	Nisheishiba	287	1 204
Butana*	"	242	1 095
Butana*	Atbara	220	1 213
Baggara**	G. Gawazat	244	671

* Kenana and Butana herds raised on green pastures

** Baggara herd on natural range

Table 5 MILK PRODUCTION (kg) OF KENANA CATTLE ABROAD

Year	Young cows		Mature cows		Lact.(days)	Calving int. (days)
1957	1 671	(1)	-		-	-
1958	1 726	(6)	1 543	(1)	305	388
1959	-		2 029	(6)	282	412
1960	-		1 856	(4)	304	412
1961	-		1 540	(3)	305	419
1962	1 508	(2)	2 214	(4)	305	366
Total/ Average	1 671	(9)	1 923	(18)	300	399

NB: In 1956 ten cows and two Kenana bulls were exported to the Livestock Experiment Station, Entebbe, Uganda. Ref. ABA (CAB). Annotated Bibliography No. 107.

BREEDING PLANS FOR IMPROVEMENT OF INDIGENOUS BREEDS AND SPECIES

P.N. Bhat1

SUMMARY

This paper discusses the strategies for preventing the loss to posterity, the fruits of thousands of years of natural and artificial selection of indigenous breeds and species through conservation by effective management and improvement. The need for conservation of indigenous breeds and species has been discussed and the breeds and species in danger of extinction indicated. The systems of husbandry and management under which these exist at present have been outlined. The available inputs for schemes of conservation have also been outlined. Breeding plans for improvement of indigenous breeds and species have been indicated. It has been shown that the current genetic improvement programmes in existence today involve either within population selection of indigenous breeds or a scheme of crossbreeding with improved germplasm. A number of genetic designs have been suggested for improvement. Earlier designs have been reviewed. Operational breeding plans for improvement of indigenous breeds of cattle like Shaiwal, Hariana and Jamnapari goats have been detailed. Similar plans for buffaloes and sheep have been discussed. It has been shown that for implementation of any breeding plan for improvement of indigenous breeds, it is necessary that the inputs should be available in their entirety at the very start.

1. INTRODUCTION

The growth in human population and man's interference with natural ecosystems has accelerated the pace of extinction of species and of genotypes within species. According to the estimates of the International Union for the Conservation of Nature and Natural Resources (IUCN), on an average one animal species or subspecies is lost each year. Since 1960, more extinctions have occurred than during the period from 80 AD when the extinction of the European lion was recorded. About 1000 birds and animals are now believed to be in jeopardy. Highly specialized adaptations resulting in a narrow genetic base could lead to an evolutionary blind alley and thereby ultimate extinction.

While the need for arresting species extinction is urgent, there is even greater need for preventing the loss to posterity, the fruits of thousands of years of natural and artificial selection through inadequate efforts in conserving genetic variability within the species. Asia has immense diversity of genetic resources in respect of animals and birds but these are fast vanishing because no systematic effort has been made in the past to conserve them. This is a gap which needs to be filled on a. priority basis. Due to large variation in the soil, climate and plant combinations in various parts of Asia, a large number of breeds and types of domesticated livestock and birds have evolved over a period of many centuries. These breeds have considerable adaptability to local environments, possess good resistance against certain diseases and are eminently suited for economic purposes in their areas of origin. It is well known that the breeds of livestock and poultry which have been evolved in the region are well adapted to the tropical heat and diseases.

According to the FAO Yearbook (1978) a resource inventory of these countries shows that about 1.8 billion people live in the tropics, out of which one billion depend on agriculture and forests for their livelihood, on a land area of 5.4 billion hectares. Out of 1.4 billion domestic livestock excluding poultry, there are 618 million cattle, 8.3 million buffaloes, 120 million pigs, 357 million sheep and 256 million goats. In spite of such large resources of renewable protein and carbohydrates the human population of this region cannot be properly fed on these animals; they suffer from serious shortages of protein, and general malnutrition. This is a paradox; in spite of these large numbers of farm animals they cannot produce sufficiently to feed the human population. The gap between availability and demand is primarily a result of bad management of these vast animal genetic resources.

Experimental evidence has proved that zebu herds of cattle have lower metabolic heat production which suits them well in the hot climate and make them comparatively better utilizers of low grade roughages available in the tropics. For these traits the Indian breeds of cattle have been in demand for crossing for evolving more adapted breeds of cattle in the Latin American countries, in Australia and the warmer regions of the USA. Purebred herds of zebu cattle like Gir, Kankrej and Sahiwal are found in Brazil, West Indies, Australia, Kenya, etc. The zebu breeds have helped to produce high yielding beef cattle like Santa Gertrudis, Brahman, Brangus and Indo-Brazil. These have also served as a base for evolving new breeds like Jamaica-Hope and Australian Milking Zebu (AMZ). In Australia, zebu breeds have been valued for their resistance to tick infestation and for their heat tolerance.

Little effort has been made on evaluation, conservation and improvement of available genetic resources of indigenous livestock. Such an effort must be made without any loss of time. Some of the breeds have extremely limited breeding tracts, are of relatively little economic value currently and for various reasons are fast declining in numbers; efforts to conserve, multiply and improve them must be made. For example populations of Sahiwal, Red Sindhi and Tharparkar cattle in India, Toda and Ganjam breeds of buffaloes, Mandya, Magra, Hissardale and Nilgiri breeds of sheep, Jamnapari and Barbari breeds of goats have declined seriously and would deserve immediate attention.

Most developing countries are embarking on large-scale animal improvement programmes often accompanied by the introduction of high yielding breeds from temperate zones with a resultant decline in the number of local livestock types. The latter have, through natural and artificial selection, developed characteristics which made them well adapted to the often harsh environmental and climatic conditions. It is, therefore, important that this valuable genetic material be used in the building up and improvement of the national livestock resources. Ways and means must be found by which rapid genetic progress may be made through intensive selection and/or the introduction of breeding material from outside without jeopardizing the genetic adaptation to environment and nutritional condition.

Before the advent of fossil fuel, animal energy was the only source of farm power. This came mainly from bullocks and a number of cattle breeds had to be specifically developed for this purpose. India thus possesses the best draught breeds of cattle in the world today. It has been estimated that a bullock is capable of generating on an average half a horsepower of energy. The bullock population in India alone generates 36 million hp, equal to approximately 27 138 MW of electric power. The total installed capacity of electric energy in India is around 26 000 MW. It has been estimated that two thirds of the energy input into our farm operations comes from animals, a renewable source of energy. Of the rest 15 percent comes from human exertion, and only 10 percent is derived from other forms of energy like fossil fuels (petroleum and coal) and hydro power. This would indicate that renewed effort should be made not only in conservation of the different draught breeds of various species of livestock available in Asia but also on their multiplication and further improvement.

Barring a few attempts at evaluation mainly connected with animal improvement programmes there has been very little real awareness of the resources we possess, or appreciation of the dangers they face. The wealth which has been gifted to us by our ancestors and nature needs to be carefully managed. In our legitimate concern for assuring animal products for today we should not forget to conserve and manage resources for the benefit of our future generations.

There are two major problems which are relevant today as far as animal genetic resources utilization is concerned; one is that of breed displacement through crossbreeding and another and more serious one is that of dilution and negative selection from urbanization as in the case of the Indian buffalo. It is not possible to preserve all the breed populations. Conservation primarily for reasons of their genetic uniqueness or their beauty or their history are reasons which cannot support conservation effort in under developed or developing countries. The only possible method of conservation is through proper management through scientific improvement programmes of the indigenous livestock, so that these breeds or species which have innate adaptable merit can stand on their own under harsh environment.

2. SYSTEMS OF HUSBANDRY AND MANAGEMENT

In large parts of the developing world animal husbandry is a normal adjunct to crop agriculture and animals are kept as a source of power for farm operations, transportation, irrigation and production of manure. They are generally maintained on crop residues and byproducts of agriculture for milk, meat and wool. The bulk of animal rearing is done by small and marginal farmers and landless agricultural labourers with land holdings of 1/4 to a hectare. This kind of input is available in most of the Asia and Oceania region. In parts of the Middle East, North Africa, parts of Latin America and Southern Asia large land holdings are also common. Size of holdings and total inputs available are rather small. Governmental improvement programmes are fairly clearly drawn out with respect to breeding structure but the implementation of these plans and programmes suffers due primarily to lack of inputs in either technology or finance or both.

In some of these countries an institutional structure funded by the government also exists which maintains herds of livestock as nuclear or multiplier herds and for research and training in various colleges and universities. Some countries have large farms run by the government for commercial production of milk like military dairy farms in India and Pakistan and national livestock farm complexes in Iraq and Egypt. These are also used for spreading superior germplasm to the rural population for improvement of their stock. This is primarily the structure available on which any breeding plan has to become operational.

3. BREEDING PLANS

Why should the indigenous breeds or species be improved The reason is obvious, because a high proportion of total human food requirement is produced by these animals, they are adapted to village or small farmer conditions, they utilize low quality feeds, crop residues and human waste and thus have low energy and low economic inputs, they provide an important source of income and work to the villager and small farmers who are under employed for most parts of the year. The indigenous breeds have developed an adaptation to the environment (climate, system of husbandry and health and input level which are generally low) which enables them to produce and reproduce where exotic breeds have serious survival and reproduction problems (Bhat 1981a).

Bhat (1977; 1981a) has detailed the kind of indigenous breeds available in large parts of the Asia and Oceania region and their production potential. He concluded that the levels of production and reproduction were relatively low when compared to improved breeds of Europe and North America. The total intake nutrient levels were, however, low and the survival was superior. Under certain environmental situations (foraging, supplemented by kitchen waste) the improved exotic breeds had genotypic value of zero for most production traits.

A number of critical gaps were observed from the information available on evaluation. The data were inadequate, being either incomplete, based on small numbers of animals or based on inadequate definition of traits and environments. A comtemporary comparison of indigenous breeds under a given environment has never been attempted. Consequently it is very difficult to even guess what would be the kind of ranking of various breeds within a region. One can only draw very general conclusions because of the lack of properly designed evaluation studies which could lead to specific recommendations with respect to breeds/species and regions. It is therefore necessary that the breeding plans should involve such comparisons under various agro-ecological conditions so that our data base is widened and proper breeding designs can be developed. Two conclusions which can, however, be drawn with some quantitative vigour are:

i. that large variability exists in most economic traits;

ii. the selection experiments wherever undertaken have given genetic gains of 1.5 to 5 percent of the herd average.

Most genetic improvement programmes in existence today, are those which involve the basic genetic hypothesis that if an inferior genotype is crossed with a superior one and continuously backcrossed, it would lead eventually to a locally adapted purebred. This is the main plank, in those countries whose investment in animal husbandry is limited by the financial constraints. In some of the oil rich countries this policy has been supplemented by a large transfer of temperate dairy cattle from Europe and America. Similar approaches have also been adopted by a few South Asian countries. All these policy decisions have been based on research findings in animal breeding and genetic improvement in the temperate and developed countries.

There is no method currently known for measuring genetic improvement or the deterioration in populations which have neither been recorded for the performance nor subjected to any organized effort at selection. Most programmes of genetic improvement through crossbreeding have been haphazardly drawn and poorly implemented and crossbreds are produced without any clear breeding plan. In many areas of the world this technique has raised more problems than it has tried to solve.

The most important part of this problem is to set up a system which would permit selection within populations. One such system is detailed in Figure 1. In developing the strategies for genetic improvement within these populations, location specific parameters have to be given first preference. The selection scheme should give consideration to input situations which according to me are generally of three types HIP (high input), LIP (low input) and ZIP (zero input). All these three environments exist at the same time and location in most countries, hence the challenge to animal geneticists and breeders is to develop genotypes which will produce efficiently under all these three environments.

A number of genetic designs have been suggested for improvement of indigenous breeds. These are based on either within population selection (Fig. 1) or crossbreeding and within population selection of indigenous breeds (Hickman 1979; Cunningham 1979; 1980) involving crossbreeding and selection programmes together. The essential feature of these plans is to improve the local population from within through selection programmes and/or crossing with exotic strains for a few generations in order to make rapid progress and then backcrossing the progeny to the improved local breed/strain, or to mould the synthetic genotype to the local environment by selection (Bhat 1977; 1981b). Rotational crossbreeding designed to maintain high level of heterozygocity and at the same time achieve specific proportions of indigenous and exotic inheritance or variants of this concept. The reciprocal backcrossing between indigenous and exotic strains which would require selection within the local indigenous population from which sires for crossing would be derived (Cunningham 1980) have also been suggested. Grading up to F_1 males and combination thereof suggested by Hickman (1979) has also been proposed. These breeding plans rely on crossbreeding and exploitation of heterosis to achieve breed replacement or to establish and maintain a combination of two or more strains. They all require an indigenous selection programme as part of the operation.

4. OPERATIONAL BREEDING PLANS

In India we have tried to solve this problem through two different alternatives. One alternative refers to associate herd programmes. This has so far been tried with two breeds Sahiwal and Hariana. The population of Sahiwal breed in various herds is around 3000 breeding females. The herd size varies from 50 breeding females to about 250, spread over a number of locations. Initially three locations were involved. At present about 9 locations are in the programme with a breedable population of about 900 females. Most of these herds had varying levels of inbreeding ranging from zero to about 12 percent. Average milk production in 305 days was about 1600 kg bodyweight at first calving around 320 kg, and the mature weight of 360 kg. The calving interval is 450 days and herd life about 9 years. Most of these herds did not register any improvement in milk over their period of existence. The reasons are obvious. Smaller herd size, use of sires selected on the basis of their dams' records, and conformation, resulted invariably in a negative genetic trend. In two of the herds, one at NDRI Karnal and the other at Lucknow, some of the outstanding bulls were produced and therefore progress in milk yield was observed through these bulls over varying periods. Some of the sons of these bulls which were retained as sires later we found to have a negative breeding value on the basis of their daughters' performance.

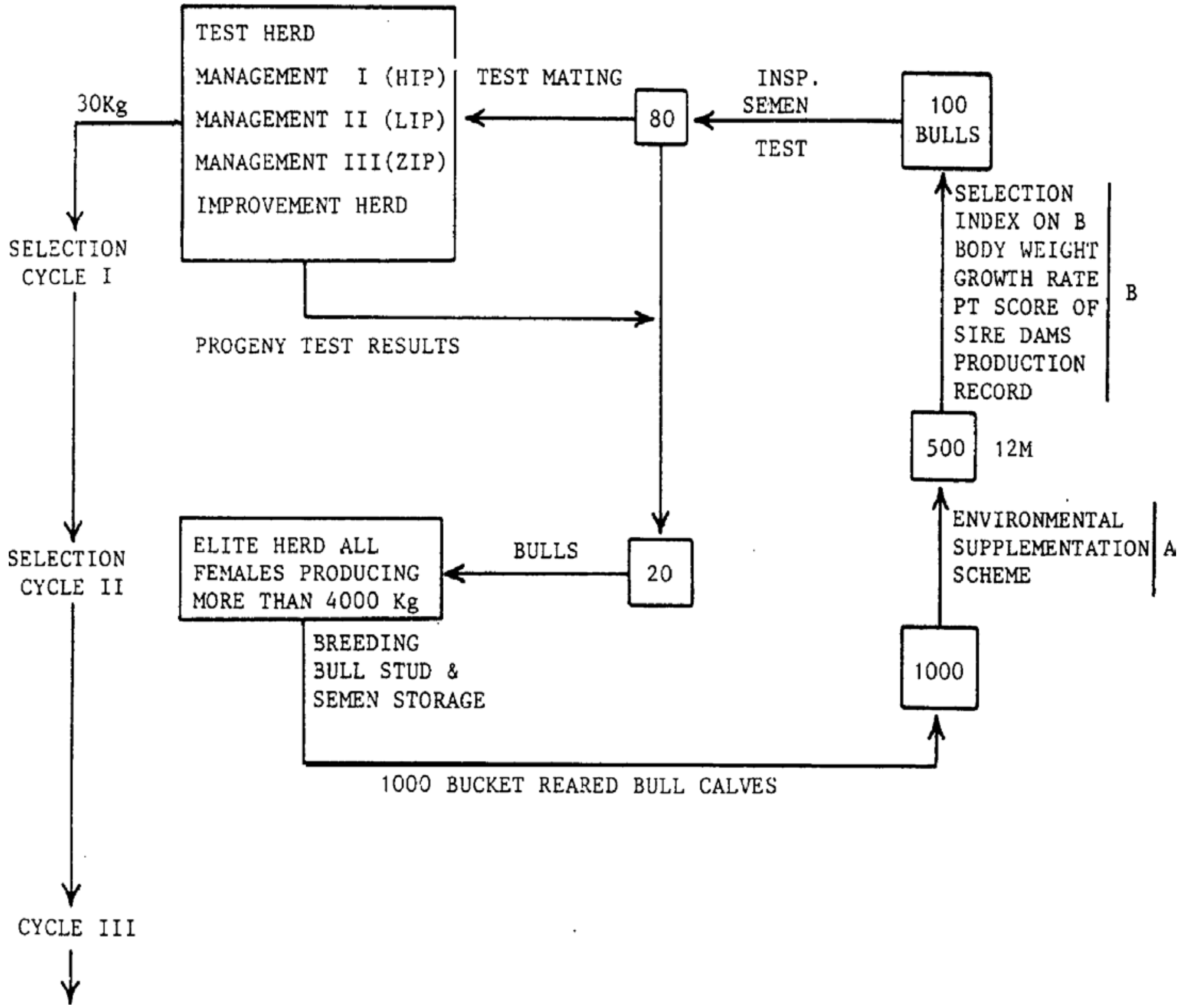

Fig. 1 A breeding plan for genetic improvement from indigenous livestock (cows and buffaloes) foundation population

For the purposes of this breeding plan it was decided that this herd should be treated as one breeding nucleus and out of all the bulls in service in 1980 based on their progeny, dams' and sisters' performance, six bulls were selected for breeding whose semen was frozen and distributed among these 8 herds. Another set of 13 young bulls was also selected out of which another six bulls would be selected on the basis of their growth performance and semen test. These six will become the next set of six sires to be tested. This programme is now in its third year of operation and the breeding plan involves progeny testing of a set of the six bulls and their subsequent ranking and selection of the two best bulls for nominated matings and improvement. After the first cycle it is hoped that every year two bulls would become available whose estimated genetic merit would be around 20 to 30 kg over the herd average. These bulls will then be used on Sahiwal pockets in the country or outside.

A similar but much larger programme has been finalized for the Hariana breed. Hariana is the most important cattle breed in India and is widely used in the Indo-Gangetic plains as a dual purpose (draught and milk) animal. This programme initially involves six breeding farms with a total breedable population of 1500 females. The major aim is to conserve the Hariana breed through its improvement in draught quality and milk yield. The programme involves 20 bulls whose semen will be frozen and distributed to all the farms and efforts will be made to have all the 20 bulls available at each farm. The workability and work efficiency of these 20 bulls will be taken into consideration for selection. As soon as the programme gets well set, the herds of small land holders' and breeders' herds under the Central Herd Registration Scheme operational in districts of Rahtak (which is the breeding tract of the Hariana breed), Ajmer, Mahendargarh and Bhiwani, 10 000 cows registered under this scheme will be involved in progeny testing through field recording and subsequent selection. It is proposed that 25-50 percent breedable cattle population of the herds will be used for this scheme. For selection of young males for further breeding 5 sons of each sire will be selected at random and tested for draught capacity at the age of *2 1/2* years using a draught capacity index.

The Indian Council of Agricultural Research (ICAR) considering the importance of conservation and improvement of indigenous breeds of cattle has sanctioned an All India Coordinated Research Project (AICRP) on improvement of indigenous cattle breeds. This project is to involve three major milk breeds, three dual purpose breeds and three draught breeds in this programme. This project will use within population selection based on milk and work for improvement. This project will be initiated within this plan period and two institutional programmes discussed above will also be coordinated through this project. The project will introduce selection criteria based on milk production survivability, disease resistance indicators and measures of work efficiency.

Under the development programmes of various states the well defined indigenous breeds like Hariana, Gir, Kankrij, Ongol, Nagor, Rathi are being improved through the use of semen of selected bulls. No crossbreeding is permitted in these tracts.

Similar programmes for improvement of indigenous breeds have also been taken up in Syria with Shami cattle and goats, with trypanotolerant cattle in Africa and zebus in Kenya.

5. BUFFALO

The buffalo is the most important milk, meat and draught type animal of the tropics. It has received least attention. The main components of low productivity of buffaloes are (i) delayed age of maturity and first calving; (ii) long calving interval; (iii) short lactation; (iv) low average milk yield. Any attempt to increae the productivity of indigenous buffaloes must, therefore, be concerned with some or all of these component traits. Estimates of genetic variability of these traits do indicate the possibility of improvement through suitable methods of selection and breeding programmes. Progeny testing of buffalo bulls and intense selection of suitable breeding females are the only ways which lead to rapid genetic improvement in milk yield and other desirable characteristics.

Considering a heritability of 8 percent for milk yield in 300 days and different selection intensities (culling at 10, 20, 30 percent of the herd), the improvement (G) will be as follows:

Rate of Genetic Improvement

% culled i		h^2	p	ΔG per Generation (kg)	ΔG per year (kg)
1	0.195	0.08	600	9.4	2.4
20	0.340	0.08	600	16.3	3.2
30	0.498	0.08	600	23.9	4.8

p will vary from herd to herd depending upon the variability in the population for milk yield. The variability in the population for milk yield for nondescript buffaloes is rather high. With the selection intensity of 0.50 which is rather high for buffaloes where calf mortality is also high, it will take around 250 years to double the milk production in a herd with an average lactation yield of 800 kg. Much quicker results in the improvement of milk production, reduction in age at maturity, improvement in breeding efficiency, and economics of milk production have to be obtained if buffaloes have to survive as milch animals vis-à-vis crossbred cows.

<u>A Breeding Plan for Buffalo</u>

The important steps which need to be taken to break the yield barriers in buffaloes are:

i. Large buffalo breeding farms of at least 1000 adult units should be set upwhere a minimum of 30-40 bulls can be progeny tested in sequential order, and the females selected on the basis of an index incorporating traits of growth, reproduction and production.
ii. The information needed on distinct breed differences for characters of production is not available which makes a definite recommendation with regard to any breed improvement difficult. However, crosses between breeds may be attempted to develop new strains breeds by incorporation of genes from different sources.

The second method of attaining this goal with much less expense is to create bull farms in all cities having a buffalo population of 10 000 and above, and tie these together so that the buffaloes can be registered, branded and then regularly given sexual health control help. Using the nominated bulls from the breeders herds on this population and then recording progeny for growth, production and reproduction could be undertaken regionally or centrally so that bulls could be progeny tested and better females selected. This programme could be more vigorously implemented in milk colonies and cooperatives established by various State Governments or private organizations.

The facilities for freezing the buffalo semen should be generated forthwith and semen banks created and an intense programme of progeny testing of the bulls at village level be introduced. The recording of daughters should be the responsibility of an independent agency.

In recent years, reproductive physiologists have devoted much attention *to* methods of augmenting fertility of animals with multiple ovulation and embryo transfer (MOET). There are a number of methods by which MOET can be utilized in buffaloes. In the context of Figure 1 it will be observed that even if the infrastructure and the resources could be found to test 400 bulls out of which 40 could be used for propagation, a genetic improvement of 1 to 11*/2* percent is all that can be hoped for in milk production. If this needs to be increased to 3 percent, this innovation (MOET) offers the only possibility.

It is necessary that an intercountry action programme, for its improvement, be initiated for improvement in meat, milk and draught.

6. IMPROVEMENT PLANS FOR INDIGENOUS BREEDS OF SHEEP

Indiscriminate crossbreeding during the last few decades has endangered a few important indigenous breeds, e.g. Guraz, Karnah, Gadi of J&K State, Magra, Pugal and Chokla breeds of Rajasthan. The major reasons for serious reduction in numbers are difficulties of climate, insufficient attention to the development of feed and water resources in their home tracts. The number of animals of Mandya breed of Karnataka is also fast coming down because most of the land in its home tract has been brought under irrigated cultivation. Due to high incidence of cryptorchidism resulting from selection for meaty conformation known to be related to this condition has also caused some reduction in numbers. There is no major programme for conservation of these breeds. The programme involving cooperation among breeders and development of a nuclear farm for these breeds created from selected male and female from the cooperating flocks is to be used for selection of superior rams. State departments are establishing large stud farms where within population selection will be practised and such rams will be distributed to the breeders' flocks for improvement.

The Indian Council of Agricultural Research is in the process of considering establishment of an All India Cordinated Research Project on Carpet Wool Production using selection within indigenous breeds as a major instrument to attain the goal of producing better carpet wool breeds. This coordinated project will involve a large number of indigenous breeds whose numbers are fast declining and are in danger of extinction. It is hoped that this will act as a focal point of action and other associated activities like establishment of cooperative breeders' flocks and state farms will take care of rejuvenation of these flocks.

7. BREEDING PLANS FOR IMPROVEMENT OF INDIGENOUS GOAT BREEDS

A number of important indigenous breeds *of goats* have shown a decline in numbers. Two of these breeds Jamnapari a good tropical milch breed and Barbari are in serious danger of extinction. It is reported that only 5000 animals of the Jamnapari breed exist at present in its purist form. Major action programmes need to be taken to conserve these two breeds. Apart from the normal channels of slaughter these two breeds are in great demand for export to other states of the Indian Union and to various countries of southeast Asia. The number of animals going out of the breeding tract is not keeping pace with the numbers of animals being raised.

The Central Institute for Research on Goats (CIRG) has therefore started two major flocks of these two breeds, each comprising 300 females and followers. These two nucleus herds have been established at the main campus of the institute. A comparative breeders society has been established in the breeding tract of the two breeds. The breeding plan envisages selection of 10 sires in each breed selected on the basis of their own performance with respect to growth and the relative performance for milk yield, and subsequently on the basis of daughters' performance for growth and milk yield. The frozen semen of these sires will be used on the breeders' flock for improvement. This programme will be conducted for 7 generations. The recording of milk and body weights in the breeders' flock will be done by the staff of the Institute. The Government of Uttar Pradesh, the state in which the breeding tracts of these goat breeds are located, is establishing a large farm in the breeding tract of these two breeds.

8. CONCLUSION

Among the Indian breeds of horses, there has been a gradual and progressive decline in almost all breeds but in the case of Zanskar breed the decline has been very sharp. In order to take up effective measures of conservation, ICAR has established a National Centre for Horse Breeding. Similarly a national centre on camels, Mithun and yak has also been established to undertake work on conservation of these species. The National Bureau of Animal Genetic Resources is concerned with identification, evaluation and conservation of the animal genetic resources and is to act as coordinating agency for national and international programmes.

Breeding experiments are generally of long duration and a system where paucity of trained animal breeding scientists makes it imperative to induct people from related disciplines in the project.

Many of the breeding experiments suffered from dilution of the objectives. Consequently the pressure on genetic component gets diluted and other issues take priority.

Most of the research projects even of applied nature had to perforce be modelled on structure of developed countries and many were also manned by scientists trained in developed countries, the gap between developed and developing countries in their application of research in animal production is nearly 100 years, at least in large livestock whereas the first and foremost necessity was to gather factual data on the resources available and make use of proven technology. A large outlay on experiments which are not even relevant was made with technologies which had neither been proven nor had any relationship with the social milieu in which it had been applied.

Information on the productivity of various livestock species in the developing countries under the environment in which these are raised is generally lacking. The concept of herd recording has not been initiated in most of these countries.

The gap between research and development has been widening. The research workers have been able to develop new technology but its use in the actual improvement of the livestock of the country has been marginal. Recognizing this the Indian Council of Agricultural research has developed the concept of national demonstrations, operational research projects and laboratory to land programmes. These projects are based on a package of practices developed by scientists in their laboratories which are tried in a field area by the scientists themselves involving such development agencies who would eventually be responsible for extending these programmes in the field. These projects are basically for the scientists to develop confidence in their technology. They would also learn from actual field conditions the lacunae in the transfer of this technology to the field. They would have an opportunity to make such modification in the technology package which would be necessary to make it effective under the given set of conditions.

In most developing countries the development programmes are run by extension services which are not tied up with the research organizations. The research programmes are also isolated and there is no linkage between research stations and the field programme. Two programmes where such a linkage has been effective are the operational flood programme and the programmes of Kerala livestock marketing and meat board. These two programmes are directed primarily at increasing income levels of small and marginal farmers and landless labourers as an instrument of social change through dairying and livestock development. Initially the Kerala programme started as a programme of genetic improvement through crossbreeding of cattle with Brown Swiss and Jersey breeds. But when the crossbreds came in milk it become obvious that an artificial insemination programme supported by a veterinary service could not lead to success unless the milk produced was marketed at a remunerative price to the producers and the feed to be given to cows was compounded centrally, and farmers given advice on cropping patterns to include high yielding forages in their crop rotation calendars. This naturally called for development of infrastructure for milk marketing establishment of dairy plants, feed mills and vaccine production units and forage seed production, programmes, all to be backed up with research programmes. From small beginnings in the middle fifties this programme has grown into a state milch herd of 0.7 million crossbred cows. The programme has undergone tremendous changes during the past 25 years due to a number of constraints of feed resources, population numbers and training of personnel; these have been overcome and improvement of 1200 kg per unit cow has been achieved. In 1979 when a review of the enitire programme was made it was observed that the total milk and milk products requirements of the entire state could be met from 1 million crossbred cows, a target which would be obtained in the next three years. Once this target population was obtained 0.3 million crossbred cows would be surplus to the system and no feed was available for them. Therefore, a breeding decision was called for, a new objective had to be defined, from extensive breeding to increase in productivity per unit animal by intense selection through use of progeny tested, crossbred bulls and a reduction in the number of foundation population by sale or slaughter.

An integral part of a progeny testing programme is a good field recording system so that accurate information on sire's daughters becomes available along with other production parameters. This programme is now entering a phase where genetic improvement is the most important part of the programme and sophisticated genetic knowledge is now an absolute necessity, if the programme is to make any headway. This example has been given to show that if a breeding plan is properly implemented, it can lead to substantial improvements within a reasonable time frame.

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1 Death of embryos.

2 Ability to live on poor pasture, relative resistance to protozoan diseases (babesiosis, trypanosomiasis, anaplasmosis, etc.)

1 Calves born in one year.

2 Depending on the level of parasitaemia, on pathologic events attributable to trypanosomiasis, and on individual performance.

1

$$\{ E(\Delta G) = \frac{1}{2}\, i\, R_{G\hat{G}}\, \sigma_G$$

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