

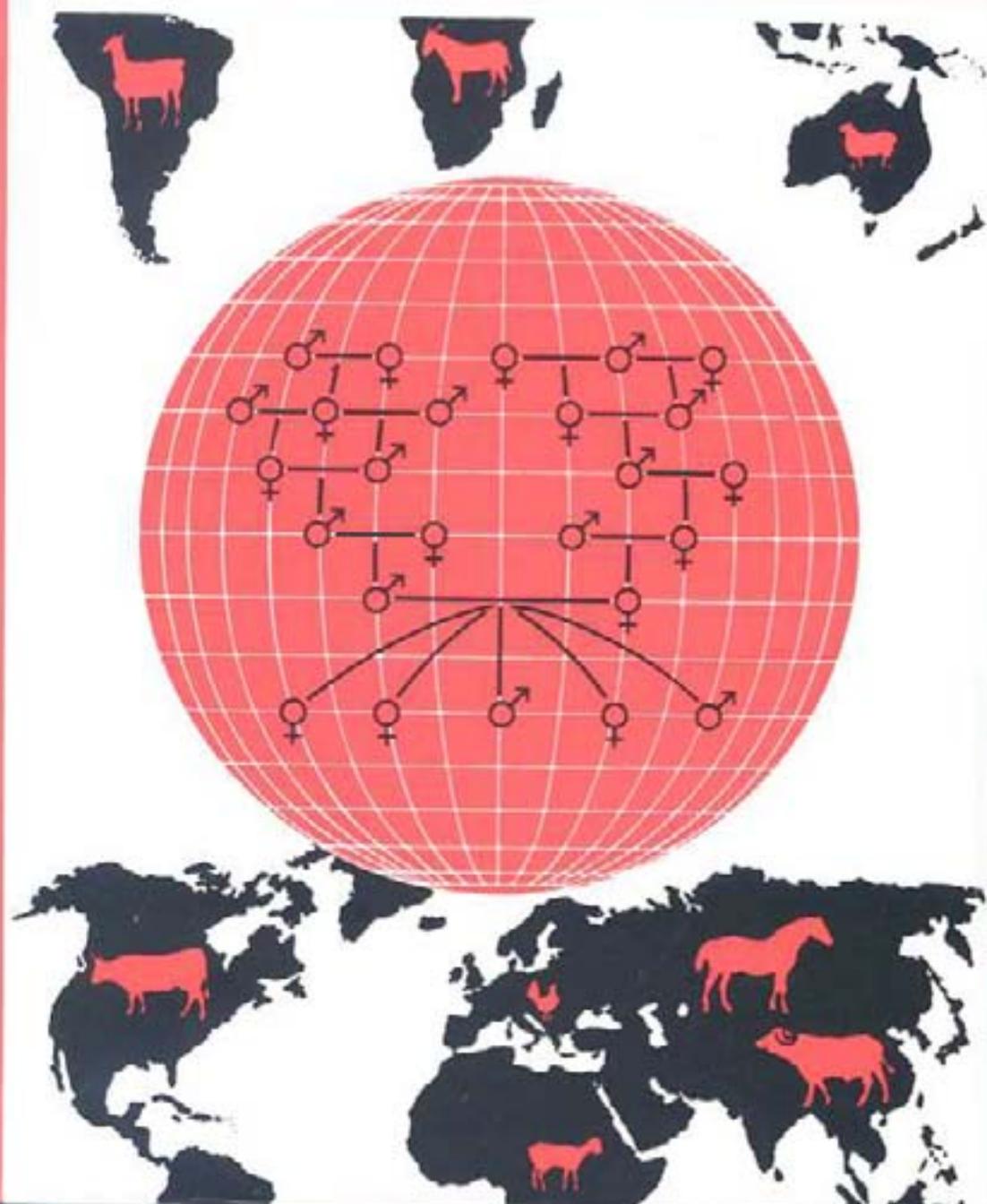
Animal genetic resources

Strategies for improved use and conservation

FAO
ANIMAL
PRODUCTION
AND HEALTH
PAPER

66

S238
35
(E)
no 66
C.2



FOOD
AND
AGRICULTURE
ORGANIZATION
OF THE
UNITED NATIONS

1986
with
Proceedings of the EAAP/PSAS Symposium on Small Populations of Domestic
Animals
edited by
John Hodges
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 1987

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations and of the United Nations Environment Programme concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

M-22
ISBN 92-5-102589-4

The copyright in this book is vested in the Food and Agriculture Organization of the United Nations and in the United Nations Environment Programme. Applications for permission to reproduce this book, in whole or in part, by any method or process, should be addressed, with a statement of the purpose and extent of the reproduction desired, to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

© FAO and UNEP 1987

TABLE OF CONTENTS

INTRODUCTION

ABSTRACT

CONTENTS

RECOMMENDATIONS

All Livestock

Cattle

Sheep and Goats

Camels and Camelidae

Pigs

Buffaloes

Education and Training for Animal Genetic Resources in the Tropics

Professional raining in Embryo Transfer Methods

Principles for Preservation of Endangered Species and Breeds in the Tropics

Horses

Donkeys

Cryo-preservation of Genetic Material

PAPERS PRESENTED AT FAO/UNEP EXPERT PANEL MEETING

I. PRINCIPLES FOR INDIGENOUS ANIMAL IMPROVEMENT IN THE TROPICS

1. Conservation of the Kenana Breed in Sudan, E.P. Cunningham
2. Crossbreeding Cattle in Latin America, F.E. Madalena
3. Criollo Cattle of Latin America, J. de Alba
4. Principles of Indigenous Animal Improvement in the Tropics - The Programmes for India, P.N. Bhat and V.K. Taneja
5. Sahiwal in Kenya and Pakistan, J. Hodges
6. Improvement and Conservation of Buffalo Genetic Resources in Asia, S. Sivarajasingam
7. Philippine Carabao Crossbreeding Research, J. Hodges
8. Principles of Indigenous Sheep Improvement in North Africa, A. Lahlou-Kassi
9. Principles for Animal Improvement in the Tropics - Sheep and Goats: Asian Experiences, P.N. Bhat
10. Principles for Indigenous Animal Improvement in the Tropics - African Experiences with Sheep and Goats, L.O. Ngere
11. Improvement of Andean Camelids, C. Novoa
12. Improvement of Pigs in the Tropics: General Principles, J.W.B. King

II. EDUCATION AND TRAINING FOR ANIMAL GENETIC IMPROVEMENT IN THE TROPICS

1. Education and Training for Animal Genetic Resources in Africa, A. Lahlou-Kassi
2. Education and Training for Animal Genetic Resources in Asia, S. Sivarajasingam

3. Education and Training on Animal Genetic Resources in Latin America - a Background note on the Camelids, C. Novoa

4. Education and Training for Animal Genetic Resources in the Tropics - Developed Country View, E.P. Cunningham

III. PRINCIPLES FOR PRESERVATION OF ENDANGERED SPECIES AND BREEDS IN THE TROPICS

1. Conservation of Animal Genetic Resources: Brazil National Programme, A.T. Primo

2. India's Effort in Conservation and Management of Indigenous Livestock and Poultry Genetic Resources and Creation of Data Base, R.M. Acharya

3. Principles for Preservation of Endangered Species and Breeds in the Tropics, H. Newton Turner

4. Principles in Use of Live Animals, I. Bodó

5. Experience in Application of Embryo and Semen Freezing to Establish a Reserve of Genetic Material, S. Wierzbowski

IV. PAPERS PRESENTED AT EAAP/PSAP SYMPOSIUM ON SMALL POPULATIONS OF DOMESTIC ANIMALS IN EUROPE

1. Possible Role of Animal Gene Resource in Production, Natural Environment Conservation, Human Pleasure and Recreation, K. Majjala

2. The Use of Native Rare Breeds in Management of Areas of Importance for Nature Conservation in Sweden, C. Matzon

3. Breeding Scheme and Genetic Progress in a Small Cattle Population, F. Pirchner and J. Aumann

4. Possibilities of Utilization of Endangered Cattle Breeds in Production of Milk, Beef and Veal, in Conservation of the Natural Environment or in Other Non-Economic Spheres, R. Siler, L. Bartos, J. Fiedler and J. Plesnik

5. Polish Red Cattle - Breed Preservation and Utilization, K. Zukowski and Z. Reklewski

6. Genetic Analysis of the European Bison Population, W. Olech

7. The Role of Sheep and Goat Gene Resources in Production, Natural Environment Conservation and in Other Activities, L. Veress

8. Future Prospects on the Use of Polish Native Sheep Breeds, S. Zalewska, S. Jankowski and M.J. Radomska

9. Olkuska Sheep - A Highly Prolific Polish Sheep, W. Grabowski, J. Klewicz, A. Knothe, M.J. Radomska

10. Utilization of Equines Maintained as a Genetic Reserve in Agriculture, Transportation, Meat production, Sports and Other Activities, E. Rossier, B. Langlois and A. Audiot
11. Future Use of the Polish Native Breed, Konik Polski, as a Draught Horse in Agriculture and as a Riding Horse for Sport and Recreation, T. Jezierski
12. Prospects of Utilizing Hucul Horses in Agriculture, Sport and Recreation, E. Brzeski and M. Jackowski
13. Polish Koniks in the Roztocze National Park, E. Sasimowski and J. Slomiany

V. APPENDICES

Appendix 1. Addresses of Welcome

Appendix 2. FAO/UNEP Joint Expert Panel on Animal Genetic Resources Conservation and Management -Terms of Reference

Appendix 3. Members of Joint FAO/UNEP Panel of Experts on Animal Genetic Resources and Management

Appendix 4. Second Meeting of the Joint FAO/UNEP Expert Panel on Animal Genetic Resources - Agenda

Appendix 5. Joint FAO/UNEP Expert Panel on Animal Genetic Resources - Participants at Meeting

Appendix 6. Definitions Pertaining to Animal Genetic Resources

FAO TECHNICAL PAPERS

INTRODUCTION

The joint activities of FAO and UNEP in the field of animal genetic resources conservation and management in recent years have been most fruitful. The indigenous species and breeds of domestic livestock and poultry in the tropics are undoubtedly being threatened by the need for higher animal production, which often involves breed substitution or crossbreeding. There is an urgent need in this changing situation for rational planning and action to ensure both improved production and the preservation of the unique animal genetic resources of the tropics. Initiatives have been taken by FAO and UNEP to achieve these objectives in Africa, Asia and Latin America both by support of national government activities and by the creation of regional infrastructures. It is expected that these joint FAO/UNEP activities will continue to serve the interests of developing countries. The Joint Expert Panel is one of these ongoing fields of cooperation.

The FAO/UNEP Expert Panel on Animal Genetic Resources Conservation and Management held its second meeting in June 1986 in Warsaw, Poland. The first meeting of the Panel had been held in Rome, Italy in 1983. The Panel consists of 36 distinguished scientists whose expertise covers all the major disciplines within animal breeding and genetics, all the major species of domestic animals, and among them represents the major areas of the globe. The scientists are appointed in their individual capacities and not as representatives of governments or institutions. Funds did not permit all members of the Panel to attend. On this occasion 13 members of the Panel were assembled.

The meeting was convened by FAO and UNEP to take place in Warsaw at the same time as a scientific symposium organized on behalf of the European Association of Animal Production (EAAP) by the Polish Society of Animal Production (PSAP). This meeting addressed the issue of the use of small populations of

domestic animals in the European context. Thus there was a meeting of minds and interchange of ideas which was particularly valuable as it brought into focus the methods and resources of both developing and developed countries concerning animal genetic resources utilization and preservation. The papers presented at both the FAO/UNEP Expert Panel meeting and at the EAAP/PSAP symposium are given in full in this volume.

Dr. Helen Newton-Turner of Australia was unanimously elected Chairman of the FAO/UNEP Expert Panel and thus provided valuable continuity with the first meeting of the Panel in 1983 and with the FAO/UNEP Technical Consultation in 1980, both of which she chaired. Dr. J. de Alba of Mexico, who also served as Vice-Chairman in 1983 was unanimously elected again.

The recommendations of the FAO/UNEP Expert Panel are given first in this publication, followed by the papers presented at the Panel meeting, and the papers given at the Symposium; in the Appendices supporting information relating to the activities of the Expert Panel is provided.

H.A. Jasiorowski
Director
Animal Production and Health Division, FAO

ABSTRACT

This publication on animal breeding and genetic resources covers both improved utilization and preservation. It contains the papers presented on the occasion of the 2nd meeting of the FAO/UNEP Expert Panel on Animal Genetic Resources, held in Warsaw, Poland in June 1986, and the recommendations of that meeting. These relate primarily to the issues affecting developing countries. It also contains the papers of the EAAP/PSAP Symposium held at the same time on use of rare breeds in Europe, and thus brings into the same volume experiences in developed countries. The papers cover all species of domestic animals and relate to issues and principles in all types of environmental conditions in tropical and temperate climates and conditions.

KEY WORDS

Cattle, Buffalo, Sheep, Goats, Camilidae, Pigs, Equines, genetics, breeding, conservation, cryogenic, education, training, small populations, environment, heterosis, crossbreeding, selection, embryo transfer, artificial insemination, gene bank, data bank, animal descriptors.

RECOMMENDATIONS **OF** **FAO/UNEP EXPERT PANEL** **ON** **ANIMAL GENETIC RESOURCES**

SECTION A
PRINCIPLES FOR GENETIC IMPROVEMENT OF INDIGENOUS ANIMALS IN THE TROPICS

ALL LIVESTOCK**TO FAO/UNEP**1. The Panel **recommends** that:

- i. FAO/UNEP should initiate action to help establish Regional Data Banks for animal genetic resources now that the methodological studies are complete. National governments should be encouraged and guided in the preparation of national data for entry into the Regional Data Banks. It is essential to plan to use a fully compatible system from the beginning.
- ii. FAO/UNEP should examine and evaluate the invitation from the Government of India to develop a regional data bank for Asia at the newly-established National Data Bank located at the National Bureau of Animal Genetic Resources.
- iii. FAO/UNEP should initiate actions for the establishment of regional International Cryogenic Animal Gene Banks to serve all developing countries.
- iv. FAO/UNEP should continue to foster inter-country cooperation in the exchange of germplasm, with due regard to quarantine precautions.

2. The Panel **recommends** that FAO/UNEP should actively participate in the preparation of four publications:

- i. A manual concerned with the conservation (preservation and better utilization) of indigenous animal genetic resources for tropical areas. It should include information on assessing the potential economic value of less-known breeds.
- ii. Further publications on unknown or poorly documented animal genetic resources. The recent publications on Chinese livestock and on the Awassi sheep indicate the value of such comprehensive and competently researched works.
- iii. A manual addressing the methodologies for improved productivity and utilization of animal genetic resources in the tropics. Farmer participation is highly desirable, but ways and means of achieving it have rarely been formulated.

The manual should include discussion of:

- monitoring animal performances;
- selection of outstanding individuals by population screening;
- interactions between experiment station and farmer herds;
- use of nucleus herds;
- establishment of societies for recording pedigree and performance;
- assignment of valid genetic values to bulls and cows;
- use of artificial insemination and embryo transfer;
- avoidance of inbreeding.

The manual should be aimed at administrators, extension officers and researchers and be in appropriate local languages.

- iv. A manual dealing with the design of breeding plans for the genetic evaluation of small populations.
3. The Panel recommends that FAO/UNEP should develop guidelines for national governments to use when deciding priorities to derive maximum benefits from the application of new technologies such as embryo transfer, artificial insemination, etc. to the improvement of a livestock species.
4. The Panel recommends that FAO/UNEP encourage the application of biotechnology to animal production and health. Priorities for the rapid application of biotechnology to livestock in developing countries should be drawn up.

CATTLE

To FAO/UNEP and National Governments

5. The Panel recommends that, in consultation with national governments in Latin America, FAO/UNEP should establish a permanent consultative committee on experimental designs for crossbreeding programmes in Latin America involving Criollo and Zebu with European breeds. F₁ hybrids have proved successful, but data are still scanty on the effect of continued crossing. The permanent committee should give priority to schemes which would add to knowledge, and should help design and implement an experiment or series of experiments to answer questions on unresolved areas of concern, such as:

- the extent of F₁ heterosis (or recombination) at different levels of stress, and its loss in subsequent generations;
- the efficiency of milk, meat and draught production, based on total lifetime merit.

6. The Panel recommends that, together with national governments, FAO/UNEP should establish procedures periodically to identify superior Sahiwal bulls and cows in India, Kenya and Pakistan; their use should be directed towards the propagation of superior F₁ offspring for farmer programmes in tropical areas. The international sale of F₁ Sahiwal hybrids of unknown dairy merit should be discouraged.

7. Where cattle breeds are spread over many countries, (e.g., the Sahiwal in Pakistan, India, Kenya, Malaysia, Australia, and so on), the Panel recommends that FAO/UNEP working with national governments should develop programmes of inter-country linkages so that data, semen, and embryos can be exchanged, with the aim of maximizing production and with due regard to animal health requirements. Such programmes could be developed between India and Latin American countries for the Ongole, GIR and Haryana breeds, and for the Criollo breeds.

SHEEP AND GOATS

To FAO/UNEP and National Governments

8. The Panel recommends that FAO/UNEP together with national governments:
 - i. Should stimulate the evaluation of indigenous breeds of sheep and goats, beginning with those which are numerically more important and whose product is in keeping with the local needs, such as meat, milk and wool.

- ii. Should direct attention to the evaluation of breeds for their potential in crossing with local breeds for increased meat, milk and wool production (quantity and quality). This evaluation should include breeds from within and outside the region.
 - iii. Should particularly promote more detailed and extensive documentation on the performance characteristics of African sheep and goats, such as West African dwarf sheep and goats and the D'man sheep.
9. Since most sheep breeds in the tropics have long breeding seasons and since in some breeds ewes cycle throughout the year, and in some sheep breeds' two peaks of breeding activity have been reported, the Panel recommends that more use should be made of this sheep trait. There is sufficient evidence under experiment station conditions to show that it is technically feasible to breed every eight months, but field tests should be made to identify practical problems under nomadic and transhumant conditions.
10. The Panel recommends that studies on the reproductive behaviour of indigenous sheep breeds in the tropical environment are needed, as there is growing interest in the use of hormones for synchronization of oestrus, superovulation and induction of early sexual maturity. However, the physiology of reproduction in the local environment should always be thoroughly investigated first.
11. The Panel recommends that research be encouraged to develop two strains of Java Thin-Tailed (JTT) sheep, one homozygous for the "prolificacy" gene and the other without it. Ewes of this breed show considerable variation in litter size. A homozygous strain should be uniformly high, while a strain without the gene would have singles or twins - an adequate level of prolificacy for most current practical management conditions.
12. The Panel recommends that for sheep meat production:
- i. Selection on body weight gain, which is heritable, should be encouraged to improve the poor body weight gains and efficiency of conversion of most indigenous breeds.
 - ii. Crossbreeding of extremely coarse and hairy wool breeds with exotic mutton breeds should be undertaken to improve meat production, especially under intensive feed management.
13. The Panel recommends that for wool production:
- i. Where breeds produce fleeces with high average fibre diameter and percent medullation, suitable for various grades of carpets, selection on first six-monthly fleece for high greasy weight and lower medullation should be made to improve both fleece weight and quality; with breeds having very coarse and hairy wools, the animals should be crossed for meat production.
 - ii. Where the aim is apparel wool production, attempts might be made to cross exotic finewools on to native breeds which have a lower average fibre diameter and medullation percentage. Exotic inheritance should not exceed 50%, with subsequent selection in the crossbreds for greasy fleece weight and against percent medullation.
14. Since some Indian goat breeds with valuable genetic traits are declining numerically {for example the Barbari, present population 30 000, and Jamunapari 5000}, the Panel recommends that conservation is needed.
15. Since selection within breeds of sheep and goats seems the most favourable method at present for genetic improvement of small ruminants, the Panel recommends that such schemes should take account of habitat and flock size. The practice of population screening for individuals of outstanding merit should be more widely used to supplement normal selection and breeding methods. It should be noted that crossbreeding and development of new breeds should also have a place under improved husbandry conditions and in the more developed countries; also that milk production in goats can be improved through selection for first lactation milk yield and age at first kidding.

CAMELS AND CAMELIDAE

The camel species is widely distributed among the Far Eastern (two-humped camel), Middle Eastern, North African and Sahelian (one humped) countries. The species is well adapted to desert climates and is used for milk, meat, draught, transport and racing. Camelidae exist in the Andean high altitude areas, where pastoralism is the main activity.

The Panel took note of the extreme importance of camels in providing milk, meat and transport for populations living in sub-desert and desert areas, and of the camelidae in producing meat, fibre and transport for people in the Andean regions. It recognized there are still wide gaps in knowledge about both camels and camelidae.

To FAO/UNEP and National Governments

16. The Panel recommends that FAO/UNEP:

- i. Should establish a research network in countries where camels are numerous, and actively support studies on breeding, management, nutrition, performance and reproductive behaviour.
- ii. Should emphasize the need for collecting information on camels for inclusion in regional data banks. Descriptors for camels and the camelidae should be developed.
- iii. Should produce comprehensive publication(s) covering available information on camels and camelidae species.
- iv. Should promote the establishment of regional centres to enhance conservation and improvement of camels, one in Africa for the one-humped, and the other in Asia for the two-humped.
- v. Should stimulate studies on range utilization, particularly the interactions between alpacas, llamas, sheep, pastures, parasites, etc., since animals and pastures are so closely linked.
- vi. Should promote studies on various aspects of the biology of the camelidae. Information is urgently needed on reproduction, disease control and the genetic basis of the traits of economic importance (colour, fleece weight, skin follicle types in relation to the production and marketing of specialist fibres, body weight).

17. The Panel recommends that:

- i. Extensive crossing between camelids be discouraged until more adequate information is available for individual species (or breeds) and the effect of crossing on production.
- ii. Integrated management of wild vicuna and domesticated alpaca and/or llama should be studied. Of particular interest is the use of surplus castrated vicuna males as fibre producers.
- iii. Attempts should be made to tame vicunas. One possible approach would be to transfer vicuña embryos to domesticated alpacas; the new-born vicuna could then be imprinted with alpaca and managed in a flock as domesticated animals.

PIGS

The Panel noted that in most developing countries, two kinds of pig production have developed over the last three decades:

- i. An industrial structure, based on well-developed exotics and their crosses with local breeds.
- ii. Smallholders who raise indigenous populations/breeds as scavengers with zero inputs. These animals have generally low production but high qualities of survival.

18. The Panel recommends that FAO/UNEP:

- i. Should stimulate an examination of the smallholder system followed in Asia, so that breeding programmes could be developed to improve the system and benefit smallholders.

- ii. Should stimulate studies on the digestive capacity of indigenous pigs, in view of their value as scavengers and converters of waste vegetable products to edible protein. Considering the importance of this role of the indigenous pig in utilizing roughages there is little research on its special capacity. Some breeds which apparently live entirely on pasture, such as some in Mongolia, might be particularly appropriate for such studies, and for evaluation as a potential genetic resource for developing countries.
- iii. Should encourage national governments to develop organizational structures which would allow reasonable selection intensities and estimates of heterosis when indigenous pigs are crossed to temperate exotics. It further recommends that these organizational structures should support the utilization of heterosis either by breeding crossbred females with a second exotic breed, or by backcrossing to the exotic parent.

19. The Panel recommends:

- i. That development of synthetics based on interbreeding of F₁ crosses should be avoided as far as possible, although this is the most easy to do organizationally. Wherever sufficiently large populations now exist, as in China, efforts should be made to select them with well defined breeding goals.
- ii. That it would be desirable to improve prolificacy in many tropical breeds by introducing high prolificacy genes from some Chinese breeds.
- iii. That research on feed efficiency/conversion using agro-industrial by-products should be encouraged and non-conventional feed resources should be examined to help smallholders.
- iv. That research on the Asian pigmy hog should be encouraged, as little is known about it.

BUFFALOES

20. The Panel recommends that FAO/UNEP:

- i. Should encourage the extension of a network between countries in Asia for the exchange and evaluation of the Murrah and Nili-Ravi, both as purebreds and in crosses with swamp buffalo. The exchange should include data, semen and live animals. The Panel understands that Peninsular Malaysia is willing to conduct a study on these lines, with international technical and financial assistance.
- ii. Should cooperate with other international agencies in organizing research on the evaluation of breeds and crosses, with particular emphasis on the improvement of reproductive efficiency.
- iii. Should promote an evaluation and selection programme for draught, growth and semen quality in the swamp buffalo. Although this is not yet an endangered species, superior genes are lost through bulls being removed from herds.

EDUCATION AND TRAINING FOR ANIMAL GENETIC RESOURCES IN THE TROPICS

There was general agreement on the high priority to be attached to education and training in the tropics. Courses of various kinds should be set up with defined objectives using methods and languages appropriate to the participants. While courses should be set at suitable technical levels it was emphasized that screening of applicants is essential. The proper sharing of experiences will only be achieved by bringing in some experts from outside the Region and at the same time balancing this with local personnel with a good knowledge of local production requirements. In this latter respect it is very important to appreciate socio-economic aspects of current animal production and their interaction with the intended changes.

21. To FAO/UNEP the Panel recommends that FAO/UNEP, in association with national governments, should organize training courses at three levels:

- i. For administrators and heads of departments such as extension and animal health, designed to give an appreciation of what is to be attempted in managing animal genetic resources, and explaining the major steps of documentation and subsequent plans for conservation and improvement.
 - ii. For professionals with a basic training in animal breeding but perhaps requiring updating, including specialized information which is still unfortunately missing from some animal breeding courses.
 - iii. For technicians responsible for execution in the field of schemes. These are seen to be of high importance because of the need to convey reasons for the scheme and to obtain cooperation by using methods set at levels of literacy and numeracy appropriate to those concerned.
22. Training manuals should be compiled in association with the planning of the relevant courses above.
23. The Panel recommends that FAO/UNEP should make special merit awards to recognize outstanding performance by individual technicians. This is suggested to encourage pride in achievement; strong motivation is required to create close involvement and commitment from the farming community.
24. On the subject matter of courses, the Panel recognizes that various types of courses will be required varying in length and technical content according to particular requirements. It recommends the following subjects to be considered:
- animal breeding and genetics (including organizational aspects);
 - conservation and management of animal genetic resources;
 - design and analysis of genetic experiments;
 - data acquisition; data banks and computing;
 - cryopreservation and techniques for the manipulation of reproduction;
 - extension methods and socio-economic factors.
25. The Panel recommends that:
- i. Courses should be evaluated to check on their effectiveness.
 - ii. New educational methods such as videos, etc., be used to maximum advantage.

PROFESSIONAL TRAINING IN EMBRYO TRANSFER METHODS

Embryo transfer is a basic method in all aspects of applied and experimental embryology, and knowledge of embryo collection, evaluation and freezing is essential in relation to cryo-preservation of genetic material from endangered breeds and in the improved utilization of germ plasm in certain situations.

26. To FAO/UNEP the Panel recommends that:
- i. Training of local staff is a more effective and cheaper long-term approach than bringing in groups of foreign technicians to carry out embryo transfer work.
 - ii. Knowledge of embryo transfer has to be considered for the future use of such special techniques as:
 - embryo manipulation

- fertilization in vitro
 - production of transgenic animals.
- iii. Semen collection and freezing are also likely to be used in gene preservation and the technology is popular. Difficulties in semen collection from males of less-domesticated species have to be considered. Two techniques available are:
- electro-ejaculation, which, however, gives semen of lower quality;
 - use of the imprinting effect, which involves artificial rearing of newborn males, but leads to easy handling of mature animals.

PRINCIPLES FOR PRESERVATION OF ENDANGERED SPECIES AND BREEDS IN THE TROPICS

27. The Panel recognizes that although specific information is not available on decline in numbers in various tropical breed populations, indiscriminate crossing with temperate exotics is putting many of these populations in danger of extinction, e.g. Criollo breeds of Latin America, Sahiwals of India, Pakistan and Kenya, Jamnapari goats of India, Siri cattle of Bhutan and India. The need for preservation/conservation of breeds and local populations with specific adaptations, some of which are clearly endangered for various reasons, has now been clearly established.

A number of methods for preservation have been identified and costs worked out for each. There are two main categories:

- in situ preservation of live animals;
- ex situ preservation of parts in cryogenic storage.

Advantages of the in situ method are:

- the animals are visible, and so pleasing to the eye, and have some cultural value;
- they are a gene bank for future use;
- they are a constant reminder that the needs of posterity must be considered;
- the herd/flock may have some economic advantage (e.g. disease resistance in chickens) which can be exploited and so render the enterprise economically viable.

The costs of in situ preservation worked out so far for Europe are not applicable to many tropical countries; these could be much less and need to be estimated for each ecosystem.

Disadvantages of the in situ method are:

- small population size, leading to inbreeding and random drift. Many models are now available which reduce inbreeding to a minimum, but some scientists argue that random drift over long periods (say hundreds of years; may lead to a population very different in genetic composition from the initial one;
- gene x environment interactions.

Because of random drift and possible gene by environment interactions, ex situ methods are generally preferred over in situ.

Ex situ storage can be of semen, ova or embryos. At present, embryos are preferred for obvious reasons, as the breed can be reconstructed at any time. There is agreement, however, that it is desirable to store semen as well as embryos.

The fast growing science of biotechnology may lead to newer techniques of gene preservation. DNA recombinant techniques, embryo manipulation, cloning of desirable genes from the same or other breed populations may one day become commonplace.

28. To FAO/UNEP the Panel therefore recommends that:

- i. FAO/UNEP should take note of the trends in biotechnology and assist appropriate developing countries to generate the necessary information bases, infrastructures and manpower capabilities in this important area.
- ii. A survey should be made of various breed populations in the tropics to identify rare or endangered breeds for which action programmes for preservation need to be initiated immediately.
- iii. Cryogenic storage of embryos/germ plasma should be organized on a regional basis under international control. Problems of access to the gene bank, and how the access is to be arranged between donors and recipients, need to be clarified.

HORSES

29. The Panel recommends that:

- i. Although other species may be more important for the economics of developing countries the breeding of equidae not be neglected.
- ii. Generally speaking, indigenous horse populations which are free of English and Arabian Thoroughbred genes should be studied and where necessary, preserved. This is because all the light horse populations (even the ponies) seem to have a high level of English and Arabian Thoroughbred genes, which are not endangered.
- iii. In the regions having distinct horse breeds or lines well adapted to harsh conditions (e.g. in North Africa and the Arabian Peninsula), these breeds should be maintained under their original environmental conditions, even when they are also used as improvers in developed countries.
- iv. The developed countries should preserve the genetic variation of light and heavy horses and ponies. The large scale of their utilization ensures the use of some of them also in developing countries.
- v. The programme for saving the Przewalski horse in the wild in its natural habitat in Mongolia should be supported.

DONKEYS

30. The Panel recommends that:

- i. The maintenance and improvement of donkey populations of the world should also be surveyed, since in the tropics and for some developing countries this species is more important than the horse. The different breeds should be evaluated and preserved where necessary; the first steps have been taken in Brazil and France.
- ii. In the evaluation of donkeys, not only draught power but also meat production, the extent of other uses and above all, the adaptability of the breeds should be emphasized.

CRYO-PRESERVATION OF GENETIC MATERIAL

There is a substantial risk of transferring contaminating agents when cryo-preservation of genetic material is used for breeds not kept under strict hygienic control.

- semen may be contaminated;
- viruses may stick to the zona pellucida of the embryos;
- contaminating agents are effectively frozen with semen or embryos and may be preserved indefinitely;
- contaminating agents cannot be removed from semen;
- addition of antibiotics does not offer guarantee of neutralization of contaminating agents.

31. To FAO/UNEP the Panel recommends that:

- i. Only specific pathogen free animals as semen donors should be used.
- ii. Embryos should be treated according to the rules of the International Embryo Transfer Society (Organisation Epizootique Internationale).