CENTRO AGRONOMICO TROPICAL
DE INVESTIGACION Y ENSEÑANZA
C A T I E

REGIONAL PROGRAM ON ANIMAL GENETIC RESOURCES CONSERVATION AND MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN

TURRIALBA, COSTA RICA
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AKNOWLEDGEMENT

As coordinator of the recently held meeting on animal genetic resources conservation for development in CATIE, Turrialba, Costa Rica from June 23 to June 26, 1992 and now as the network coordinator would like to express my appreciations and thanks to the following: those organizations who sponsored the meeting including CATIE, FAO, IUCN and CROCEVIA; all those participants who made the discussions and presentations at the meeting very enriching and based on whose conclusions and recomendations this document is produced; Drs. Robert McDowell, Jerome Baker, Carlo Reineri and Arnoldo Gonzalez for having jointly developed the first draft of the document in collaboration with the undersigned; and all those who kindly offered to review the first draft among them would like to make special metion of Drs. David Steane of FAO-Rome and William D. Hohenboken of Virginia Polytechnic Institute and University for their detailed and critical revisions. Would also like to express my appreciation for M.C. Pedro Guerra of IDIAP, Panama for his editorial work on the final document. Finally would like to thank all who contributed to the organization of the meeting, preparation of this document and to those who have been supportive and encouraging of the idea. Finaly my thanks to our secretary Rose Mary Garro for putting all these together.

Assefaw Tewolde
Coordinator

EXECUTIVE SUMMARY

Latin America has one of the broadest base of animal genetic resources being utilized in different production systems and under varied ecological and social conditions. Some of these include, bovine, sheep, goats, camelides, poultry, buffaloes, donkeys, horses, etc. Several of these resources possess characteristics that are unique to certain production environments that it may be tragic to let them suffer loss or genetic erosion. This can be particulary critical at a time when issues of adapting animal types to the environment, hence sustainability of the production systems, are being raised more than ever in the continent.

In recognition to these, several efforts have been made to develop programs and projects in aspects of animal genetic resources conservation and management. Such efforts include the different meetings that have been held at national, regional and international levels in the last 20 years. In each of these meetings the importance of these resources has been clearly stated. However, it is not until recently that a concern to develop sound conservation and management program in Latin America in accordance with sustainable production systems has been raised.

In view of the above a technical meeting on conservation for development of animal genetic resources was

recently held in CATIE (June 23-26, 1992). Participants came from 15 countries (Cuba and Guatemala sent their presentations) in Latin America and the Carribean as well as organizations such as FAO, IUCN, CROCEVIA and Universities such as North Carolina State University, University of Georgia, the Autonomous University of Tamaulipas and the University of Peruggia in Italy (see list of participants). Each country presented its national program, existing or planned, on animal genetic resources and their relation to the national livestock development programs. From the presentations it was evident that countries varied highly in the level and magnitude of their programs in that there are countries that have structured programs in animal genetic resources conservation and management as there are several that do not. In view of such variability and in recognition of the important role that animal genetic resources can play in generating sustainable animal production systems in the region participants drew conclusions and recommendations pertaining to this area of urgent need.

The conclusions and recommendations of the meeting were then taken up by a group of scientits who elaborated and prepared this document "Program on Animal Genetic Resources Conservation and Management in Latin America and the Carribean". The main purpose and scope of this document are to serve as:

1. The basis for national and regional animal genetic resources conservation and management program in relation to sustainable production systems. This will be especially important for those countries that do not have programs at present.

2. The basis for specific project identification and implementation by those interested in the area of animal genetic resources and in collaboration with the national institutions.

3. An instrument to promote animal genetic resources conservation and management in Latin America on a uniform basis implementing the strategies herein outlined. In this way, it is hoped that the role of the animal genetic resources in Latin America's and the Carribean sustainable agriculture will greatly be enhanced.

4. Resource document to be used by regional and international organizations and agencies in the better definition of their genetic resources conservation and management program for Latin America responding to the needs expressed by the countries and as outlined in this document.

5. The basis for defining a better focus on training programs in the continent's animal genetic resources convervation and management area and its application to appropiate animal production systems. For that, it is hoped that this document can be used by research and educational institutions arround which interinstitutional cooperation can be easily promoted.

The documnent generally outlines main activities recommended for conservation and management of animal genetics resources and possible strategies to implement them. These include:

1. Survey and determination of livestock populations: Accurate assessment of the identity and abundance of breeds, strains and populations of animals of current or potential agricultural importance is the first step toward the implementation of a conservation program. A comprehensive national or regional program therefore, is necessary to allow assessment of germplasm needing conservation for biological, economic ecological or social reasons. Management strategies for populations in need of preservation according to the number of breeding females can be used following those suggested by FAO. Determination of the genetic status of populations will be the main product of the survey and based on which the corresponding conservation strategy can be considered.

2. Phenotypic and Genotypic Characterization:

Indigenous populations of many species in Latin America and the Carribean have been reduced in number through: a) introduction of foreign germplasm; b) destruction of an envinmental niche; c) over exploitation; d) loss of economic sustainability or e) desease. Due to these genotypic and phenotypic characterization of the populations will be needed especially accompanied by the

knowledge of characteristcs of the environment in which characterization occurred. Knowledge of the latter can be used to predict performance of the population in other defined environments.

3. Management of genetic variation:

Conservation of animal genetic resources is a part of overall responsibility of human being in the management of the biosphere for the sustained benefit of present and future generations. Management of genetic variation of animal populations in Latin America is important for the beniefit of rural peoples. Such people depend upon livestock for food, fiber, draught, insurance and income.

However, there will be a need to prioritize conservation programs on a per country or regional basis and then define their respective management. In this regard it is recognized that the effective population size will greatly influence the types of conservation programs, be they ex-situ or in-situ. Ex-situ and in-situ conservation strategies are very useful tools in conservation of animal genetic resources. The feasibility of establishing ex-situ (conservation of genetic resources outside their normal environment within which animals evolved) through animals and/or the crypreservation of genetic and/or embryos accompanied by in-situ conservation program is strongly advocated. Several issues related to these strategies and required management of genetic variation are described in greater detail.

4. Data Banks

The basis for any conservation and management program is the knowledge and information on breeds and breed types, main traits and population numbers as well as the production environment under which the animals are utilized. One way of making such information available is through highly reliable data banks. In this document the need to strengthen data banks on animal genetic resources at national and regional levels to eventually tie them up to FAO`s global data bank is strongly recommended. This and the preceding first two activities should probably be a high priority to be taken up in Latin America.

5. Exchange of animal genetic resources:

Eventually, a program on conservation and management of animal genetic resources is to make a flow of such resources between countries in the continent or else where possible. However, consideration of animal health regulations withen and between countries should be taken into consideration. Further detalis in this regard are given in this document.

6. Implementation of biotechnological components in animal genetic resources.

Any attempt to develop a program, be it national or regional, in animal genetic resource conservation will be significantly served by present day and future biotechnological advances. Some of the biotechnological

components that should be introduced (where they are not available at present) in relation to conservation programs, in-situ or ex-situ, include among others gene markers, nuclear and mitochondrial DNA, DNA mapping and manipulation and storage of semen, oocytes and embryos. This is also an area where training is highly called for.

7. Utilization of conserved animal genetic resorces.

Latin America can only afford to promote conservation programs if the benefits from utilizing such resources are clearly described. Purebreeding and crossbreeding, as generally well accepted strategies to increase productivity should be employed in as far as they are well designed. So, breeding programs that utilize conserved animal genetic resources (duly characterized and evaluated) should be enhanced. The effect of this will be to facilite the matching of animal types to the agro-ecological, economical and social conditions where sustainable animal production systems are called for as was earlier stated.

Also, one of the main recommendations made by the participating countries in the meeting held in CATIE was the creation of the Network on Animal Genetic Resources Conservation and Management in Latin America and the Carribean. The general objectives and scope of action of this network are described. Some, if not all of the above mentioned activities and strategies can greatly benefit from

a strong network, via the stablishment of national comissions on animal genetic resources.

In this document emphasis is made on the need to strengthen the network on animal genetic resources.

In sumary then, strategies and urgent actions that should be considered in animal genetic resources are outlined. It is within the context of these strategies that projects can be developed at national and regional levels in cooperation with institutions and organizations related to this area of interest. In this way Latin America will have positioned itself at the forefront in the area of animal genetic resources conservation and management the forefront. To make that more feasible a network on animal genetic resources is now in existence.

PREFACE

A technical meeting on Animal Genetic Resources Conservation and Management was held June 23-26 of 1992 in CATIE, Turrialba, Costa Rica. This meeting was sponsored and funded by CATIE, FAO-Rome, IUCN and CROCEVIA. The participants were from countries that included Argentina, Brazil, Bolivia, Colombia, Costa Rica, Cuba (sent only its contributed paper), the Dominican Republic, Ecuador, El Salvador, Guatemala (also sent only its contributed paper), Honduras, Jamaica, Mexico, Nicaragua and Panama. Also, in addition to the participation of the sponsoring agencies scientists universities in the United States (North Carolina State University and University of Georgia), Europe (University of Peruggia) and Mexico (University of Tamaulipas and Yucatan) also participated in this meeting. A list of the participants is included at the end of this document.

The main objetive of this meeting was to assess the current status of animal genetic resources ant its relationship to sustainable livestock production systems in Latin America. To advieve this objetive, each participating country presented its national programme on animal genetic resources conservation for development and were discussed and analysis in detail. From the presentations, it was obvious that countries varied in

programs related to animal genetic resources and its relation to their national livestock production. After holding discussions and deliberations during the week, the participants came to certain conclusions and recomendations pertaining to Animal Genetic Resources program in the Latin America Continent.

The conclusions reached at the meeting were recommended to be taken up by a group of scientits to develop a program document on animal genetic resources conservation and management. The present document is a product of this. The group of scientists that worked on this document consisted of Drs. Robert McDowell from North Carolina State University, Jerome Baker from the University of Georgia, Arnoldo Gonzalez Reyna from the Autonomous University of Tamaulipas, Carlo Reineri from the University of Peruggia and Assefaw Tewolde from CATIE, who also served as the chairman of the group.

The above mentioned group of scientits developed this document outlining major lines of action in the area of animal genetic resources conservation and management ranzing from the characterization of available animal genetic resources of bioeconomic secological importance data banks, exchange of animal genetic resources and utilization to management of genetic variation. The document's main purpose is to provide the basis for any program on animal genetic

resources conservation and management at national and/or regional levels. In this way it is hoped that Latin America can have a uniform and organized conservation and management program of animal genetic resources.

On another issue the participants recomended the creation of a Network on Animal Genetic Resources Conservation and Management in Latin America and the Caribbean whose main purpose is to facilitate and promote national and regional programs in this area involving instituions and organizations versed in its within the context of the strategies outlined in this document. For this Dr. Assefaw Tewolde of CATIE was nominated to be its coordinator.

In that regards the program document referred to here envisions the effective use of the Network not only limiting itself to Latin America, but also serve as liason, whenever necessary, to other initiatives in other parts of the world in cooperation with organizations and institutions associated with such areas of action. In addition a network such as this can and should establish as well as strengthen ties with the global animal genetic resources conservation and management program of FAO.

I. INTRODUCTION

The need for consideration of domestic animal genetic resources as a component of biological diversity has long been recognized. As such, it is a well known fact that losses of genetic diversity have occurred and will continue to occur. In Latin America the issue of animal genetic resources and conservation is being given closer attention and importance due to the overriding concern on environmental issues, hence the concern for integrating appropriate animal types into different agro-ecological animal production systems. In addition, animals have been part of the social life of the people in Latin America in many ways.

In recognition to the above there have been several initiatives, especially live animal preservation meetings at national, regional and international levels that addressed animal genetic resources and programs as well as activities associated with them.

For example, an expert consultation meeting was held in 1978 in Bogota, Colombia, which was sponsored by FAO. In this meeting most of the recommendations pertained to the Criollo cattle of Latin America even though it was recommended that other species such as pigs, goats, sheep, guinea pigs, camelids and poultry be given emphasis in the

future. Particular mention was made of the advantages that the Criollo type animals have when managed under unfavorable environments and the expected heterosis when they are crossed with other European breeds and Zebu types. This meeting also recognized the need for cooperation between organizations such as FAO, regional centers such as CATIE and national institutions to promote studies and evaluation programs. Previously, a bibliography on the Criollo cattle in Latin America was developed (Hayes, 1977). This report included most documented literature on the Criollo cattle of the region. Again, it is worth noting that no bibliography was developed in animal genetic resourse issues for other species.

FAO held an expert consultation meeting in Rome in 1988, where regional presentations were made on animal genetic resources. The part corresponding to Latin America reviewed the then existing conservation and preservation programs almost on a per country basis while at the same time indicating the risk status of the different species. Once more, the emphasis was on cattle but other species also were considered. The peculiarity of this expert consultation meeting was the fact that animal genetic resources were for the first time associated with sustainable agricultural development programmes. The latter concept is today more than ever important concernig the rational use of resources. Establishment of regional gene

and data banks was discussed and recommendations were made to initiate such activities in Latin America. To that effect, Brasil and Argentina were suggested for these banks for South America.

In 1989, another meeting on improvement of Criollo cattle in South America was held in Santa Cruz, Bolivia. Again the theme of the meeting was cattle.

In 1990 during the Latin American Association for Animal Production (ALPA) meeting in Campinas, Brazil there was an informal gathering to discuss ways to move ahead on regional animal genetic resource conservation and management with special emphasis on Criollo cattle. In this meeting, it was agreed that ideas such as this be promoted, but species other than just cattle should be included. It should be recognized here that the issue of animal genetic resources in Latin American has always been well embraced by ALPA.

Following this meeting, an international symposium on Criollo cattle was held in Cajamarca, Perú. At this meeting, the emphasis again was given to Criollo cattle since 70% of the cattle population in Perú is known as Criollo or have a mixed gene pool, with adaptation to the different Andean regions of the country. Again the economic, social and ecologial importance of these animal

types was clearly stated. However, little emphasis was given to other species.

In that same year (1991), a workshop was held to provide training both in data bank and gene bank practices to nationals of several countries in Latin America. The workshop was sponsored by FAO.

In 1992 more initiatives along these lines took place. First, an expert consultation group meeting on global animal genetic resources conservation management was held in FAO-Rome. The group recommended program actions on conservation, preservation (in-situ and ex-situ), monitoring improvement, world watch list, criteria and reasons of conservation, biotechnology, and data and gene banks. It also recognized that regional initiatives, as well as non-governmental organizations, could contribute significantly to animal genetic resource programs. The group also recommended that the management entity be FAO, answerable to representative from other institutions and organizations in the world. More important, however, was the fact that this meeting was held just prior to the UNCED meeting in Río de Janeiro in 1992. At this meeting the agenda on biodiversity, within which the issue on animal genetic resources lies, was signed and endorsed by most countries attending the meeting. This makes it opportune to formulate and implement a programm such as the current one for Latin

America as a region. On the other hand, still in 1992, the Central American Program on Agricultural Cooperation (PCCMCA) resolved and agreed in its annual meeting to create a regional commission on animal genetic resources.

With that background a Latin American and Caribbean technical meeting on Animal Genetic Resources Conservation for Development was held from June 23-26, 1992, in CATIE, Turrialba, Costa Rica sponsored by the host institution, FAO-Rome, CROCEVIA (an Italian NGO) and the International Union for Conservation of Nature (IUCN). Each participating country (see list of participants and their country in the appendix section) was previously asked to prepare a document on their national strategies for development programs in animal genetic resource preservation. Some countries did not attend the meeting but submitted presentations which were read. From the presentations, it was clear that there are countries in Latin America with clearly active programs in animal genetic resources; while others indicated either activities related to conservation and/or planned future programs on animal genetic resources, conservation and management. Often times efforts of establishing priorities of species at national levels were not evident.

The presentations by the countries gave very clear evidence of the different species of economic and biological importance that they considered deserving of national and

international attention in conservation and management. This was especially true of the ruminants, camelids, guinea pigs and poultry. In every one of the papers presented there was recognized need for animal genetic resource conservation and management. It should be indicated here that this was the first meeting where countries in Latin America described their respective national programs in animal genetic resources and their relationship to general national livestock development programs.

Participants agreed that a comprehensive program on Animal Genetic Resource Conservation and Utilization should be drawn up including all species in accordance to the list of priorities established by the respective countries. Such a programme should be regional in scope and sub-regional in operation to promote development in tone with the increasing need for sustainable livestock production systems in each country. To do this, it is important to recognize and emphasize species known to be of economic importance, in addition to those traditionally emphasized.

II. BACKGROUND

Throughout Latin America there is a strong interdependence between humans and animals which has evoloved from incorporating goods and services from animals into economic and cultural systems. Among these are foods in the form of meat, milk and eggs, other goods such as fibers, skins, waste for building soil fertility, generation of income, storage of capital, providing sport, and power for agriculture and transport.

When European settlers arrived, they found wide use of animal species indigenous to the area, such as the four species of the family Camelidae (alpaca, llama, vicuña and guanaco), certain species of the family Rodentia, (rodents), such as the capybara and güinea pig, as well as numerous other species, such as turkeys, iguana, and armadillo. With the introduction by the settlers of cattle, pigs, poultry, horses, donkeys and buffalo, Latin America today probably has the broadest germplasm base of animal species identified by humans as having utility. In domestic animals, Latin America is most unique in having groups of Bos taurus cattle, commonly refered to as Criollo, with long adaptation to the stresses of tropical climates.

Latin America's indigenous species have made global contributions. The turkey is now used throughout the world

as a food source and to a lesser degree for sport hunting. The guinea pig has become a vital laboratory animal for research in human and animal health besides it is used as protein source by Andean population. Certain of the Camelids are gaining in popularity outside the region as draft and/or companion animals and are found useful as protectors of small ruminants grazing on range areas from predators. Hair and short wool sheep types and certain goats are becoming popular outside the region for the improvement of meat characteristics of these species. This discussion leads to the conclusion that animal scientists and scientists from other disciplines need to focus greater attention to characterization of unique animal germplasm, throughout Latin America.

Policies on animal production emerging over the past 50 years have promoted partial or complete replacement of the poultry and livestock types with a long history in Latin America with exotic types. A number of the indigenous or long adapted types are approaching danger of extinction, following the FAO classification of "critical", meaning fewer than 100 breeding females. This is a second factor to draw attention to assessment of Latin American animal germplasm.

Some Zebu (Bos indicus) cattle were imported to Latin America from India about the middle of the 19th century.

Some of these were kept as pure types, leading to the development of several breeds unique to Latin America. The main use of Zebu has been for crossing with the local cattle. This system began to have a real impact during the 1945s and 1950s. In this system, the Zebu became the type for grading-up, which has led to replacement of the Criollo. The graded-up animals (Zebu) produced larger cattle which seemed to be the major motivation for implementing the up-grading policy. There was, however, inadequate testing to determine whether the larger animals were really more efficient producers than the local cattle.

Commencing about 1950, growth of many Latin American urban centers accelerated to 6% or more per annum. This development led to a rise in demand for milk which could not be met under traditional production systems and the limits in genetic potential of both Criollo and Zebu cattle. The proposed solution was the importation of exotic dairy breeds for use as pure stocks and for crossbreeding. Since the Criollo were less temperamental than the Zebu, the crossing for dairy purposes tended further to hasten the decline in numbers of the Criollo types.

In both beef and milk production, several attempts have been made to develop new strains from crossbred combinations. Overall, the success rate for these strains has not been high, due to limited population sizes and lack

of acceptance of these cattle on private farms. The conclusion is that "replacement of cattle stocks" with non-native types continues.

Traditionally, pigs and poultry have been a part of most households in the region. Commercial sales from these units were low. Hence with increasing demand for poultry and pork by urban centers, direct transfer of technology, including genetic resources, from outside the region has tended to become the norm for these two species.

Even though there are nucleus holdings of buffaloes in several countries of the region but, this species was not discussed extensively at this conference. The general concensus was that niche for the buffalo has not yet been determined nor were the samples of buffalo likely unique.

Marked changes in production systems and predominat types of livestock which have occurred over the past five decades partially were influenced by foreigners seeking markets for exotic stocks or equipment and by people of Latin America observing breeds and systems of production as they traveled abroad. Now that institutions in Latin America are offering training through the graduate level, animal scientists should be responsible for planning, evaluating and implementing improvements to Latin America's integrated production systems. Furthermore, they should be

encouraged to evaluate scientific findindgs and new technology from throughout the world with appropiate ideas and systems being adapted to local needs. A partial output of these endeavors will be to determine what this region has to offer in animal germplasm which can be useful elsewhere, through strategies such as the ones out-lined in this document.

III. JUSTIFICATION

There are social, ecological, economic and biological justifications for greater attention to animal germplasm conservation in Latin America and to investigating the potential use of species which have not received their due attention by scientists.

On the social side, there is rising view that the use of domesticated animals to produce food should decline with the projected expansion in human population and the corresponding need for more food. The central core of this argument is that animals compete with humans for foods. Animal scientists of the region need to consider this possible conflict as they explore various sources of germplasm to ensure best efficiencies in the use of feed resources unsuitable for human consumption within the context of proper land use and agricultural sustainability.

Livestock production in most of Latin America during the 20th century has increased through the opening of "new lands", mainly through reduction of forests. Much of these lands are marginal in productive capability thereby often leading to environmental degradation. Emphasis is increasing to return these lands to permanent cover of trees and shrubs. In pursuit of this goal, ruminant animals in

particular will need greater integration into total farming systems, including agroforestry.

To further address the ecological issue, animal scientists can demonstrate situations in which animals can play vital roles in environmental conservation. Farmers will be quite reluctant to forfeit use of land to grow trees which require long periods before receipt of returns. The planting of leguminous trees and shrubs to use as animal feed adds returns from animal products. Providing animal feed also becomes a motivating force to farmers to plant "second crops" or rotate crops with forage legumes which are recommended features of conservation. Exploitation of animal germplasm can be quite valuable in promoting conservation.

Justification for increasing the output of livestock products generally centers on their value as food. In several countries of the region, however, economic contributions to individual communities can be even more important than the contribution to human welfare from food production. This is through creation of continuing employment and the sale of products by smallholders providing the capital to increase crop production through purchases of better seeds, fertilizer, etc. Thus, there may be a positive correlation between increased crop and livestock production. Different breed types, e.g. dual

purpose type cattle, may have comparative advantages over specialized breeds in such situations. This is where certain of the Criollo types may be more suitable than pure beef or dairy breeds, which is another motivation for action on germplasm preservation.

The participants of the conference held at CATIE in June, agreed that a factor often overlooked in animal production in Latin America is biological efficiency of the animal and of the animal production system. With the adoption of large breeds of cattle, for example, by ranchers and commercial dairies, offspring often are transfered to small farms where feed resources can be quite limited. Under such conditions, the animals may utilize 80% or more of their feed energy merely to meet body maintenance requirements, leaving only a small fraction for productive purposes. Not only is milk yield or growth rate low but reproductive rate declines markedly and mortality increases. There is a need to examine the types of all domestic species and types which can be created from crossbreeding and selection programs to obtain biological efficiency as high as possible under limited feeding conditions.

Without reservations, the 1992 CATIE meeting participants felt there were strong justifications for all countries in the region to participate in planned regional program and network on animal germplasm conservation and

utilization; in a regional and national data bank on local species; participate in the FAO Global Databank for Domestic Livestock; and formulation of policies and plan activities directed towards germplasm conservation and utilization focused to wards the survey and characterization of bioeconomically important traits associated with animal genetic resources in Latin America.

IV. OBJECTIVES

The objetives set out by the conference on the Latin American Animal Genetic Resources Conservation and Management comprising this program were:

General:

The identification, characterization, conservation and utilization of domestic animal genetic resources.

Specific:

1.- Survey and characterize animal genetic resources in Latin America (domestic and semi-domesticated) with special emphasis to those that have bio-economic and ecological importance for these traits of importance in zebu cattle, criollos, pigs, sheep, goats, poultry, horses, camelides, buffals among others.

2.- Promote the establishment of management practices to maintain genetic variability in those characterized animals.

3.- Promote, strengthen and consolidate data banks on animal genetic resources.

4.- Promote the exchange of information on characterized animal genetic resources.

5.- Encourage, when and where possible, exchange of animal genetic resources between countries and regions.

6.- Implement biotechnological components to facilitate animal genetic resources conservation and management programs directed towards their utilization and improvement.

From the above, it is apparent that certain of the objectives are of short and/or medium term in scope short to medium term basis (e.g. objetives 1 through 4) while the rest tend to be of medium to long term.

V. ACTIVITIES RECOMMENDED FOR CONSERVATION AND MANAGEMENT OF ANIMAL GENETIC RESOURCES

The need for conservation of animal genetic resources was endorsed by all conference attendes. They all acknowledged the value of structured conservation programs and collaboration among organizations in the region. To accomplish these, activities must be designed which will permit the conservation, utilization and management of animal genetic resources. This section is a review of the activities recommended by the conference membership to achieve the objectives outlined earlier.

The achievement of all or part of these objectives will require that there be a coordination of the different activities that will hereafter be indicated. Such coordination will presumably influence institutional development in the area of animal genetic resources at national and or regional levels. For this to happen a Network of Animal Genetic Resources Conservation and Management was unanimously established by all participants in CATIE's meeting. The network's main objectives and purposes will be outlined in the organization section of this document as were made by the participants of the meeting.

5.1. SURVEY AND DETERMINE LIVESTOCK POPULATIONS

Accurate assessment of the identity and abundance of breeds, strains or populations of animals of current or potential agricultural importance is the fisrt step toward the implementation of a conservation program. A comprehensive national or regional program therefore is necessary to allow assessment of germplasm needing conservation for biological, economic or social reasons. The 1992 FAO report described management strategies for populations in need of preservation according to the number of breeding females (see Table 1). Procedures must be developed that will sufficiently describe the populations so that preservation strategies can be implemented.

It is known that within some species, sub-populations exist within a country or in neighboring countries. Such subpopulation might be interbred for better utilization of the germplasm. In other situations, much of the native stock within a country has been crossed with introduced breeds and few straightbred individuals remain. Purebreds from other countries may be needed to re-establish viable breeding populations in such instances.

The 1992 FAO document recommends the establishment of standardized mechanisms to survey agriculturally important animals in each country. Table 2 provides examples of

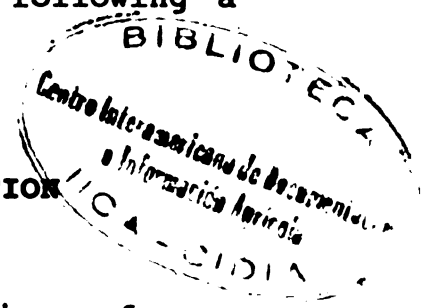
questions to help identify breeds, strains or populations to be included in a database. The 1989 FAO document also has identified descriptors based on simplified questionaires that would help standardize the data and enhance its utility.

It would not be necessary that a phenotypic or genotypic characterization of a population be completed before conservation steps were initiated. Populations that have fewer than 100 breeding females are in a critical status, and immediated steps would be necessary in such cases to prevent extinction. Once steps are taken to preclude further genetic loss, a satisfactory characterization can then be completed.

Decision regarding long term conservation would be made after a thorough survey was completed by other countries and a satisfactory characterization was completed. If satisfactory collections and cryogenic storage have been completed and the populations have no unique biological, sociological, economical or historical value, then they may be allowed to become extinct.

It was generally agreed that currently there are neither sufficient resources nor expectations of sufficient resources for conservation of all breeds, populations or strains of animals important to agriculture in Latin

American countries. The difficult decisions on which populations to conserve should be made only following a satisfactory survey.



5.2. PHENOTYPIC AND GENOTYPIC CHARACTERIZATION

It is widely known that indigenous populations of many species have been reduced in number through: a) introduction of outside germplasm, b) destruction of an environmental niche; c) over exploitation; d) loss of economic sustainability or e) disease. In some circumstances genetically stable populations can be achieved through regulation of utilization. In other circumstances more elaborate procedures will be needed to achieve genetic stability. In any case, characterization of the population will be needed.

Characterization of both phenotype and genotype will allow comparison to other populations. For best utility, the characterization needs to follow a uniform format. The 1989 FAO report provided a format that included information for: performance data, qualitative descriptors, origin and breed development, genetic peculiarities, genetic parameters and standardized breed comparisons. In addition to animal features, it is necessary to sufficiently describe the environment. Knowledge of characteristics of the environment in which characterization occured can be used to

predict performance of the population in other defined environments. Environmental descriptors include items such as climate, topography, primary nutrient resources, water availability, endemic parasites, disease risks and predominant management features. Where social or cultural practices may influence animal utility or performance descriptors of these factors should also be included. The purpose of characterization is to enhance collaboration and cooperation between countries for comparison of the breeds, strains or populations within a species. It will facilitate for potential exchanges of germplasm.

The characterization process should not simply be a review of the past, because the germplasm and environment both may be dynamic. Adaptation is a continuous process and indigenous breeds and strains must be able to continue to evole as conditions dictate. Therefore the process of characterization must permit periodic updates.

5.3. MANAGEMENT OF GENETIC VARIATION

Conservation of animal genetic resources is a part of our over all responsability for management of the biosphere for the sustained benefit of present and future generations. Management of genetic variation of indigenous animal populations in Latin America is important for the benefit of rural peoples. Such people depend upon livestock for food,

fiber, draught, insurance and income. To accomplish the goals of the conservation of the natural enviroment, the people of the rural areas of the world must have a more stable economic situation and opportunities for personal growth and develpoment. Management of germplasm should be complementary to efforts of preserving, restoring and enhancing the natural environment.

The membership at this conference generally agreed that there was a need to prioritize conservation programs for critical populations. There was recognition of the needs of individual countries to have different priorities. The priorities should be set for each population of a species after a thorough inventory and characterization have been completed. The priorization process must consider biological, social, cultural, environmental and economic value and should be done by a country itself with the colabotation of the network if needed.

The efective population size (Ne) will greatly influence the types of conservation programs (ex-situ and in-situ) that can be utilized for specific populations. The Ne for a population is equal to 4*(Nm)*(Nf)/(Nm+Nf); where Nm= number of breeding males per generation and Nf= number of breeding females per generation. In addition to the number of animals, the ratio of males to females is important. Inbreeding depression is a likely consequence of

a small Ne. The 1992 FAO report has recommended a minimum Ne of 50 for a breeding nucleus. The effects of inbreeding depression are usually more detrimental to fitness and reproductive traits tham to growth performance or product quality. Thus the inbreeding that will occur in small populations needs to be monitored and controlled as much as possible. Management of the population should consider breeding systems which will minimize long term cumulative effects of inbreeding.

Ex-situ and in-situ conservation programs can both be valuable in conservation of animal genetic resources. The appropriate use of both will be complementary in small populations that have been deemed to have value. Ex-situ can be explained as the maintaince of a population outside of its normal environment through live animals and/or the cryopreservation of gametic and/or embryos.

Ex-situ conservation will be more useful for species where cryopreservation procedures are commercially feasible. In species where these procedures are feasible and technical expertise is available, then the next problem is one of sampling. In populations, specially those that are small, sampling should be as wide as possible. If semen can be frozen then as many males as possible should be collected. Priority should be to preserve genes from unrelated individuals. If super ovulation and embryo collection are

possible, then each female collected should be bred to a different male for each collection. The objective of this wide sampling is to increase the variation available when these individuals are used in the future. Detailed records of performance and pedigree for all the animals sampled should be obtained and recorded.

Ex-situ conservation with live animals outside the normal environment within which the population evolved means that relative superiority within that environment may be reduced or lost. This risk must be assessed within the context of the other risks associated with in-situ conservation. The trade offs must be weighed by those directly involved and with knowledge of potential changes in the environment. In some situations reproductive rate and animal survival may be enhanced under controlled ex-situ environmental conditions, which would improve the outlook for long-term genetic resource conservation program. Ex-situ conservation cannot conserve habitats and ecosystems of which the germplasm is a component. In-situ programs of genetic management are recommended to accompany ex-situ programs if possible.

In-situ conservation would allow the population and the environment to continue to evolve together. This would allow the germplasm to continue to be monitored for changes and for ranking relative to other genotypes.

Sampling may also be a problem with in-situ designs. The resources that are available may dictate breeding systems and opportunities for sampling. To maintain genetic variability, the number of males used may be greater than required in commercially orinted levestock production schemes. In species where many more females are maintained than males, the effective population size can be dramatically reduced. Smaller and more numerous breeding groups can be a partial solution.

In both ex-situ and in-situ breeding programs groups should be maintained at several locations to reduce the risk that a disease outbreak might ruin a particular conservation effort. Obviously the number of individuals sampled each generation and the number of locations in which the populations are maintained will be influenced by numerous factors such as facilities, budgets, technology and inventory. Maintaining a population at numerous locations allows for characterization to be evaluated under different environmental conditions. This would potentially be a beneficial effect.

In populations with greater than 1000 breeding females sampling may also need to place emphasis on performance. The involvement of governments, institutions, breed associations and private individuals may mean different genetic

management objectives. Individuals may be more inclined to crossbreed for economic reasons. Plans need to be developed which could accomodate the different needs while maintaining a good data base and genetic resources. Genetic trends need to be monitored in order to make adjustments in the genetic management scheme. In some populations, breeds or lines there may be too few purebreds remaining. This situation may be the result of past crossbreeding by livestock producers. If there are few pure breds remaining but numerous crossbreds then these crossbreds may need to be included in a genetic management program. The crossbred animals should therefore have been included in the inventory and characterization phases of the genetic conservation program. If pedrigree data are available for the crossbred animal, it could be utilized in the genetic management program.

If crossbred females can be used in a back crossing scheme to sires of the breed to be conserved, then the population size might more readily be increased. Breeding purebred indigenous males to crossbred females, the offspring would be greater than 50% of the desired type. The second top cross would result in offspring greater than 75% of the type (breed, line, population) that would enhance the overall program. The offspring of repeated backcrosses could be included in the population inventory.

The concurrent use of top crossing with an open nucleus breeding system would facilitate the genetic management program and improve the breed, line or population. The open nucleus breeding system (ONBS) has been recommended by FAO (1992).

A second reason to utilize the crossbred female population is that the mitochondrial lineage is most likely to trace to the indigenous population. Mitochondrial DNA in some species is considered a source of additional genetic variation between lines within a breed or population and can allow the quantification of important sources of existing genetic variation. The maintenace of the mitochondrial DNA differences may well prove to be of importance in the future as DNA technology develops. Mitochondrial DNA is also important in estimating genetic distance between populations.

It is logical that gene mapping technology will assume increased importance in the future. Therefore, it is reasonable that populations with less than 10.000 breeding females would potentially benefit from storage of DNA, DNA libraries, and tissues.

The process of technological development occurs over time and not necessarily at a continuous rate. The ability of individual countries to take advantage of new technology

will also vary. Therefore it seems that both in-situ and ex-situ genetic conservation programs be utilized. It is through the current applications of basic genetic management programs that genomic organization, regulation, and diversity of genes controlling important physiological processes can eventually be determined.

5.4. DATA BANKS

The basis for any conservation and management program is the knowledge and information on breeds and breed types, main traits and population numbers as well as the production environment under which the animals are utilized. One way of making such information available is through highly reliable data banks.

The need for and usefulness of data banks have long been recognized. At a global level FAO has developed a data bank on domestic animal genetic resourses. Certain information on animal types are also included in this bank. It is, however, not complete. Also there are data banks at certain other centers, especially those that have been involved in live animal preservation and management, such as the one at CATIE.

During the recently held meeting at CATIE, most of the Latin American country representatives recomended that each

country strenghen its data bank. Where one was not available a data bank on animal genetic resources should be compiled for national regional and/or international use. At the national level, such data banks can be used for planning in the utilization of animal genetic resources, to monitor changes in genetic status of different species, to use in training in animal genetic resources and to help define appropiate crossbreeding programs and strategies of utilization of resources.

The information to be entered into national data banks should be a short and relatively uncomplicated list, such that requirements are uniformly understood by most countries.

The national data bank associated with in-situ and ex-situ conservation and management programs, after being fully computerized, should be connected to regional data banks. In Latin America there should be at least two regional data banks (one in the foot and mouth disease area and another in the and mouth fire area) in use that should in turn be connected to FAO's developed data bank in Hannover, Germany.

It is expected that population trends and statistics will be included within data banks and that monitoring and evaluation can be greatly facilitated. For this reason, a significant effort should be made to consolidate and promote

the establisment of regional data banks in the program of the Latin American Animal Genetic Resources Conservation and Management as proposed here. Such an effect can greatly be enhanced by the previously mentioned Network.

In addition, it is clear that after computerizing all the information the data bank can be available for graduate training in some of the national and regional centers. Data banks appropiately established for animal genetic resources can also attract the involvement and participation of organized producer associations.

5.5 EXCHANGE OF ANIMAL GENETIC RESOURCES.

A program such as the one indicated in this document shold promote exchange of valuable animal genetic resources from country to country or region to region. This will be possible as a concequence of the activities indicated in sections 5.1, 5.2, 5.3 and 5.4.

An exchange of animal genetic resources should consider a lack of uniform sanitary and animal health as well as biotecnological requirements for exchange of genetic resources between countries in the region. In this regard the meeting participants recommended the following:

i.-observe and consider international animal health guidelines for international movement of embryos, oocytes and semen.

ii.-whenever an exchange is planned, request from organizations such as the Interamerican Institute for Agricultural Coopeation (IICA) the current animal health and sanitary requirements of each country involved. In that sense try to achive standard animal health and sanitary system in most of the Latin American countries.

iii.-to establish guidelines and a step by step standard techniques for semen collection and freezing, multiple ovulation and embryo transfer (MOET), artificial insemination (AI) and estrus synchronization (ES), as they adapt to a particular region or country.

However, for animal genetic resources to be exchanged between countries, the importance of genetic evaluation using data banks for example, will be very important. To this effect, the significance of the contribution of the Network in animal genetic resources as a facilitator is evident.

The form in which such resources can be exchanged can take the form of live animals; fresh and/or frozen semen; fresh and/or frozen oocites for in vitro fertilization;

fresh and/or frozen embryos; and biological material for DNA fingerprinting, gene mapping and gene sequencing where possible.

5.6 IMPLEMENTATION OF BIOTECHNOLOGICAL COMPONENTS IN ANIMAL GENETIC RESOURCES.

Biotechonology has an important role in the conservation and management of animal genetic resources, as stressed by the recent 1992 FAO Expert Consultation. This was reaffirmed by the participating countries in the Technical Meeting on Animal Genetic Resources Conservation for Development in Latin America that took please at CATIE.

Some of the relevant biological components considered included gene markers, nuclear and mitochondrial DNA, and manipulation and storage of semen, oocytes, and embryos as was mentioned earlier in the section of exchange of genetic resources.

Gene markers already available are blood proteins (serum and intraerythrocyte enzymes), milk proteins, structural and/or enzymatic proteins from other tissues (e.g. semen, cheratins, muscle structure, etc.), erythrocyte antigens ("blood groups"), histocompatibility complex, coat color phenotypes, discrete visible phenotypes (e.g. presence

and absence of horns, wattles, mane, etc.), and monofactorial genetic diseases.

The analysis of nuclear and mitochondrial DNA already allows important applications such as population analysis using genetic polymorphism and genetic frecuencies; indirect quantification of inbreeding in a population where pedigree relationship are not known and the relationship between the differet gene markers and production, desease resistance and adaptation/fitness traits is a possibility. Among other possibilities is the utilization of mitochondrial DNA variability to distinguish the evolution between species not well defined (e.g. South American domestic and wild camelids, populations with various proportions of Bos taurus and Bos indicus inheritance, etc.), and to examine maternal contributions to different characters.

The manipulation, storage and utilization of semen, embryos and oocites is especially recommended for populations with a reduced number of animals (critical, endangered and vulnerable populations). Gamete storage also is important in populations that are strongly eroded by exotic genomes as was implied earlier in the section dealing with the management of genetic variation (5-3).

Embryo transfer techniques, associated with artificial insemination in species where it is technologically

developed, is very important for in-situ conservation strategies. This will allow an increase of the number of nonrelated or distantly related animals in critical, endangered and vulnerable population status and therefore be able to implement different selection schemes.

Other biotechnologies were pointed out by the meeting members but those such as cloning and transgenic animals seem to be of limited application in most Latin American countries.

Techniques, such as the immunologial analysis of blood groups and histocompatibility complexes, DNA mapping and sequencing, protein sequencing etc., need an inter-country organization with appropriate distribution of costs between participating countries. In this situation the role of already existing international organizations such as FAO, CATIE, and alike will be very important.

The above biotechnological components greatly comprise the basis for either in-situ or ex-situ conservation of animal genetic resources conservation and management. Ex-situ and in-situ conservation techniques and reasons for them were greatly discussed during the meeting at CATIE. The committee that prepared this document recommends that there be a center for the conservation and management of small ruminants, one center for the camelides and two centers for

large ruminants, one in the foot and mouth free zone of the continent and the other in the foot and mouth endemic area. The committee also suggestes that each center has its own sattelite activities. It should be mentioned here, though, that while the concept of regional gene banks was discussed in several meetings, no concensus was reached and therefore should be resolved somehow in terms of its implications.

Some of the activities in the biotechnology area related to animal genetic resources conservation and management proposed above can be made available through the cooperation between international institutions with interest in such area of action. This would enhance related animal genetic resource conservation and management programs as outlined in this document and as recommended by the participating countries in the afore mentioned Technical Meeting.

5.7. UTILIZATION OF CONSERVED ANIMAL GENETIC RESOURCES

Latin America has to envision conservation measures only if the proper utilization of same resources is clearly defined. For this, the efficient utilization of the conserved animal genetic resources will depend upon the inherent differences between populations. The numerous species of animals of importance to livestock production in

Latin America suggests that a variety of approaches will be necessary.

It is understood that both purebreeding and crossbreeding as generally utilized in livestock production, can be beneficial methods for increasing productivity. It is also recognized by many that both should be utilized appropriately for meeting the needs of a society for food, fiber, draught and other purposes.

Purebreeding can be the best method to fix genes or traits where environmental adaptation permit them although inbreeding can also be used. This can enhance the selection of traits of economic importance. Such that differences can be quantified as is infact practiced by the purebred associations in Latin America. Effective crossbreeding programs, however, depend upon the use of suitable purebreeds for utilization of heterosis and breed effects.

Crossbreeding is an important method for improving productivity and should be utilized for optimal use of breed effects and heterosis. Crossbreeding can be used if appropriate precautions are taken to ensure the maintenance and conservation of pure breeds.

There are also numerous composite breeds that have been formed to jointly use breeds in a simpler breeding system

than systematic crossbreeding. It should be examined as a method to maintain the desired breed effects of some indigenous livestock populations.

Utilization of conserved animal genetic resources, through live animals and embryos, will also require the exchange or movement of germplasm. However, animal health regulations and status should be taken into account as indicated earlier in this document.

In addition to the conservation and utilization of breeds, lines and populations within the region, it is imperative to examine other germplasm from outside the region in which case the information collected by FAO in this regard would be valuable.

Effective utilization of animal genetic resources in the region will require: a) reliable survey and characterization data, b) designed purebreeding and sustainable crossbreeding systems, c) incorporation of in-situ and ex-situ conservation programs, d) development of cryopreservation technology, c) development of DNA technology, f) exchange of germplasm, g) selection and management of germplasm and h) introduction of new germplasm. The judicious combination of these methods on a case by case basis will help to maintain genetic variability. The above points have been discussed or

mentioned in the preceding sections of this document in ralation to a possible program (whether national or regional) on animal genetic resource conservation and management.

The conservation of animal genetic resources will require the coordination and cooperation of numerous individuals, organizations, breed associations, governments and institutions. Conservation programs affect ecological and biological systems as well as economic, social and cultural values of a country or region, all of which must be considered in the management of genetic variation.

VI. ORGANIZATION

As was indicated earlier a recommedation was made and unanimously agreed upon by the participating members at CATIE's meeting to create a network on animal genetic resources conservation and management in Latin America. The network has as its excecutive committee members Argentina, Brazil, Mexico and Nicaragua and was also agreed upon to have its headquarters at CATIE under the coordination of Dr. Assefaw Tewolde of the same institution. The main objetives of the network include:

a. Promote institutional development in the area of animal genetic resources conservation and management via establishment of national comissions on animal genetic resources in Latin America.

b. Promote and hold workshops, seminars and symposium in animal genetic resources related topics.

c. Bring together Latin American nations, international and regional organizations, non-governmental organizations as well as research and educational institutions interested in participating in Latin America's conservation and managment of animal genetic resorces within the context of agricultural sustainability.

d. Initiate the production of a Latin American Newsletter in animal genetic resources to be circulated at least quaterly among the countries exchanging news in the initiatives taking place in the area of animal genetic resources.

e. Promote exchange of technical expertise between countries to participate in national program development within the scope of the areas covered in this document.

f. Help Latin American countries develop uniform programs in the area of animal genetic resources conservation and management.

g. Act as resource entity for any of its member countries in obtaining the necessary data and information regarding germplasm exchange.

VII. SUPPLEMENTARY FUNDING REQUIREMENTS

The present regional programme on the Conservation and Management of Animal Genetic Resources will require the following funding items:

1.-Training

- -Workshops and Seminars

2.-Conservation Programs

- -In-situ 4 Centers
- -Ex-situ (National Gene Banks)

3.-Data Banks

- -Survey of Animal Genetic Resources
- -Maintenance of Regional Data Banks

4.-Improvement System

- -Maintenance of genetic variation
- -Animal Genetic Resource Utilization

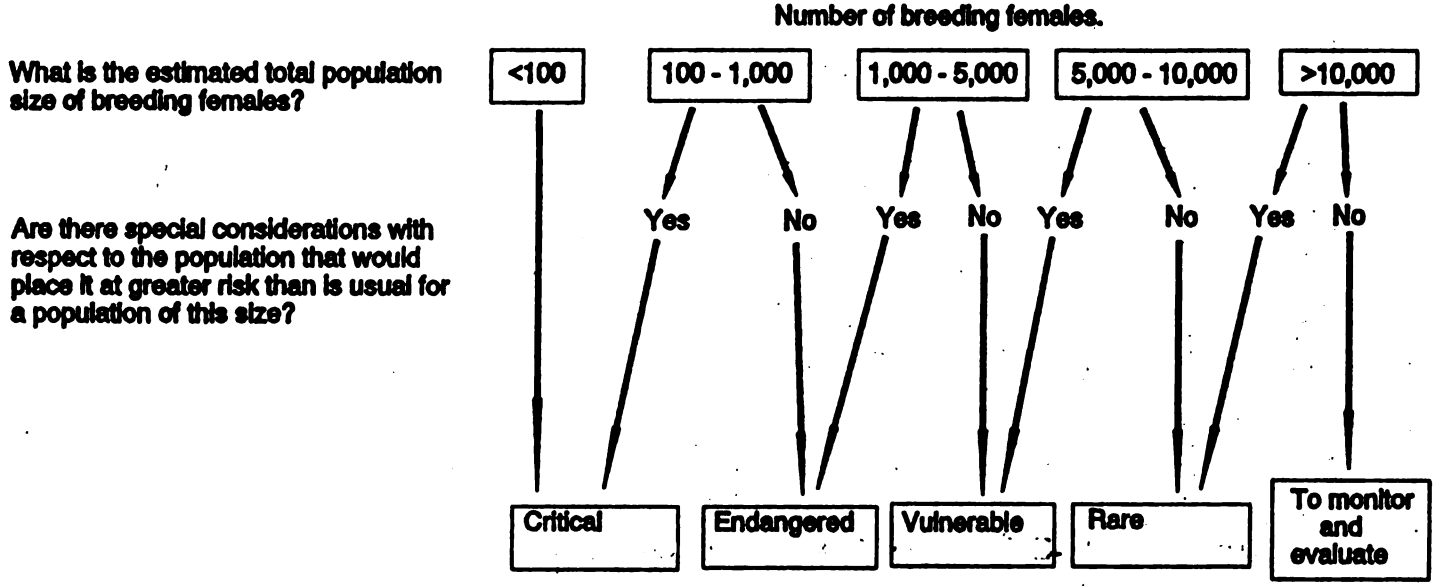
5.-Outreach Activities

- -Network on Animal Genetic Resources
- -Abstracts on Animal Genetic Resources
- -Newsletters and short communications

Funding for the different activities outlined above will be dependent on specific negotiations with organizations and entities that are supportive of these initiatives.

Table 1 - Identification of stocks in need of preservation *

For all breeds identified in table A above and not found in larger numbers in neighbouring countries.



* Adapted from FAO, 1992.

Table 1. Special Considerations

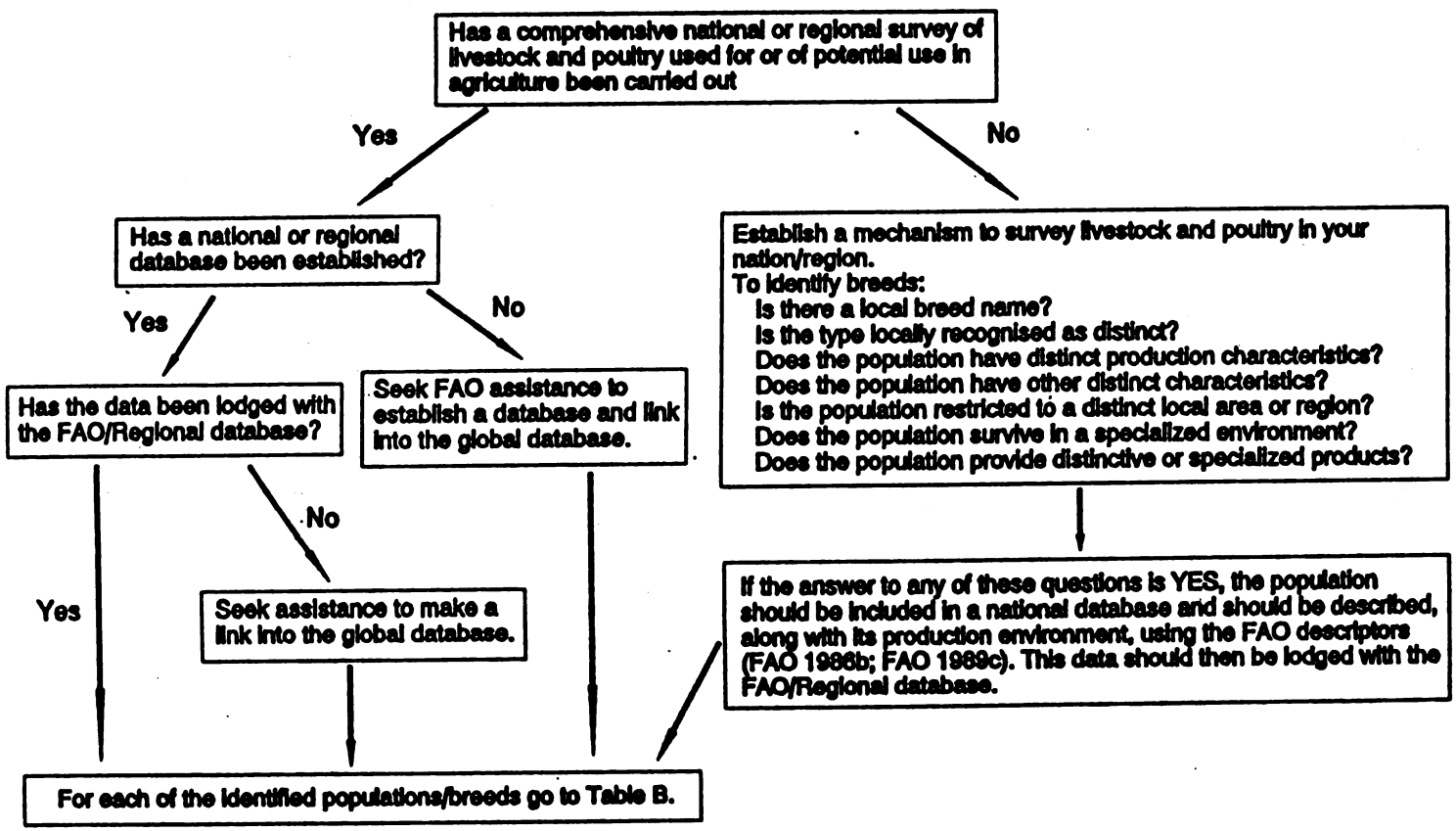
The specific situation of each population is to examined. Major considerations are:

- Degree of crossbreeding in the population.
- Reproductive rate and generation interval of the population. Populations with low reproductive rates are at relatively greater risk than populations of comparable size of high reproductive capacity.
- Special peculiarities and characteristics of the production system (intensive, extensive, nomadic, etc.).
- Historic and current rates of decline in population numbers.
- Geographic isolation of the population or its concentration in one or a few locations that would place it at risk as a result of climatic, economic or political changes or disease outbreak.

Populations deemed at additional risk with respect to the above considerations, would be placed in the next higher category (Table B).

Once classified, action plans for conservation of the population are to be implemented as per Tables C (Critical), D (Endangered), E (Vulnerable) and F (Rare) as found in FAO (1992) publication.

Table 2 - Identification of populations/breeds *



* Adapted from FAO, 1992.

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