36
2005
ISSN 1014-2339

ANIMAL GENETIC RESOURCES INFORMATION

BULLETIN D'INFORMATION SUR LES RESSOURCES GÉNÉTIQUES ANIMALES

BOLETÍN DE INFORMACIÓN SOBRE RECURSOS GENÉTICOS ANIMALES

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Editorial Advisory Board (EAB) of Animal Genetic Information (AGRI)

Editorial - Finalizing the first *Report on the State of the World's Animal Genetic Resources*

The Commission on Genetic Resources for Food and Agriculture held its 10th Regular Session in Rome, from 8 to 12 November 2004. The Commission endorsed the report of the 3rd Session of the Intergovernmental Technical Working Group on Animal Genetic Resources.

The first *Report on the State of the World's Animal Genetic Resources* has six main sections:

1. The state of agricultural biodiversity in the farm animal sector, describes the major animal production systems and related animal genetic resources, their utilization and conservation;
2. The state of the art in animal genetic resources management, is a review of current scientific and technical methodologies for the utilization, development and conservation of animal genetic resources, including characterization and valuation, conservation methodologies, biotechnologies, genetic evaluation and improvement;
3. Changing demands on livestock production and their implications for future policies, strategies and programmes, is a review of past and present policies, strategies, programmes and management practices, analyzing future demands and trends of animal products, changes in production systems and their impacts on animal genetic resources;
4. The state of national capacities and future capacity building requirements, is an assessment of the state of capacities at the national and regional levels and the requirements and opportunities for capacity building;
5. The strategic priorities for action, includes the *Report on Strategic Priorities for Action*, revised by the 10th Session of the Commission and based mainly on Country Reports;
6. The way ahead - mainstreaming animal genetic resources, considers options for achieving the effective and efficient implementation of priority actions identified in section 5 above.

The first *Report on the State of the World's Animal Genetic Resources* will be presented to the 4th Session of the Working Group in May 2006 and, after revision, to the 11th Session of the Commission to be held late 2006 or beginning 2007. Its final adoption by countries will be at an International Technical Conference on Animal Genetic Resources planned for 2007 in a host country not yet determined.

The Editors

Editorial - Finalisation du premier *Rapport sur l'état des ressources zoogénétiques dans le monde*

La Commission des ressources génétiques pour l'alimentation et l'agriculture a tenu sa Dixième session ordinaire à Rome du 8 au 12 novembre 2004, durant laquelle le rapport de la troisième session du Groupe de travail technique intergouvernemental sur les ressources zoogénétiques fut approuvé.

Le premier *Rapport sur l'état des ressources zoogénétiques dans le monde* est composé de six sections :

1. L'état de la biodiversité agricole dans le secteur d'élevage, qui décrit les systèmes de production les plus importants, leurs ressources zoogénétiques, ainsi que l'utilisation et la conservation de ces ressources;
2. L'état actuel de la gestion des ressources zoogénétiques. Cette section révise des méthodologies scientifiques et techniques actuellement disponibles pour l'utilisation, le développement et la conservation des ressources zoogénétiques, y compris la caractérisation, l'évaluation génétique et l'amélioration de ces ressources, les méthodologies de conservation et les biotechnologies;
3. Les changements dans la demande en production d'élevage et leurs implications sur les politiques futures, les stratégies et les programmes, qui est une révision des politiques, des stratégies, des programmes et des types de gestion développés et appliqués aussi bien dans le passé que de nos jours. Cette section présente une analyse des tendances de la future demande des produits d'origine animale, des changements prévus dans les systèmes de production et leurs impacts sur les ressources zoogénétiques;
4. L'état des capacités nationales et des besoins futurs de formation, évalue l'état des capacités aux niveaux national et régional, ainsi que les besoins et les possibilités de formation des ressources humaines;
5. Les priorités stratégiques, incluent le *Rapport sur les priorités stratégiques*, qui est essentiellement basé sur les rapports nationaux et qui a été révisé par la dixième session ordinaire de la Commission;
6. La démarche à suivre – promouvoir les ressources zoogénétiques. Cette section examine les options qui permettront d'achever une implémentation efficace des actions prioritaires identifiées dans la section ci-dessus.

Le premier *Rapport sur l'état des ressources zoogénétiques dans le monde* sera présenté à la quatrième session du Groupe de travail en Mai 2006 et, une fois révisé, à la onzième session ordinaire de la Commission, qui sera tenue à la fin de 2006 ou au début 2007. Le Rapport sera finalement adopté par les pays lors d'une conférence technique internationale sur les ressources zoogénétiques qui est planifiée pour l'année 2007, dans un pays hôte qui reste encore à être déterminé.

Les Editeurs

Editorial - Finalización del primer *Informe Mundial sobre los Recursos Zoogenéticos*

La Comisión de Recursos Genéticos para la Alimentación y la Agricultura realizó su décima sesión ordinaria en Roma del 8 al 12 de Noviembre de 2004. La Comisión aprobó el informe de la tercera sesión del Grupo de Trabajo Técnico Intergubernamental sobre Recursos Zoogenéticos.

El primer *Informe Mundial sobre los Recursos Zoogenéticos* tiene seis secciones:

1. Estado de la biodiversidad agrícola en el sector ganadero, que describe los sistemas de producción animal más importantes y los recursos zoogenéticos correspondientes, así como su utilización y conservación;
2. Estado de la gestión de los recursos zoogenéticos, que es una revisión de las metodologías técnico-científicas para el uso, desarrollo y conservación de los recursos zoogenéticos, incluyendo su caracterización y valoración, métodos de conservación, biotecnologías, evaluación genética y mejora;
3. Cambios de la demanda en producción ganadera y sus implicaciones en políticas futuras, estrategias y programas, que es una revisión de las políticas, estrategias, programas y tipos de gestión pasados y presentes, analizándose demandas futuras y tendencias en productos de origen animal, cambios en los sistemas de producción y sus impactos sobre los recursos zoogenéticos;
4. Estado de la capacidad existente y de las necesidades futuras de formación, que es una evaluación de la capacidad existente a nivel nacional y regional, y de las necesidades y oportunidades para la formación de recursos humanos;
5. Prioridades estratégicas para la acción, que incluye el Informe sobre *Prioridades Estratégicas para la Acción*, considerado por la décima sesión ordinaria de la Comisión y basado mayormente en los informes de país;
6. Marcando rumbos – promoción de los recursos zoogenéticos, que considera las opciones abiertas para lograr la implementación efectiva y eficiente de las prioridades para la acción, identificadas en la parte anterior.

El primer *Informe Mundial sobre los Recursos Zoogenéticos* será presentado a la cuarta sesión del Grupo de Trabajo en Mayo de 2006 y, luego de revisado, a la undécima sesión ordinaria de la Comisión, que se realizará a fines de 2006 o principios de 2007. Será adoptado finalmente por los países en la Conferencia Técnica Internacional sobre Recursos Zoogenéticos que se espera realizar en 2007, en un país anfitrión aún no determinado.

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A world wide emergency programme for the creation of national genebanks of endangered breeds in animal agriculture[1]

E. Groeneveld

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Summary

In response to the rapid loss of animal genetic resources, a world wide emergency program is proposed to create national genebanks on the basis of somatic cells. Contrary to other procedures, like storing deep frozen semen or embryos, collection and storage of somatic cells can be done cheaply and rapidly for any species. Only in this way can an emergency store of animal genetic resources be created fast enough to forestall the ongoing rapid erosion of animal biodiversity. While animals can already be produced from somatic cells for 10 species, this number will continue to rise in the future. A layered strategy is proposed which is based on collection and storage within individual countries, thus leaving execution of the program, responsibility and ownership of these national cryobanks with those countries. After a pilot study, more country genebanks could be created as funds become available. With a limited effort, the creation of a network of national genebanks of last resort are a realistic option.

Resumen

Se propone un programa mundial de emergencia para crear bancos de genes nacionales basados sobre las células somáticas en respuesta a la rápida pérdida de recursos zoogenéticos. Al revés que con otros procedimientos, tales como el almacenamiento de semen o embriones congelados, la recogida y almacenamiento de células somáticas puede llevarse a cabo de forma más rápida y económica y para cualquier especie. Sólo de esta manera se puede establecer un stock de emergencia de recursos zoogenéticos de forma rápida para hacer frente a la futura erosión de la biodiversidad animal. Los animales pueden ser producidos desde células somáticas ya en 10 especies, y este número seguirá creciendo en el futuro. Se propone una estrategia por etapas basada en la recolección y almacenamiento a nivel de cada país, y dejando la ejecución del programa, la responsabilidad y propiedad de estos crio-bancos nacionales a cada uno de estos países. Tras un estudio piloto se podrán crear más bancos de genes nacionales según se vayan obteniendo mayores fondos. Con un esfuerzo limitado se puede considerar como una opción realista la creación de una red de bancos de genes nacionales.

Keywords: *Somatic cells, Genebank, Cryogenic conservation, Animal genetic resources, Endangered breeds conservation programmes, Cost evaluation, Database, FAO.*

Introduction

Since the Convention on Biological Diversity (United Nations, 1992), conservation of genetic variability has become a generally accepted responsibility of United Nations

[1]Paper submitted on 7 Febuary 2004

member states. While developed countries have taken on the responsibility, and have the means, to preserve their endangered breeds in the area of animal agriculture thereby reducing the rate of extinction, breeds are still disappearing on a global level at a worrying rate (Scherf, 2000). As a result, the Food and Agricultural Organization (FAO) of the United Nations has set up the Animal Genetic Resources Group to develop a strategy for the management and utilisation of animal genetic resources. Many of the activities were geared towards the creation of infrastructure in member countries with the objective, amongst others, to create awareness about the importance of animal genetic resources. National coordinators for animal genetic resources are responsible within countries for their national genetic resources. The development of the global strategy created the Domestic Animal Diversity Information System (DAD-IS *http://dad.fao.org*) as an international information exchange platform, that, based on the EAAP breeds database, presents an overview of the breeds of the world.

The Rational for Using Somatic Cells in Cryogenic Conservation

Clearly, utilization and improvement of local breeds would be the best means of conservation. However, the dynamics driving population development in many parts of the world are different, and is often achieved by replacing local breeds by exotic genetics imported from the first and second world. While the indiscriminate replacement of local breeds with these high input, high yielding breeds may not be sustainable in many instances, they will continue to replace local populations where the 'environment' in terms of management, housing and feeding can also be imported. With progressing urbanization this process is and will be very rapid. As a result, it will be very difficult to counteract the replacement and the implicit loss of local breeds. The World Watch List demonstrates impressively the need to counteract this development (Scherf, 2000).

There are a number of options for conservation when used in its broadest sense:

1. conservation through utilization and improvement;
2. *in-vivo* conservation;
3. *in-vitro* conservation.

As is generally known, the three strategies serve very different objectives and are also very different in terms of costs and effort required. Improvement and utilization is a long term process. Setting up breeding programs has taken many decades to develop in Europe, a time frame that will also have to be expected for many parts of the world where they are intended to be developed. Thus, this option is not suited to counteract the rapid decline in population sizes which will take place in the meantime.

In-vivo conservation of endangered breeds requires subsidies that make up for the financial difference to competing breeds. While this may be affordable in the developed world, it is not an option in many developing countries.

This leaves us with the *in-vitro* conservation. Traditionally, it comprises material like semen, embryos and perhaps oocytes. Placement in liquid nitrogen allows unlimited storage, while recovery is relatively straight forward. There are however a number of reasons, why these techniques cannot generally be used for endangered breeds world wide. Deep freezing of semen and embryos can be done for a number of species only. Furthermore, it requires substantial infrastructure in the countries which is not generally available, not to mention considerable costs, an issue also pointed out by Woolliams and Wilmut (1999). As a consequence, this is also not an option.

We need to develop a strategy which can be deployed quickly because breeds are being lost continually, is sufficiently cheap and is simple enough to be carried out in parts of the world with little infrastructure. Here, storage of somatic cells may open an option as pointed out by Corley-Smith and Brandhorst (1999).

Somatic cells can be collected from every animal; either a skin or ear notch or blood can be used. In this way the collection of samples can be cheap and fast. Tissue samples can be cryo-conserved in liquid nitrogen easily. Collecting a sufficiently large number of samples is thus also a distinct possibility even in those countries with little infrastructure.

Under an *in-vivo* conservation scheme live animals are available for utilization, where semen and embryos are a proven path to reconstitute a breed, albeit a time consuming and costly one. While this is not as straight forward with somatic cells, a new path is developing rapidly via cloning. Already now it is possible to reconstitute an animal from basically every sample of somatic cells (to date demonstrated for 10 species). Currently, this process is very costly, but this is expected to change in the future.

The question about which strategy to pursue in the conservation of endangered breeds basically narrows down to these alternatives:

1. Traditional conservation means; and
2. Somatic Cell Cryo Conservation (SCCC)

Traditional conservation means

In-vivo conservation via breed improvement programs will not stop breed loss in many parts of the world where currently breeds are disappearing. The reason for not being able to turn the tide against breed loss via breed improvement programs is that an infrastructure will have to be created first. This requires a large financial investment but more importantly time, which is running out. Thus, even if money were available to set up improvement programs (management and genetic), by the time this has an impact on the population, many breeds would have disappeared. (Having said this, wherever possible breed improvement programs ought to be developed, but relying on them as a means to preserve breeds will in many instances fail.)

Also, cryo-preservation using semen and/or embryos is no option for the same reason. Firstly, this technique also requires substantial infrastructure including human investment which is always a lengthy process. Furthermore, cryo-preservation is not possible for certain species. Even where it would be technically possible, the sheer time it takes to perform the tasks will make it impossible to acquire samples from sufficient numbers of animals rapidly enough.

Somatic Cell Cryo Conservation (SCCC)

The tissue collection phase is short and simple. Once an animal has been located and restrained, a tissue sample like an ear clipping can be collected within seconds. Furthermore, somatic cells can be collected from all species. The samples can be stored initially in cooling boxes until moved to a tank containing liquid nitrogen. Using this strategy, harvesting a sufficiently large number of samples from a large number of breeds of different species can be done in a limited time with limited funds. The most important issue is knowing where the animals are and which samples are to be taken.

Admittedly, SCCC has limited scope as regards reconstitution of animals at this point in time. If the objective is to save something that would otherwise be lost and is considered potentially very important in the future, but without knowing if it will be utilized, then SCCC provides a possibility to do something. The question to be answered is then: do we rather want to have no samples (or very few) in store from the semen/embryo category or complete coverage (which could be achieved with some effort) of somatic cells that may be difficult to reconstitute now (although even that is possible) but will become much easier in all likelihood in the future. The logical conclusion is very clear: the only option to create a genetic backup for many endangered breeds at this time is via SCCC. Thus, a global program should be developed as soon as possible to create national SCCC banks preferably under the umbrella of FAO AGAP.

Technical Issues for SCCC

A large number of tissues can be used as the starting material for SCCC, such as blood, skin samples and tissues from ears. For cattle, pigs, sheep, goats, camelids and llamas, a unified and identical procedure can be used by obtaining a tissue sample from the ear using notchers which are also used for setting earmarks (e.g. www.biopsytec.de). Clearly, for all species lymphocytes could be used, but somatic cells from ear clippings will be much easier to obtain and are therefore preferable.

The complete process from an animal via deep frozen somatic cells to its reconstitution by cloning comprises the following steps (Niemann, personal communication, 2003):

1. Collect samples:
   a. identify animal as sample source;
   b. take tissue sample, for instance using an ear notcher;
   c. place the plastic vial containing the tissue sample into the cooler;
   d. record the vial number plus all info required for the animal;
   e. go back to the centre where the deep freezer (liquid nitrogen) is located;
   f. put all samples into the freezer and record their location;
   g. enter data into database
2. Use samples for genotyping/cloning:
   a. take somatic cell sample from the freezer;
   b. thaw;
   c. create and cultivate fibroblast culture (i.e. multiplying the tissue material);
   d. take sample from the fibroblast culture for use;
   e. freeze the rest (this process can be repeated);

To date, creating clones from somatic cells has been successful for 10 species, three having been added only during the year 2003 (Kues and Niemann, 2004). Therefore, it can be expected that this procedure will be available in the future also for those species where cloning thus far has not been done or has not been successful.

If ear notchers are used for sampling the tissues, the tagging process will place the sample automatically into a small plastic vial. Then these samples need to be put into cooling boxes until they are stored later into more permanent containers in liquid nitrogen at a location to be determined by the member country.

Without individual documentation the samples stored will be useless. Thus a system needs to be readily available to facilitate bookkeeping and identification of each tissue sampled stored. A minimum set of data elements should be recorded allowing a uniform documentation of a samples world wide. Data collected comprises: species, breed, location, tissue type, location within the liquid nitrogen tank. Currently, development of generic genebank information systems are under way (Groeneveld *et al*., 2004) that would be available for this documentation, including free exchange of data, perhaps as part of an expanded DAD-IS data structure.

The Within-Country Strategy

Animal genetic resources are the responsibility of individual countries. Therefore, development of conservation programs should also be done by each countries. Only there is the knowledge about the location and the breeds under threat readily available. Therefore, countries need to identify which breeds they want to put into cryo-conservation. In this way the ownership of the samples also remains clear, they belong to the country of origin. Accordingly, samples are best stored within the country itself.

Collection of samples is relatively straight forward with limited demands on resources. The storage facilities are somewhat more costly but more importantly, do require a constant and secured supply of nitrogen or electricity for the deep freezer. Perhaps this cannot be guaranteed everywhere. Where this is not possible, one might consider undertaking contractual cooperation with neighbouring countries that are in a somewhat safer position. Such a solution could be temporary.

Expanding to a Global Program

Over recent years, FAO-AGAP has created a remarkable infrastructure at the national and regional level through their national and regional coordinators for animal genetic resources. It has lobbied heavily to create awareness about their importance. While inroads have been made in this area, the decrease in breed numbers has not been halted.

Initiating actual classical conservation programs in member countries is close to impossible because of the costs and the organizational issues involved. With the new possibilities that SCCC creates, the situation has changed. Given the limited amount of funds required and the infrastructure created by FAO, the conditions are really very good to try to create a global initiative for the set-up of country based SCCC in a relatively short time.

An Initial Pilot Program

The FAO-AGAP could be the promoter, coordinator and executor of this program. An initial pilot program should concentrate on the verification of the collection and storage procedures. It would be preferable if this was undertaken with one country only. The experience gained would result in guidelines to be used for the much broader action to follow. The issues to be dealt with are:

- identification and testing of tissue collection procedures for each species, where it is probable broad groupings can be made such as mammals and birds;
- verifying the procedures for the creation of fibroblast cultures from the sampling procedure used;
- work flow from identification of animals to be sampled, initial recording of relevant information on sire, intermediate storage of samples;
- placement in final cryo-store;
- finalizing a cryo-database, setup and training;
- entering information in national database with connection to DAD-IS.

Expansion to Global Action

After the pilot project has been carried out and evaluated, the program can be expanded through other countries using the FAO AGAP infrastructure. If it not possible to secure funding for the complete worldwide program in one block, the program can get started and then expand as funds become available.

Costs and Time Frame

Due to the fact that only somatic cells are being collected with a robust technology, the cost for even a global program will be limited. The largest block of start up costs for physical equipment for the execution of this program within a country is for the cryogenic tank which is in the order of $ 700. Then there will be costs for a cooling box plus the notcher. Thus, the total investment in this area is in the order of $ 1 000 per country. The biggest costs will be travel and personnel which increase in direct proportion to the number of samples taken. As stated before, one of the biggest advantages of this procedure is that it can produce results very much faster than any other. Given that funds are available and the operational procedures established, an emergency backup of a country's animal genetic resources in the form of a somatic cell cryo-conservation bank could well be established within a year or so. Together with the relatively low costs, this fact may turn out to be a very persuasive argument to convince potential donors.

List of References

Corley-Smith, G.E. & B.P. Brandhorst. 1999. Preservation of Endangered Species and Populations: A Role for Genome Banking, Somatic Cell Cloning, and Androgenesis? Molecular Reproduction and Development, 53: 363–367.

Groeneveld, E., L. Yordanova, & S.J. Hiemstra. 2004. Organizational Structure and Information Technological Support of National Gene Banks. Livestock Production Science. 89: 297-304.

Kues, W.A. & H. Niemann. 2004. The contribution of farm animals to human health.

Scherf, B.D. (Ed.). 2000. World Watch List for domestic animal diversity. Food and Agricultural Organization of the United Nations, Rome, Italy, 3rd edition.

United Nations. 1992. United Nations Environment Program Convention on Biological Diversity. *http://dad.fao.org/en/refer/library/conventn/cbd.pdf*.

Woolliams, J.A. & I. Wilmut. 1999. New advances in cloning and their potential impact on genetic variation in livestock. Animal Science, 68: 245–256.

The Abergelle and Irob cattle breeds of North Ethiopia: description and on-farm characterisation

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Summary

A field survey was carried out between January and June 2002 in order to describe and evaluate two local cattle breeds, Abergelle and Irob, found in the Tigray region of North Ethiopia with little previous description available. Information from structured questionnaire of 175 farmers, twenty-one focused group discussions, field measurements of hearth girth and height at withers of 25 males and 25 females of each breed, and secondary information were utilised to carry out an on-farm characterisation and description of these breeds. The two breeds are found to be the smallest breeds in the region with an average body weight of 234 ± 13 and 153 ± 15 kg and average height at withers of 109 ± 3 and 97 ± 5 cm for males and females of the Abergelle breed. For the Irob breed the corresponding figures were 245 ± 36 and 200 ± 36 kg body weight and 106 ± 3 and 105 ± 5 cm height at withers. The Abergelle breed is recognized by farmers to have adaptive advantages to the hotter and drier low lands. Its tolerance to diseases and parasites and ability to cope with feed shortages during the long dry periods are favourably rated by the majority of farmers. The Irob cattle breed is adapted to a mountainous production environment and is highly rated by farmers for its capacity to thrive on the difficult terrain and its utilization of cactus (*Opantia ficus indica*) as a major source of nutrition.

Resumen

Se llevó a cabo una encuesta sobre el terreno entre Enero y Junio del 2002 para describir y evaluar dos razas locales de bovinos, Abergelle y Irob, situadas en la región de Tigray en el norte de Etiopia, para las cuales se tenía escasos datos de descripción. La información recogida a través de los cuestionarios entregados por 175 ganaderos, 21 grupos de discusión, medidas tomadas sobre el terreno de la circunferencia torácica y altura a la cruz de 25 machos y 25 hembras de cada raza, así como más información secundaria fueron utilizadas para realizar una caracterización y descripción de estas razas. Se observó que las dos razas eran las más pequeñas de la región con una media de peso corporal de 234 ± 13 y 153 ± 15 kg, una media de altura a la cruz de109 ± 3 y 97 ± 5 cm para los machos y hembras de la raza Abergelle. Para la raza Irob las correspondientes figuras fueron de 245 ± 36 y 200 ± 36 kg de peso corporal, y 106 ± 3 y 105 ± 5 cm de altura a la cruz. La raza Abergelle es reconocida por los ganaderos por presentar mayor capacidad de adaptación en condiciones de temperaturas muy altas y regiones secas. Su tolerancia a las enfermedades y parasitos y su habilidad para sobrevivir en situaciones difíciles con periodos largos de sequía fueron recalcados por los ganadeors. La raza Irob se adapta más a la producción en ambiente montañoso y es apreciada por los ganaderos por su capacidad para desplazarse por terrenos difíciles y por aprovechar el cactus (*Opantia ficus indica*) como fuente principal de nutrición.

Keywords: *Cattle, Abergelle, Irob, Tigray, Genetic resource, Phenotypic characterisation.*

Introduction

Ethiopia has the largest cattle population in Africa, estimated at 30 million heads. Moreover, it is home to more than 18 breeds of cattle making the country important in terms of breed diversity (derived from FAO, 2003).

Little information is available about the indigenous cattle breeds in Ethiopia. The origin and route of immigration to the country with a brief description of some of the breeds is reported by Albero and Hailemariam (1982) and more recently by Rege and Tawa (1999). However, important local breeds such as Abergelle and Irob were not included in those studies. The Abergelle breed is a small sized and early maturing found mainly in Tanqua Abergelle, Samre sehartti, Kolla Tembien, parts of Tselmti of Tigray region and adjacent districts of the Amhara region of North Ethiopia (Tsegewoin, 2000). The Irob cattle breed is small but with good body conformation and is found mainly in Irob and Gulo Mekeda districts of the Tigray region.

The two breeds have neither been described, included in any systematic evaluation or breeding program, nor incorporated in the global FAO DAD-IS database. Some information is available from local agricultural surveys (Tsegeweini, 2000; Berhane, 1996; BoANR, 1999). Both breeds have, however, been known and described as unique by farmers in the locality for more than 100 years. The role of these breeds in terms of providing draught power and nutrition (meat and milk), among other things, to the population in their respective localities is crucial.

The objective of this paper is to report basic information on the origin, population description, production system, unique

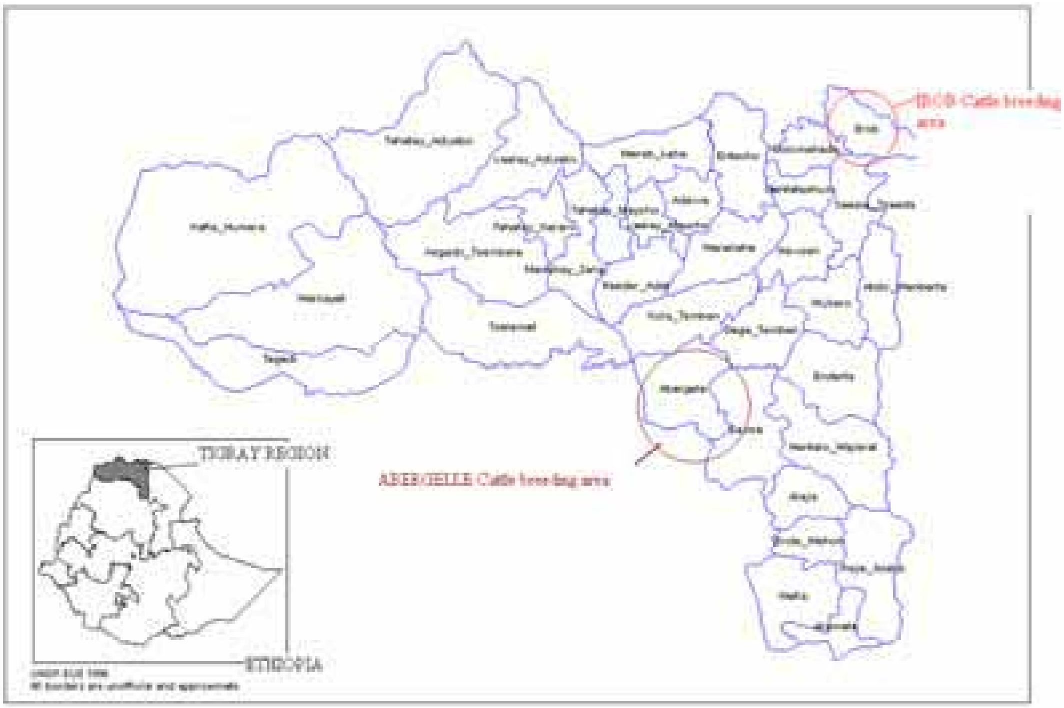

Figure 1. Geographical location of the study areas.

adaptive features and productive and reproductive performances of the Abergelle and Irob cattle breeds.

Materials and methods

Abergelle

Abergelle is a district in the northern region province of Ethiopia, Tigray. Tigray is located between latitudes of 12°20'and 14°40' N and longitudes of 36°E and 41°30' E (Figure 1). The topography of the area is dominated by plains and river valleys, with an altitude ranging between 1 300-1 550 m. Average annual temperature ranges between 27°C and 30°C, the vegetation of the area is dominated by xerophylic plants. Major cultivated crops include sorghum, maize, *Teff (Eragrostis tef*) and sesame (Amare, 1996). Cattle and goat production plays a central role in the farming system of the study area

Irob

Irob is a district located in the north-eastern part of Tigray. The topography is characterised by extremely rugged steep-slope terrain and deep narrow valleys with little or no potential for crop production. There are considerable variation in altitude (900-3 200 meters), temperature (5-30°C) and rainfall of 200-600 mm/year (Asfaha Zigta and Ann Waters-Bayer**,** 2001). Cattle and goat production with limited cultivation of crops constitutes the farming system of the area. The excellent indigenous soil and water harvesting techniques of farmers in the Irob area have helped them produce cereal crops such as barley, *Teff,* and more importantly, cactus (*Opantia ficus indica*) which at the moment is a very important source of nutrition for both people and livestock.

Data collection

A survey was conducted in three villages (Felegehiwot, Hibret and Siye) of the Abergelle and four villages (Alitena, Endalgeda, Endamusa and Hagerelukuma) of the Irob districts between January and June, 2002. Selection of the sites was based on the higher concentration of the cattle breeds and information from earlier studies that these sites are the major breeding areas of the breeds under study.

A total of 175 cattle owners (25 from each village) were interviewed based on a structured questionnaire. Besides, formal group discussions with farmers were conducted. The questionnaire (Appendix 1) was designed to collect data on the origin of the breeds, physical description, the main purpose, productive and reproductive performance, management and breeding practices, population trends, uniqueness (special traits), farmers' preference and opinions on comparisons of these breeds with other breeds known to the farmers. The Abergelle breed was compared with three breeds (Afar/Raya, Arado and Barka) very well known to interviewed farmers, while the Irob breed was compared with two breeds (Afar and Arado). The formal group discussions focussed on general issues such as:

1. status of the breed;
2. breeding management and goal;
3. awareness of diversity;
4. population trends and major threats to the breed.

Three group discussions with 7-10 farmers in each group, were conducted in each village. Information on the production environment and size of breed population was compiled from reports of earlier surveys (BoNAR, 1999; Tsegewoin, 2000). The questionnaire used in the study is presented in Appendix 1.

Height at withers and heart girth measurements of 25 male and 25 females of each breed were recorded and photos were taken for representative animals. Adult body weight was estimated from heart girth measurements (Daltons supplies Ltd).

Results and Discussion

Population size and description

According to the Tigray regional livestock census (BoNAR,1999), the population size of the Abergelle breed is 82,247 animals of which 58% and 29% are found in Tanqua Abergelle and Seharti Samre districts, the remaining 13% are found thinly spread across the Tigray region and adjacent areas in North Ethiopia (Table 1). The census does not, however, give any information on the Irob breed and in fact the breed is not presented as separate and instead was included in the Arado breed figures as is true in many other studies. In the present study it is attempted to estimate the population size of the Irob breed by taking the cattle population of the major breeding areas of the breed (Irob) from the census and add the proportion of this breed in the adjacent areas of Golomekeda based on interviews with farmers (Table 1).

Of the interviewed farmers, 69% indicated that the Abergelle breed population and its geographical spread have decreased over the years. It was indicated by 91% of interviewed farmers that the breed has decreased in body size and "purity", milk production, lactation length and productive life. The main reasons given were: absence of selection of breeding bulls, less controlled breeding practises and draught and diseases. Similarly, 98% of the interviewed farmers indicated that the Irob cattle population size has decreased significantly with a slight decline in both production and reproduction traits, while its geographical spread has remained unaffected over the years.

Origin

Of the total of seventy-five farmers interviewed, 84% responded that the origin of the Abergelle breed is a result of cross breeding between the Afar (one of the Sanga breeds in Ethiopia) and other breeds in the area, 11% said the breed is indigenous to the area and another 4% did not know its origin. The breed is described as small, tolerant to heat stress, tick resistant with smooth and various coat colours by 92% of the interviewed farmers. Furthermore, almost all farmers believe that the breed is completely different from other breeds known to them.

Almost all (97%) interviewed farmers in the Irob area believe that the origin of the breed is from the Afar breed found in the adjacent low lands and they strongly believe that the breed evolved into its current type to fit to a production environment that is more different from the low lands. Moreover, 89% of the farmers described the breed as short and small, hardy and with unique ability in grazing on mountainous terrain and utilization of cactus.

It can be proposed from the results of the present study as well as earlier study of Albero & Haile-mariam (1982), that these breeds most probably belong to the intermediate Sanga-Zebu or Zenga cattle, one of the four groups of African cattle breeds suggested by Rege (1999). Historically, this group is believed to have emerged as the result of the introduction of Zebu breeds to Ethiopia and breeding with the Sanga breed that was formed from a previous cross breeding process that involved the hump-less cattle and the Zebu (Albero, 1982; Rege, 1999).

Conformation characteristics

The Abergelle breed in the present study is found to be one of the smallest cattle breeds in the region both for average height at wither and adult body weight for males and

Table 1. Distribution and population size of Abergelle and Irob cattle breeds in Tigray, North Ethiopia (BoNAR, 1999).

Breed	Village	Population size	Average number of cattle/household
Abergelle	• Tanqua Abergelle	47 824	3
	• Seharti Samre	23 631	1
	• Adiet Nadier	5 311	0.3
	• Degua tembien	2 015	0.1
	• Tselemti	1 188	0.1
	• Others	2 278	--
Total		*82 247*	
Irob	• Irob	13 993	3
	• Gulomekeda	8 234	2
Total		*22 227*	

Table 2. Height at withers and adult body weight measurements for Abergelle and Irob cattle breeds.

Breed	Number	Height at withers (cm) Mean ± S.D.	Adult body weight(kg)[1] Mean ± S.D.
Abergelle			
• Male	25	109 ± 3	234 ± 13
• Female	25	97 ± 5	153 ±15
Irob			
• Male	25	106 ± 3	245 ± 36
• Female	25	105 ±5	200 ± 36

[1]Adult body weight is estimated from heart girth measurements.

females respectively (Table 2; Figures 2 and 3). The Abergelle breed showed a marked size difference between males and females (males were 13 and 52% taller and heavier, respectively, than females). The breed has a fine skin and coat colour that varies considerably with black and black and white spotted animals more abundant. Other colours include: chestnut, grey and light red. While females have thin and medium sized horns mostly upward with pointed ends, males have thicker and shorter horns. Polled animals are not common. The hump is small and not very well developed, small dewlap and naval flap are typical features of the breed as opposed to the zebu. The females of this breed tend to resemble more to the Sanga breeds in some phenotypic characteristics, while the males resemble more the zebu breeds.

The males of the Irob breed are of the same size as the Abergelle while females are taller and heavier than the Abergelle breed (Table 2; Figures 4 and 5). Moreover, no marked difference (0.9%) in height at withers and moderate difference in weight (22%) was observed between males and females of this breed. Coat colour is dominantly light red with white spots on the face, other colours are very rare. Both sexes have small to medium horns and males have medium to large cervico-thoracic hump.

Abergelle production

According to the current survey, the Abergelle breed is favourably rated by higher percentage of interviewed farmers (59-100%) for 14 of the 15 traits compared (Table 3). One trait, market value of live animals, is rated as worse (88%). Product quality traits such as milk fat%, hide and meat quality, and disease and tick resistance traits are highly rated with higher percentage of farmers, 100, 100, 96%, and 96 and 98% respectively. Average milk production of the breed ranges between 1.0 to 1.5 litres in the dry and wet seasons respectively, with an average lactation length of 150 days, slightly higher than the Arado breed (1 litre per day) and slightly lower than the daily average of 1.5 litres for the Afar breed reported in earlier studies (Albero, 1982; Berhane, 1996). All interviewed farmers indicated that milk production has been declining over the last 30-40 years from a daily average of 4 litres and a lactation length of up to 10 months to the present much lower levels. The reasons they gave were drought and disappearance of some grass species (milk grasses) from the grazing land. In one particular group discussion it was argued that milk-producing capacity of the breed has declined with the shift from pastoral to mixed farming system.

Of the interviewed farmers 68, 13 and 19% indicated that age at first calving for the breed as 4, 3-4 and £ 3 years. While few farmers (17%) reported a calving interval of one year, the majority (83%) have indicated a calving interval of two or more years.

Irob production

The Irob breed has been rated favourable, comparable and negatively for 6, 6 and 3 of the 15 traits compared respectively. Among the highly rated traits are: milk fat (99% of respondents), draught purpose (98%), tolerance to feed and water shortages (100%) and grazing on mountainous terrain (100%)

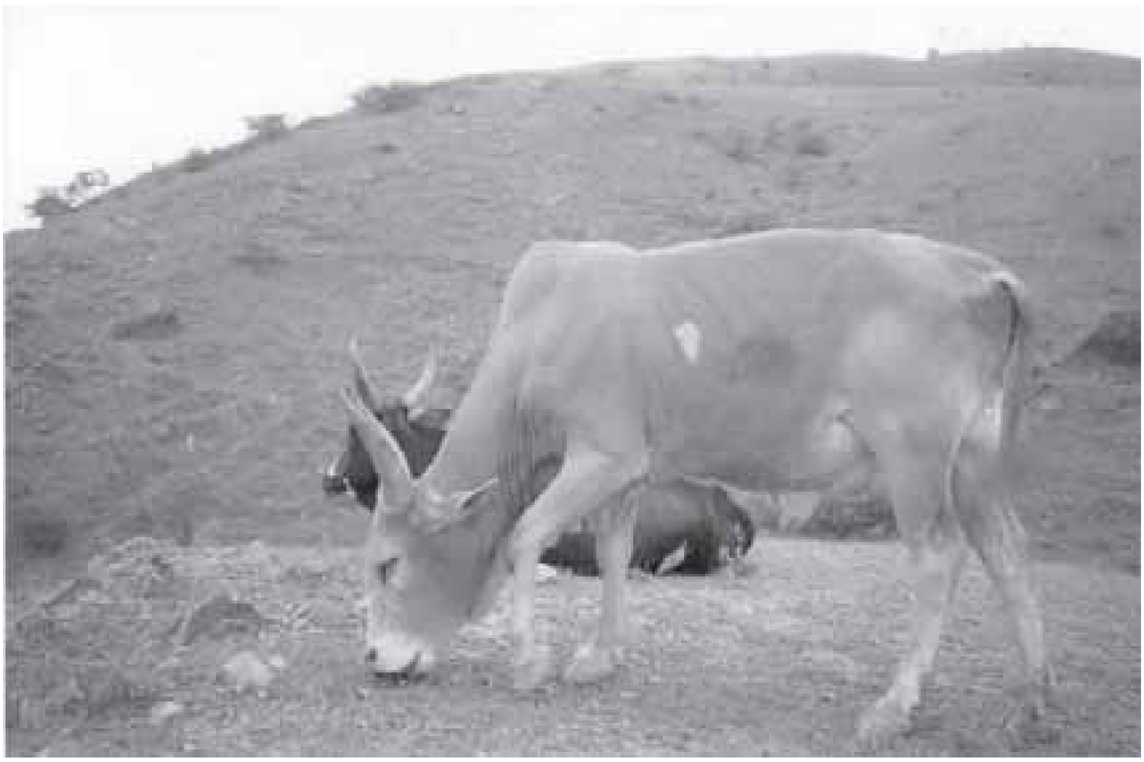

Figure 2. Abergelle bull grazing in the early rainy season (June).

Table 3. Comparisons by farmers of the Abergelle and Irob cattle with other breeds for some traits of importance.

Trait	Comparison	Abergelle *vs* others[1] % of farmers	Irob *vs* others[2] % of farmers
Body size	Smaller	95	97
	Comparable	5	3
	Larger	-	-
Age at first calving	Younger	89	-
	Comparable	8	93
	Older	3	7
Calving interval	Shorter	63	6
	Comparable	28	38
	Longer	9	56
Milk yield	Higher	68	-
	Comparable	11	17
	Lower	21	83
Lactation length	Longer	59	5
	Comparable	32	73
	Shorter	9	22
Milk fat percentage	Higher	100	99
	Comparable	-	1
	Lower	-	-
Draught power (speed & length of working hours)	Better	91	98
	Comparable	7	2
	Worse		-
Disease resistance	Better	96	3
	Comparable	4	95
	Worse		2
Tick resistance	Better	98	11
	Comparable	2	83
	Worse		6
Feed shortage	Better	88	100
	Comparable	9	-
	Worse	3	-
Watering frequency	Better	89	100
	Comparable	11	-
	Worse		-
Grazing	Better	85	100
	Comparable	10	-
	Worse	5	-
Meat quality	Better	96	4
	Comparable	3	96
	Worse	1	-
Hide quality	Better	100	4
	Comparable		89
	Worse		7
Market value of live animals	Better		-
	Comparable	12	23
	Worse	88	77

[1]The view on the Abergelle breed was based on comparison with three other breeds (Afar, Arado and Barka), well known to farmers in the area

[2]The view on the Irob breed was based on comparison with two other breeds (Afar and Arado), well known to farmers in the area

Figure 3. Abergelle cow grazing in the early rainy season (June).

Figure 4. Irob cattle grazing on the mountains.

(Table 3). Milk yield (83%), market value of live animals (77%) and calving interval (56%) are negatively rated compared to other breeds that are known to farmers interviewed.

Average daily milk production for the breed was less than a litter per day, a lactation length of 120-150 days and average age at first calving and calving interval of more than 4 and 2 years respectively.

Breeding and genetic resource management

It has been observed from both individual interviews and group discussion in this study that there is little or no attempt by farmers to improve their stock by selection or by any other method. On the other hand, farmers believe that some herds in the community are still genetically superior. Even though there are no institutionalised schemes for genetic improvement, exchange of superior animals among close relatives (mostly cows are taken and allowed to stay for some time in a herd believed to have superior bulls) is common. All interviewed farmers rejected the idea of introducing new "improved breeds" arguing strongly that only the local breed can be suitable for the area, whereas 23% indicated crossing the locals with breeds such as the Raya breed (local breed popular for draught purposes) could give better crossbreds especially ploughing oxen. A more conservative view was expressed by farmers in the Irob district where cross breeding of the Irob breed with other local breeds is disputed. The observation that farmers put much emphasis on environmental adaptation of their local breeds has been consistent in this study and other similar studies (Mwacharo & Rege, 2002) and therefore should be considered as a major criterion in designing future genetic improvement programmes. A common observation in almost all group discussions has been that farmers are more pressed by immediate problems such as shortage of draught animals than concerns for both genetic improvement and animal genetic resource management.

Traits of adaptive and economic importance

The two breeds are believed by their communities to be the best adapted to their respective local production environments. The Abergelle is outstanding compared with other breeds (Afar/Raya, Arado and Barka) known to farmers in the area. Their capacity to endure, produce and reproduce in the dry and hot climate, their special foraging ability and utilization of crop residue (*Sorghum stover*) during the long dry periods (7-8 months for the area) where feed availability is precarious are well appreciated by farmers. Of particular importance is also their ability to resist/tolerate diseases and most notably tick resistance, one of the problems hindering livestock production in the adjacent communities.
The Abergelle breed has soft, tasty meat with better marbling and excellent quality hide. Oxen of this breed are preferred to the much larger and powerful oxen from other breeds (Afar/Raya, Arado and Barka), for their quicker pace and longer working hours with significantly less feed consumption. The Irob breed on the other hand, is well known for important traits such as grazing and performing in extremely mountainous terrain, ability to tolerate feed and water shortages and its utilization of the cactus plant compared to the Afar and Arado breeds found in the region (Table 3).

Genetic conservation

Using population size as an indicator of endangerment, both breeds in the present study can be categorized as "not at risk" according to FAO criteria for determining domestic animals at risk (Scherf, 2000). However, a complete picture of the risk for both breeds can only be established if

Figure 5. Irob bull near a watering point.

information on the number of breeding males and females, effective population size, population trend, geographical spread, crossing with other breed(s) and socio-economic and political factors are included. It was observed that the two breeds have been subjected to several indiscriminate crossbreeding programmes (REST, 1997) that aimed at improving milk production without due concern to the long term effects on the conservation and maintenance of genetic diversity.

The level of endangerment of the Irob breed may even be more critical. In addition to all the factors mentioned for the Abergelle breed, the Irob breed population has severely decreased as a result of the recent boarder war between Ethiopia and Eritrea and that the geographical range of the breed is very small compared to the Abergelle breed. Most challenging of all is, however, the state of helplessness of the local community due to mainly the chronic poverty, the adverse effect of more than three decades of civil war, famine in the area and absence of active programmes for the conservation and utilization of these breeds. Tackling these underlying problems should be the primary objective of an effort to stop and/ or reverse the process of endangerment of these breeds.

Conservation of these breeds can provide unique opportunities for current and future economic and scientific values for traits such as heat and disease tolerance, tick resistance, meat and hide qualities. The Abergelle breed’s adaptation to the hot and semi-arid lowlands that are less suitable for cultivated agriculture and unique adaptation of the Irob breed to mountainous terrain and utilisation of cactus, if conserved could have far reaching contribution for not only the communities that have been breeding and managing these important genetic resource for years but also for others who may have current or future scientific, commercial and/or cultural and historical interests.

Conclusions

As in most traditional subsistence livestock production systems elsewhere, the farming communities in Abergelle and Irob, North Ethiopia, entirely depend on their local and highly adapted cattle breeds for their survival. The two breeds that are described in the present study have never been included in any genetic characterisation or evaluation programmes except in a couple of local agricultural surveys.

In the present study, it has been found that these two breeds of cattle have distinctive adaptive features that are recognised and appreciated by farmers and made these breeds first choice in their respective production systems. Assessing the degree of endangerment of these breeds based only on population size data can lead to underestimation of the problem. It is, however, observed that both breeds are at risk both from man made and natural disasters, poverty and lack of awareness and//or interest by GO and NGOs operating in the area. Devising urgent measures that incorporate the sustainable use of these genetic resources with full participation of the communities is a requisite to halt and reverse, in the long term, the journey of these breeds to extinction and making the people that depend on them for their livelihoods less vulnerable.

List of References

Albero, M. & S. Haile-Mariam. 1982. The indigenous cattle of Ethiopia. World Animal Review. 41,42: 2-10, 27-34.

Amare, G. 1996. Physical geography of the central zone of Tigray. In: Øyhus, A.O. and G. Gebru (Eds), 1996. Rural exploratory studies in the central zone of Tigray, Northern Ethiopia. Proceeding of a workshop. Addis Ababa, Ethiopia, 13-17.

Asfaha Zigta & A. Waters-Bayer. 2001. Out-witters of water: outstanding Irob innovation in northern Ethiopia. Farmer Innovation in Africa: A Source of Inspiration for Agricultural Development, Reij C., A. Waters-Bayer & A. Waters-Bayer (Eds), Earthscan Publications, London, 144-154

Berhane, G. 1996. Livestock production in central Tigray. In: Øyhus, A.O. & G. Gebru (Eds), 1996. Rural exploratory studies in the central zone of Tigray, Northern Ethiopia. Proceeding of a workshop. Addis Ababa, Ethiopia, 55-68

BoNAR 1999. Livestock Census. Regional State of Tigray, Bureau of Agriculture and Natural Resources. Mekelle, Ethiopia. Vol. 1. Daltons supplies Ltd Cattle and Pig weighing Tape.

FAO. 2003. Domestic Animal Diversity Information System; *www.fao.org/dad-is*, FAO, Rome.

Mwacharo, J.M. & J.E.O. Rege. 2002. On-farm characterization of the indigenous small East African Shorthorn Zebu cattle (SEAZ) in the Southeast rangelands of Kenya. Animal Genetic Resources Information Bulletin 32: 73-86.

Rege, J.E.O. 1999. The state of African cattle genetic resources I. Classification framework and identification of threatened and extinct breeds. Animal Genetic Resources Information Bulletin 25: 1-25.

Rege, J.E.O & C.L. Tawa. 1999. The state of African cattle genetic resources II. Geographical distribution, characteristics and uses of present-day breeds and strains. Animal Genetic Resources Information Bulletin 26: 1-25.

REST. 1997. Bull service programme, Relief Society of Tigray, Mekelle, Ethiopia.

Scherf, B.D. (Ed.). 2000 World Watch List for Domestic Animal diversity, 3rd edition, FAO, Rome, Italy.

Tekleab, T. 2000. The livestock resource diversity assessment (study) in Tigray. Bureau of Agriculture and natural resources development.

UNDP-EUE. 1996. Adminstrative weredas of Tigray region, Ethiopia.

Øyhus, A.O. & G. Gebru. 1995. Farming systems, resource management and house hold coping strategies in Northern Ethiopia: report of social and agro-ecological baseline study in central Tigray.

Appendix 1. On-farm evaluation of Abergelle and Irob cattle breeds (Questionnaire 1)

I. Name of farmer interviewed: ____

II. Location
1. Region__________________________ 2. Zone:_____________________________
3. District/ Woreda:_________________ 4. Village/Kushet: ___________________
5. Longitude:________________ 6. Latitude:____________ 7. Altitude:__________

III. Breed Name
1. Most common name:_________________ 2. Other Names:_________________

VI. Breed formation
1. History: ____
2. Ancestors____
3. Indeginous:__________ 4. Crossbred:_____________ 5. Imported:______

IV. Geographical distribution

1. Major breeding Area(s)
a. Region__________________________ b. Zone:____________________________
c. District/ *Woreda*:_________________ d. Village/*Kushet*: ____________________
e. Longitude:________________ f. Latitude:____________ g. Altitude:__________
2. Others
a. Region__________________________ b. Zone:_____________________________
c. District/ *Woreda*:_________________ d. Village/*Kushet*: ____________________
e. Longitude:________________ f. Latitude:____________ g. Altitude:__________

V. Breed Population
1. Adult: Male_______________ Female ______________
2. Young: Male _________________ Female________________
3. Source of Information and Date: Census_____Survey ______ Estimate________

VI. Population trend
1. Increasing: ______ Why?_____ 2. Decreasing: ______ Why?_____ 3. Stable. _____

VII. Main purpose/s of the breed (in ranking order)
1. Milk:___ 2. Meat:____ 3. Draught power: ______ 4. Others:______ (specify)

VIII. Phenotypic attributes

	Male	Female
1. Height at withers (cm)	_______	________
2. Heart girth (cm)	_______	________
3. Horn size and shape	_______	________
4. Most common Coat colour/s	_______	________
5. Rare and off-colour/s	_______	________
6. Hump	_______	________
7. Dewlap	_______	________
8. Naval flap	_______	________
9. Body conformation	_______	________

(To be continued...).

(...to be continued).

IX. Production and reproduction

	Compared to other breeds		
	Better	Comparable	Worse
1. Milk yield(kg)____________	______	________	______
2. Lactation length(days)_____	______	________	______
3. Butter fat%_______________	______	________	______
4. Meat yield________________	______	________	______
5. Age at first calving_________	______	________	______
6. Calving interval___________	______	________	______
7. Draught power ___________	______	________	______

X. Unique attributes

1. Quality of product (milk, meat, skin,…)	______	________	______
2. Disease resistance/tolerance	______	________	______
3. Environmental adaptation	______	________	______
4. Over all suitability	______	________	______

XI. Management

1. Production system:
   a. Pastoral/agropastoral_____ c. Crop/livestock mixed farming_______
   b. Intencive/semiintensive
2. Genetic resource management
   a. Available traditional mechanisms
      - Breed description
      - Knowledge of other breeds
      - Practice in AnGR management
3. Genetic improvement:
   a. Breeding goal:___________________
   b. Institutions involved:_______________
   c. Method: selection_____ crossbreeding _______ others:_____
   d. Breed conservation efforts: ________________________