**Delivering Systematic Information on Indigenous Animal Genetic Resources –
the development and prospects of DAGRIS**

Workneh Ayalew[1], J. Edward O. Rege, Ephrem Getahun, Markos Tibbo and Yetnayet
Mamo:
Animal Genetic Resources Group, International Livestock Research Institute, P, O Box 5689,
Addis Ababa, Ethiopia.

Abstract

This paper describes the objectives, historical development, structure, functionality,
content, utility and future prospects of the Domestic Animal Genetic Resources
Information System (DAGRIS) of ILRI. This public-domain electronic database is
designed to cater for the needs of researchers, policy makers, development
practitioners, teachers, students and farmers in developing countries for efficient
access to available published and grey literature from past and present research results
on the origin, distribution, diversity, present use and status of selected farm animal
genetic resources (FAnGR). It is currently available, free of charge, on the web as
well as on CD-ROM. It is argued that information on the extent of existing genetic
diversity, characteristics and use of FAnGR in developing countries is the basis for
their present as well as future sustainable utilization. In developing countries, neglect
and lack of accurate information on the diversity and status of the existing farm
animal genetic resources are believed to exacerbate the alarming rate of irreversible
loss of genetic diversity. Such losses reduce opportunities to improve food security,
alleviate poverty and attain sustainable agricultural practices. The situation is
alarming indeed because 16% of the finite set of 7000 unique populations (breeds or
strains) have been lost since the beginning of the 19th century, and a further 32% are
at risk of becoming extinct. Yet the rate of extinction, currently at two breeds per
week, is expected to accelerate. The content and functionality of DAGRIS is designed
to enlighten all stakeholders, in an efficient way, on the status as well as particularly
useful attributes of recognized livestock breeds at the level of individual countries.
DAGRIS supports systematic data compilation, organization, storage, access and
dissemination of information through its data entry, search, browse, display and
summary tables interfaces. It is also intended to provide the necessary decision-
support tools for the development, sustainable use and conservation of selected
FAnGR.

Keywords: Conservation, database, developing countries, domestic animal genetic
resources information system (DAGRIS), indigenous animal genetic resources system

Introduction

The term farm animal genetic resources (FAnGR) is used to include all animal
species, breeds and strains (and their wild relatives) that are of economic, scientific
and cultural interest to humankind in terms of food and agricultural production for the
present or in the future (Rege and Gibson, 2003). These come from the 40 species of
animals that have been domesticated during the past 10,000 to 12,000 years, which
contribute directly or indirectly to agricultural production (FAO, 2000).

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[1] Corresponding author. E-mail: w.ayalew@cgiar.org

Domestic animal genetic resources supply some 30% of total human requirements for food and agricultural production (FAO, 1999). They are particularly vital to subsistence and economic development in developing countries as they continually provide essential food products, contribute draught power and manure for crop production and generate income as well as employment for most of the rural poor. Livestock also produce such non-food items as hides, skins, wool, traction power and fuel (from dung) in some communities (Steinfeld and de Haan, 1997; Rege, 1998). In addition livestock are a major source of revenue and export earnings for many countries (Winrock International, 1992). Livestock can also contribute towards environmental sustainability in well-balanced mixed farming systems (de Haan et al., 1997). This may be through provision of draft power, and manure and urine as fertilizer (Steinfeld et al., 1997).

Subsistent farming communities depend directly upon genetic, species and ecosystem biodiversity for their livelihoods. Complex, diverse and risk-prone peasant livelihood systems need animal genetic resources that are flexible, resistant and diverse (Anderson, 2003).

It is argued here that information on the extent of existing genetic diversity, characteristics and use of indigenous farm animal genetic resources in developing countries is the basis for their present as well as future sustainable utilization. Information has always been an important component of economic development, but it is becoming even more so as the world moves towards an information-based economy. Astonishing technological advancements in the areas of information and communications technology now provide tremendous opportunities to improve the efficiency agricultural research and development. In developing countries, neglect and lack of accurate information on the diversity and status of the existing farm animal genetic resources are believed to exacerbate the alarming rate of irreversible loss of genetic diversity. Such losses reduce opportunities to improve food security, alleviate poverty and attain sustainable agricultural practices. The situation is alarming indeed because 16% of the finite set of 7000 unique breeds have been lost since the beginning of the 19th century, and a further 32% (22% of mammals and 48% of avian species) are at risk of becoming extinct. Yet the rate of extinction, currently at two breeds per week, is expected to accelerate (FAO, 2000).

In recognition of this, ILRI has been developing, since 1999, the Domestic Animal Genetic Resources Information System (DAGRIS) an electronic source of systematic information on indigenous farm animal genetic resources. This development was prompted by lack of a comprehensive source of information on the extent and status of existing diversity, characteristics and uses of indigenous farm animal genetic resources in developing countries on the premise that such information is vital to ensure the present as well as future sustainable utilization of these indigenous animal genetic resources.

This paper describes the objectives, historical development, structure, functionality, content, utility and future prospects of the Domestic Animal Genetic Resources Information System (DAGRIS).

Objectives

DAGRIS has been designed and developed to facilitate the compilation, organization and dissemination of information on the origin, distribution, diversity, characteristics, present uses and status of indigenous farm animal genetic resources from past and present research results. It is meant to support research, training, public awareness, genetic improvement and conservation. The specific objectives of DAGRIS are:

- Compile and organise information on farm animal genetic resources from all available sources,
- Maintain the integrity and validity of the information, and
- Disseminate the information in a readily accessible way to all key stakeholders (researchers, trainers and their students, extension personnel, policy makers and farmers).

Contents of the database are backed up by bibliographic sources. DAGRIS is also designed to help identify information gaps, provide easy access to information in the grey literature and highlight the risk status of breeds.

Historical developments

The Animal Genetic Resources Group of ILRI in Addis Ababa, Ethiopia has been developing the DAGRIS database. When the database was initiated in 1999 it was first mounted on a flat textual database on CDS/ISIS software (UNESCO, 1988). This system had more than 250 fields, all in one table, with extensive repetitions. It did not support graphics and was not user friendly. It also lacked standard data exchange formats. Expansion of the database and its future plans to better deliver its contents over the World Wide Web (WWW) have made it necessary to develop a new system using a Relational Database Management System (DBMS) software, with appropriate database structure to efficiently and effectively document and disseminate animal genetic resources information. The new system was designed to have a simplified data entry module, incorporating images with improved sorting, saving and printing facilities; there was also need for maintaining high level of data integrity and verification techniques. Based on these needs the new DAGRIS database has been developed since early 2000.

Test release of the web-based version of the database was made at the beginning of 2002 at the web address [http://dagris.ilri.cgiar.org/]. A broad range of comments and views were received from users and some improvements have since been introduced on the structure, functionality and content of the database. These led to release of Version I of the database on the web at the same address in April 2003. Data compilation and entry have continued and contents of the database have now grown to more than double the size of the database during the test-release. Subsequently, the whole content of the database has been re-configured on CD-ROM for distribution to a broader range of stakeholders with poor or no Internet connection.

Data Structure of DAGRIS

The new DAGRIS database is developed using the Relational Database Management System (RBDMS) model. In designing the database, specific data elements were

identified and grouped into entity types. The relationships between the entities were identified and each of the attributes of the entities and their descriptions defined. Microsoft SQL Server 2000 engine is used to implement and run the database. A total of fifteen major tables exist in the structure of database (Table 1).

Table 1: List of major tables in the DAGRIS database.

No.	Table names	Description/Content
1.	Species	Name of the species (a taxonomic sub-division or group of animals that actually or potentially interbreed and is reproductively isolated from other similar groups), e.g. cattle, sheep, goat.
2.	Breed group data	Name of the breed group (a group of breed names within the same species which share similar origin).
3.	Breed data (General)	General information on the name, distribution (location), main use, common name and special characteristic of the breed.
4.	Breed data (Country specific)	Country-specific information on local name, habitat, main uses and typical features of the breed.
5.	Trait data	Qualitative or quantitative data on a given physical, production, reproduction and genetic characteristic of the breed.
6.	Population data	Qualitative data on population size, trend and risk status of the breed.
7.	Environment data	Description of the habitat of the breed, including its climate, vegetation and landscape.
8.	Image data	Typical images of individuals or groups (flock, herd, etc) of the breed.
9.	Web link	Links to relevant web sites with further information about the breed.
10.	Country	Names countries in which the breed is known to exist.
11.	Region	Names of regions of continents in which the breed is known to exist.
12.	Trait Category	Specifies one of the trait type categories introduced for easy access to specific traits; these categories are: physical, production, reproduction and genetic.
13.	Trait Type	Name of the trait.
14.	Bibliography (source)	Bibliographic information on the source of the related trait data or any other information in the database.
15.	Contact (source)	Personal contact information on the source of the related data or any other information in the database.

The web interface of DAGRIS is developed using Active Server Pages (ASP) scripting environment and is served using Internet Information Services (IIS) for Microsoft Windows 2000 Server.

Schematic representation of the internal links between the tables is presented in Figure 1.

The core sections of the database are those structures containing organized trait level information by each breed. There are one-to-many relationships between most of the tables with the common field called breed code (name) that is introduced in almost all tables serving as main key field joining tables. However, there exists many-to-many relationship as well between certain tables
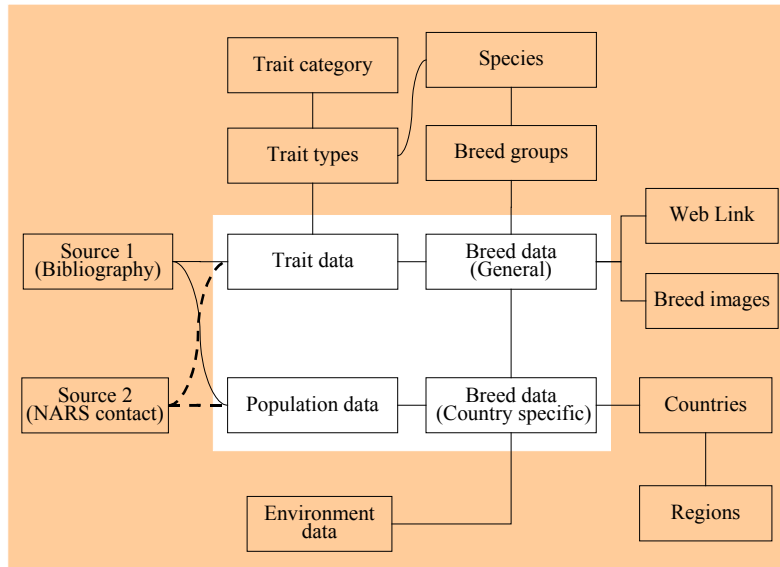
Figure 1: Structure and internal links of the DAGRIS database.

Functionality

DAGRIS has three modules for browse, search (& reporting) and entry. The browse module allows a quick skim through the contents of the database, with options to delimit the browse by species, breed groups or breeds, hence speed up the search. The output presents breed description highlights, with direct access to the trait menu for further information. The search & reporting module enables the user to query the database by narrowing the needs to specific breeds, with or without specifying the country and status of the breed. It is also possible to initiate search of the database from known bibliographic records.

The data entry module is accessible only to the database administrator and data entry personnel. Hence, integrity of the database is ensured, i.e., users cannot add, change or delete data in the database. Users can, however, download their search output.

Other important function provided by DAGRIS include:

- Sort functions on search results
- Options to specify the number of results to view on screen
- Access to preset summarised information,
- Print, save, export (to another application) or e-mail search results, and
- Hyperlinks to relevant websites for further information on the breed, and
- Help facilities

Software and hardware Requirements

DAGRIS is not dependent on any particular operating system, and runs on all of the following operating system platforms: Windows 9x/NT/2000/XP, Linux, UNIX or Macintosh. It also operates on any of the following web browsers: Microsoft Internet Explorer (3.X, 4.X, 5.X, 6.X); Netscape Navigator (4.X, 6.X), Generic Crawler (3.X), or Lynx. The particular browser that users have may have minimum hardware

requirements for normal functionality; for instance the Internet Explorer 4.x or Netscape Communicator 4.x for Windows 95 require the following minima:

- CPU: 486 (66MHz or higher)
- Memory: 16 Mb of RAM or more
- Available disk space: 20 – 70 MB.

Similarly, the Netscape Navigator 3.x or Internet Explorer 3.x for Windows 3.x have lower minima:

- CPU: 386 or higher
- Memory: 8 Mb of RAM or more
- Available disk space: 7 – 12 Mb

Content

The content and functionality of DAGRIS is designed to enlighten all stakeholders, in an efficient way, on the status as well as particularly useful attributes of recognised livestock breeds at the level of individual countries, first on cattle, sheep and goats of Africa, but also on other species as its scope expands to Asia and Latin America.

Currently the database consists of a total of 14000 trait records on 152 cattle, 96 sheep and 62 goat breeds of Africa. The publication date of bibliographic records in the database ranges from 1927 to 2003, an indication of the broad reference base of the published as well as the grey literature.

All output pages have printable versions made available on click of a button. When a breed search output is displayed, name of the respective breed group is also displayed with functional links to search for other breeds within the breed group. To ease the search process for specific traits, and hence improve system speed, a summary list of traits is presented to lead to the actual trait records. This additional hierarchy shows a list of traits for which data is available, and, on click of another button, a list of traits for which no data is available. The latter is particularly important to alert users on missing trait information, which serves as a prompt to search for missing information, by both users and the database administrators.

Output pages on traits from both the Search and Browse options provide the working definition of each of the traits, and these are displayed on click of a button on the status bar. A summary of all quantitative traits available in the database is displayed at breed level by sex category. This is invoked by a menu. There is also a selected set of relevant web links that provide further information on the breed.

Utility of DAGRIS

DAGRIS is a product of ILRI's research on livestock to develop international public goods in collaboration with its partners. It is part of ILRI's research agenda on the identification and conservation of indigenous livestock genetic resources of developing countries.

The development and delivery of DAGRIS is consistent with the new ILRI strategy, and it links up with the three pathways out of poverty (ILRI, 2002):

- To the extent that livestock are important material and social resources for many of the rural and peri-urban poor in developing countries, the delivery of systematic information on the status and value of livestock genetic resources serves the purpose of securing the current and future livestock assets of the poor (pathway 1);
- Improved productivity comes also from improved management of the indigenous breeds (pathway 2). This also depends on the availability of information on the origin, distribution, diversity, characteristics, present uses and status of indigenous farm animal genetic resources from past and present research results.
- DAGRIS also highlights particularly important attributes, including marketability, of indigenous breeds, which encourages participation of the poor in livestock related markets (pathway 3). The range of products and services that livestock provide to the poor depend on the wealth of genetic variation harbored in the indigenous animal genetic resources.

In line with ILRI's new strategy, DAGRIS focuses on those species and breeds of livestock that serve more rural communities: currently cattle, sheep and goats of Africa, and will cover chicken and swine as its scope expands into Asia.

Apart from disseminating research results to a wide and diverse audience (through the web as well as on CD-ROM), the systematic information in DAGRIS also provides for increased awareness on the role and potential of livestock to reduce poverty, which well serves ILRI's effort in capacity building using innovative training activities and research partnerships.

Synthesized information in the database on the past, present as well as potential future roles of indigenous livestock genetic resources helps in priority setting and targeting as well as mapping of the livestock resource itself. By providing breed-level information on essential attributes of livestock breeds, DAGRIS helps in the assessment of the present and evolving role of livestock, and hence for systems modeling. It also provides bibliographic sources for these and further information, which both help to setting the context for systems studies. By providing valuable information on particularly desirable attributes of indigenous livestock breeds, their status as well as location, DAGRIS enhances the market opportunities for the poor livestock producers. DAGRIS also provides valuable baseline information for the planning and implementation of programs and projects for sustainable utilization of biodiversity in general. This is particularly relevant because the poor happen to be custodians of about 70% of the existing global livestock biodiversity to date.

Future prospects of DAGRIS

In terms of geographical coverage, DAGRIS currently covers only Africa, where about 72% of ILRI's current research activity is directed. But it is planned to expand the scope of DAGRIS to Asia, which according to ILRI's global poverty map is home to 57% of the world's poor that are associated with livestock (Thornton et al., 2002).

Data entry and verification will continue under the DAGRIS team at least in the short-term. The long-term management of the database is under discussion. Meanwhile, additional systems structures will be introduced to handle the following issues:

1. Module for uploading and downloading non-curated genetic information;
2. Module to incorporate decision support tools needed for sustainable use and conservation of animal genetic resources in developing countries,
3. Module for capturing molecular genetic information,and
4. Facilities to link with GIS to provide overlays of various geographic information systems.

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