Evy Thies

Promising and Underutilized Species Crops and Breeds

Deutsche Gesellschaft für
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ABBREVIATIONS

AnGR	Animal Genetic Resources
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CWANA	Central and West Asia and North Africa
DAD-IS	Domestic Animal Diversity Information System
FAO	Food and Agriculture Organization
GEF	Global Environment Facility
GFAR	Global Forum on Agricultural Research
GPA	Global Plan of Action
GRPC	Genetic Resources Policy Committee
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
IARC	International Agricultural Research Center
ILRI	International Livestock Research Institute
IPGRI	International Plant Genetic Resources Institute
IPR	Intellectual Property Rights
NARS	National Agricultural Research Systems
NGO	Non-Governmental Organization
MoDAD	Measurement of Domestic Animal Diversity
PGRFA	Plant Genetic Resources for Food and Agriculture
SADC	South African Development Community
SSSP	Sustainable Seed Supply Program
WWL-DAD	World Watch List on Domestic Animal Diversity

1 SUMMARY

The present study has been written on behalf of the GTZ Sector Project “Managing Agrobiodiversity in Rural Areas” to provide an overview about the current dialog and initiatives concerning “underutilized and neglected” crops and breeds. Some proposals for activities are addressed to the GTZ Sector Project which are mainly designed as a catalyst but do not constitute time-consuming additional activities. They aim at enhancing collaboration with field projects that are concerned with underutilized/promising crops and breeds.

The evolution of the use of genetic resources for food and agriculture is briefly illustrated, from ancient times with a high level of diversity, to the green revolution which in the past quite often ignored the importance of genetic diversity for the development and stability of farming systems under difficult site conditions. Respective experiences led to an “increasing endorsement at national and international level of the important role in sustainable farming systems and human well-being of less-used crops and species, particularly in less favorable and marginal lands” (Padulosi et al., 1999, IPGRI 2000).

Special attention has been given to “the farmers perspective” concerning the choice of varieties of breeds and crops. Two tables compare high-yield and local crops and animal breeds under farm management, commercialization, ecological, and cultural criteria which may bring advantages as well as disadvantages.

The analysis of the main publications and documents treating the issue of underutilized/promising species, crops and breeds illustrates that the dialog and concepts concerning Plant Genetic Resources (PGR) are much more developed than those concerning Animal Genetic Resources (AnGR). Further analysis might show whether and which of these concepts are transferable from PGR to AnGR.

Important initiatives at the international level and new approaches are presented. New forms of partnership have to be developed between farmers, extension workers, the private sector and research specialists that are conducive to a community-based management of Plant and Animal Genetic Resources. These partnerships have to be somehow institutionalized in the National Plan of Action on Plant Genetic Resources and the National Animal Genetic Resources Management Plans. If they are not incorporated on both levels, new approaches will not become sustainable. The newly-defined “commodity chain approach” of the Global Forum on Agricultural Research may constitute a framework to initiate partnership and to better take into account economic and market-policy aspects.

2 INTRODUCTION

The present study has been written on behalf of the GTZ Sector Project "Managing Agrobiodiversity in Rural Areas" to provide an overview about the current dialog and initiatives concerning "underutilized and neglected" crops and breeds. The importance of the issue is illustrated by the fact that there is an ongoing discussion regarding terminology: whether to speak about "minor", "neglected", "underutilized" or "promising" species, crops and breeds. The discussion is not yet finished, but there seems to be a clear preference in favor of "underutilized" or "promising" species, crops and breeds. The author herself has chosen the terms "underutilized/ promising".

For at least 12,000 years, humans have actively practiced plant and animal breeding. By simply paying close attention to differences among and within the crops they grow, and the animals they breed, farmers have selected and developed an impressively rich legacy of crop and breed variety.

In the 1920s, Vavilov identified geographic centers of crop diversity that in most cases correspond to the regions where crops were first domesticated. There were, for example, probably over 100,000 rice landraces under cultivation in Asia, with at least 30,000 in India alone (Tuxill, 1999). Out of approx. 7,000 cultivated species, 30 or so crop species have become intensively and widely used and are now the basis of much of the world's agriculture (Padulosi et al., 1999).

According to numerous publications of the Food and Agriculture Organization (FAO), the International Livestock Research Institute (ILRI) and others, an estimated 12 % of the world's population live in areas where people depend almost entirely on products obtained from ruminant livestock – cattle, sheep and goats. Approximately 40 % of the total land available in developing countries can be used only for forage production. Animals account for 19 % of the world's food directly. They also provide fuel, credit facilities, spread employment, draught power and fertilizer for crop production etc., bringing their overall contribution to above 30% (FAO estimate). In addition, animals serve as very important cash reserves in many mixed farming and pastoral systems.

Many of the landraces were lost with the "green revolution" that introduced high-yield varieties of crops to boost food self-sufficiency in famine-prone countries.
The high-yield crop varieties were widely distributed, often with government subsidies to encourage their adoption, and they displaced local crops from many farmland areas. The "pushing forward" of high-yield crops in developing countries through subsidies in the widest sense has quite often eliminated farmers' economic rationale.

The livestock development effort in the 20th century in developing countries has seen a more devastating biological approach than the green revolution. Genetic development of animals has occurred primarily for higher input and in comparatively low stress environments. However, concepts ignoring the very complex adaptation of AnGR have rarely kept to this promise and have instead quite often reduced the gene pool.

Now, “there is an increasing endorsement at national and international level of the important role in sustainable farming systems and human well-being of less-used crops and species, particularly in less favorable and marginal lands” (Padulosi et al., 1999, IPGRI 2000).

Such attention stems from developments such as:

- **Food security and nutrition**: many underutilized crops and breeds are nutritionally rich and adapted to low input agriculture.
- **Environmental changes and ecosystem stability**: climate changes, degradation of land and water resources have led to a greater appreciation of those crops and animal breeds which are better adapted to stress and difficult environments where they play a strategic role in maintaining a diversity rich and hence more stable environment.
- **New market opportunities**: new tools are available to transform useful plant species and animal products into diverse products or to extend the shelf life of perishable crops and products. The movement of people across countries and regions provides opportunities for strengthening markets of underutilized crops and breeds in which immigrants identify their own culture and traditions. Tourism represents an increasingly important source for supporting local commodity chains built around underutilized species. The high standard of living in industrialized countries generates demands for more natural food and environmentally-friendly products, a demand which can also be met by underutilized species.
- **Increased attention to indigenous knowledge**: underutilized species hold great genetic diversity, and a vast heritage of indigenous knowledge is linked to these species (Padulosi et al., 1999, Frison et al., 2000).

Hence there is the potential to make a “promising” crop out of one which is underutilized. Some of these opportunities, especially the better adaptation of local breeds to difficult environments, are also valuable for AnGR. The author formulates some proposals concerning the role of the GTZ Sector Project in supporting relevant initiatives and towards overcoming obstacles in the promotion of underutilized/promising species, crops and breeds.

Chapters 3 and 4 provide a resumé of facts, current discussions and strategic considerations for crops and breeds, respectively. Chapter 5 provides information on GTZ projects dealing with underutilized/promising crops and breeds, and a list of resource persons is attached in annex 1. Recommendations to the GTZ-Sector Project can be found in chapter 6.

3 UNDERUTILIZED / PROMISING CROPS

3.1 Some figures about the evolution of the use of crops

According to Bermejo et al. (1994), today only 150 plant species are cultivated, 12 of which provide approximately 75 percent of the world's food, and four of which produce over half of it. Prescott-Allen et al. (1990) state that common figures in literature range from seven plant species providing 75 % of human nutrition to 30 plant species providing 95 % of human nutrition.

According to the "State of the World's Plant Genetic Resources", the three major cereal crops (wheat, rice and maize) provide more than half of the world's total food requirements. 70%, 74% and 57% of the areas planted with wheat, rice and maize respectively are planted with modern varieties (Alexandratos 1995, cited in Virchow 1999). However, when food energy supplies are analyzed on a sub-regional level, a much greater number and type of crops emerge as significant (see Box 1).

BOX 1: Major staple crops/products for food energy supply

Staple crops			**Products**	
Wheat	23 %		Sugar	9 %
Rice	26 %		Soybean Oil	3 %
Maize	7 %		Other vegetable Oils	6 %
Millet & Sorghum	4 %			
Potatoes	2 %		Others	18 %
Sweet potatoes	2 %			

Source: Adapted from FAO 1996

Many of the major staple crops are the subject of private sector research programs and mandate crops to a CGIAR – Center (Consultative Group on International Agricultural Research) and are therefore largely promoted and represented in gene banks. However, this emphasis on a handful of major crops has narrowed the number of species upon which global food security depends. The consequences of crop failures due to unforeseen stresses, pests and diseases are potentially catastrophic (Prescott-Allen et al., 1990).

Active broadening of the species portfolio for agriculture and food security is essential. A much larger range of plants than the above mentioned major staple crops are important from a local, national or regional perspective. These include:

- Locally important crops like yam, proso millet, fonio, bambara groundnut, oca, taro/cocoyam, canihua, breadfruit, Amaranthus and buckwheat
- Vegetables, fruits and other species including wild species and weeds
- Multipurpose trees
- Crops which can contribute to agricultural diversification including uncultivated or little cultivated species with alimentary or agricultural potential.

Some of these crops have started to be promoted through special networks such as the Bambara Groundnut Network or the Central and West Asia and North Africa (CWANA) Networks for rocket, various types of hulled wheat, pistachio nuts and oregano.

3.2 The farmer's perspective

This chapter tries to analyze the key question "Why are certain crops neglected and/or underutilized?" from the farmer's point of view.

The use of a certain crop depends mainly on the choice of the farmer, and the farmer's choice is above all an economic one. If he is a subsistence farmer, the objective is to ensure the food security of the family and this, in most cases, is based on a high diversity of local crops coupled with risk avoidance. There is no money for external inputs like fertilizers or pesticides. A commercial farmer, on the other hand, will maximize monetary income taking into account prices on the world market and subsidies for particular high-yield crops. Many farming systems are situated between these two extremes, but the choice of crop varieties, whether diversification or concentration is preferred, above all follows economic considerations.

The following table compares high-yield and local crops under farm management, commercialization, ecological, and cultural criteria. The criteria may represent advantages as well as disadvantages, and some of them fit into more than one category.

Table 3.1: Main differences between high-yield and local crops

High-yield crops	Local crops
Farm management criteria	
High production – high risk	Low production – low risk
High production cost	Low production cost
Yield stability through fertilizers and pest management	Yield stability through diversity
Subsidies on particular crops (e.g. EU) may influence choice of varieties	Subsidies on particular crops (e.g. development projects or EU) may influence choice of varieties
High private sector interest	Low private sector interest
One product (e.g. grain)	Several products (grain, straw, feed for livestock etc.)
Homogeneous ripeness	Heterogeneous ripeness
Homogeneous germination	Heterogeneous germination
Homogeneous products suitable for export	Heterogeneous products, difficult to export
Often not well adapted to mixed farming systems	Traditionally adapted to mixed farming systems

High fertilizer input	Low fertilizer input
Sometimes highly vulnerable to pests	Locally adapted to pests
Sophisticated and integrated pest management	Very little or no pest management
Certified seed, hybrid seed	Local seed supply systems
Seeds have to be bought, royalties have to be paid for patented seeds	Part of the harvest may be saved as seed for the next season
High dependency on supply networks (seed, fertilizer etc.)	Communal or local supply networks
Extension of new techniques necessary	Traditional knowledge in most cases sufficient
High machinery input	High manual work input
Commercialization criteria	
Product corresponds to “modern” nutritional habits	Product corresponds to local nutritional habits
Product for regional, national and international markets	Products for subsistence, local and regional markets
High marketing and cash potential	Low marketing and cash potential
Dependency on world market prices	Local market may be disturbed through food for work programs or food security aid
Ecological criteria	
Highly sensitive to climate (drought, excessive rain, frost etc.)	Locally adapted to climate variations
Highly sensitive to site conditions	Adapted to difficult site conditions
From the ecological point of view often an “alien element” (in the sense of the “alien species” which are subject to the implementation of the CBD)	Ecologically adapted
Replacement of natural and locally adapted vegetation	May correspond to natural vegetation, e.g. in agroforestry systems
Cultural criteria	
Traditional role of women may be undermined	Traditional role of women promoted
Internationally defined names	Vernacular names for different phenotypes (may correspond to different genotypes)
Internationally promoted and often subsidized	Often neglected by research and the international donor community
Quality criteria focus mainly on uniformity, site etc.	Quality criteria focus mainly on nutritional values

Source: own elaboration

Various constraints on the use of many underutilized/promising crops have to be mentioned that go beyond the farmer's rationale:

- Economic constraints and counter-productive incentives
- The limited availability and poor quality of germ plasm and seeds
- The limited availability of information
- Difficulties in or lack of knowledge about processing, handling and marketing
- Lack of farmer-driven participatory research, breeding systems and on-farm management
- Change in nutritional habits, consideration of minor, neglected and underutilized crops as crops of the poor, and preference for "modern" crops
- A lack of knowledge or awareness of their potential and uses.

Some of these constraints are subject to national, regional and international legislation, others subject to research, marketing or extension services. The following chapter describes the most important international initiatives active in these fields.

3.3 Important international initiatives

The German Federal Ministry for Economic Cooperation and Development (BMZ) financed from November 1993 to June 1997 a project implemented by GTZ at the International Plant Genetic Resources Institute (IPGRI) with the title: "Genetic resources of neglected crops with good development potential: their conservation, use and breeding status". This project collaborated with numerous national and international research centers and contributed considerably to the IPGRI "Strategy for Neglected and Underutilized Species and the Human Dimension of Agrobiodiversity" which was developed in 1998.

The goal of the Strategy has been defined as aiming "to enhance the contributions that neglected and underutilized species can make to food security, better livelihoods for the rural poor, and conservation of biodiversity" (IPGRI, 1998).

In this context, IPGRI has formulated definitions for the terms "neglected" and "underutilized" which are social rather than biological. For IPGRI, "neglected" refers to the lack of attention given to useful species by research and development institutions. "Underutilized" refers to the status and trends in the distribution of uses of a species by farmers and consumers. However, most of the species and varieties are both neglected and underutilized.

BOX 2: Definitions

Neglected species are those grown primarily in their centers of origin or centers of diversity by traditional farmers, where they are still important for the subsistence of local communities. Some species may be globally distributed, but tend to occupy special niches in the local economy and in local production and consumption systems. While these crops continue to be maintained by socio-cultural preferences and local use practices, they remain inadequately characterized, and neglected by research and conservation.

Underutilized species were once more widely grown but are falling into disuse due to various agronomic, genetic, economic and cultural factors. Farmers may find these species less competitive than other crop species in the same agricultural environment. Consumers may be influenced by changing food culture, ease of processing and availability. The eco-geographic decline of these species may erode their genetic base thus restricting future development options.

Source: IPGRI Strategy 1998

The following strategic elements have been developed by IPGRI, focusing on the promotion of neglected and underutilized crops:

BOX 3: Strategic elements

Strategy for the promotion of neglected crops:

- Support on-farm conservation strategies
- Support the documentation of diversity and sustainable uses by farmers
- Support the monitoring of genetic resources use for eventual expanded deployment or improvement
- Support policies and frameworks that return the benefit of future genetic resources development of neglected crops to farmers in the areas where they are maintained

Strategy for the promotion of underutilized crops:

- Support the networking of scientists and germ plasm users interested in extending production and the utilization of the crop or species
- Identify constraints to increased use within the production to consumption system, as well as areas for improvement (marketing, cultural, informational, genetic) that support a broader range of uses
- Focus attention on the need to conserve and maintain genetic resources ***ex situ*** and ***in situ*** to support promotion, commercialization, or rapid expansion of use
- Promote the wide deployment of underutilized species in similar ecosystems to increase the security of the genetic resources and to add to the sustainability and productivity of ecosystems

Source: IPGRI Strategy 1998

IPGRI places clear emphasis on those species which are crucial for food security, poverty alleviation and equity in economic development.

During the GTZ/IPGRI-project, criteria have already been developed for the selection of neglected and underutilized crops that are to be further studied (IPGRI, July 1997):

- Crops of local or regional importance
- Good socioeconomic and agricultural development potential
- Linkages with IPGRI and other projects
- Amount of information available for monographs (scientifically neglected)
- Amount of germ plasm accessions collected and described
- Danger of genetic erosion
- Selection of crops with (1) importance as staple food, (2) specific ecological adaptation (infertile, salty or temporarily flooded soils, swamps, semi-arid regions, high altitudes), (3) wide botanical diversity (different families, trees/shrubs/annuals…)
- Awareness of possible problems (becoming a weed)
- Geographical distribution of the diversity and of the (potential) production areas
- High probability of establishing networks

On this basis, the GTZ/IPGRI-project has coordinated work on 25 carefully-selected neglected or underutilized crops, and the following monographs can actually be downloaded from the Internet: www.cgiar.org/ipgri/doc/download.htm

- Bambara groundnut, pulse (***Vigna subterranea***);
- Black Nightshades, vegetable (***Solanum nigrum*** and related species);
- Breadfruit, fruit (***Arthocarpus altilis***)
- Carob tree, fruits (***Ceratonia siliqua***);
- Cat's whiskers, vegetable (***Cleome gynandra***);
- Chayote, vegetable (***Sechium edule***);
- Coriander, spice (***Coriandrum sativum***);
- Grass pea, pulse (***Latyrus sativus***);
- Hulled Wheat (various), cereals (***Triticum monococcum, T. dicoccum, T. spelta***);
- Niger, oil plant (***Guizotia abyssinica***);
- Oregano, spice (***Oreganum*** spp.);
- Peach palm, fruit (***Bactris gasipaes***);
- Purgier nut, oil plants (***Jatropha curcas***);
- Pili nut, fruit (Canarium ovatum);
- Safflower, oil plant (***Carthamus tinctorius***);
- Sago palm, fruit (***Metroxylon sagu***);
- Tef, millet (***Eragrostis tef***) and
- Yam Bean, tubers (***Pachyrhizus*** spp.).

Additional titles will follow. Several workshops and conferences, e.g. on Safflower, Bambara groundnut or Purgier nut, have taken place and networks have been established.

Important partners of the GTZ-project at IPGRI are the International Center for Under-utilized Crops (ICUC) – UK, and the Bureau of Science and Technology for Development of the USA National Academy of Sciences (BOSTID/NAS).

The dialog on underutilized/promising species is currently very active within the International Agricultural Research Centers (IARC), the CGIAR and its Genetic Resources Policy Committee (GRPC), which has been considering the question of extending the base of food security by including underutilized/promising crops in the farming systems research programs of IARCs.

In October 1998, a System Review of the CGIAR took place and the System Review Panel proposed the following mission statement:

"To contribute to food security and poverty eradication in developing countries through research, partnership, capacity building and policy support promoting sustainable agricultural development based on environmentally sound management of natural resources" (GRPC, 1999)

This mission statement was endorsed by the CGIAR. The System Review Panel recommended the widening of the food security basket by including underutilized crops in the integrated gene and natural resources management programs of IARCs. GRPC decided to convene a conference on the theme "Enlarging the basis of food security: role of underutilized species", and this workshop took place from February 17th to 19th 1999 in Madras, India.

The most important proposals of the workshop were:

- To introduce the expression "promising" instead of underutilized, neglected or minor – the distinction between neglected and underutilized has been abandoned;
- To commission a survey on individuals and organizations which are active in the field of promising species/crops;
- To do regional surveys on relevant research centers, processing and marketing companies;
- To initiate 3 to 5 pilot projects on selected crops which consider the whole commodity chain;
- The redefinition of the role of the IARCs as primarily catalysts for the National Agricultural Research Systems (NARS) and other initiatives

The latest event dealing with underutilized/promising species/crops was the Global Forum on Agricultural Research, which took place in May 2000 in Dresden, Germany.

IPGRI was requested by the GFAR Steering Committee to prepare a document on "The role of underutilized plant species in the 21st Century" (Padulosi et al. 2000). The potential inherent in underutilized/promising species has already been mentioned in the introduction. To enhance the use of underutilized species, the authors propose to take into consideration the following points:

- Many underutilized species have multiple uses and do not belong to any one specific category of crops
- The potential of some underutilized species to become commodity crops should not be underestimated

- Some underutilized species are essentially geared to the market, while others are important for subsistence farming

As strategic domains the authors mention the following needs:

- To promote participatory research in order to take into account the important role of farmers in terms of knowledge, local uses and conservation efforts
- To ensure the availability of genetic diversity, accessible to the main users, and ensuring that benefits are distributed to the farmers who have maintained and developed the genetic diversity in the form of land races*.
- To document and disseminate information
- To promote processing and value-adding activities, e.g. improve storability and develop low-cost processing methods
- To develop new markets and promote marketing while establishing and investigating the whole commodity chain
- To foster synergies and networks at national, regional and international levels
- To adapt legal and policy frameworks, and to enhance public awareness.

The currently promoted approach is the “commodity chain approach”, which is focused on important crops that are currently not fully covered by the CGIAR-mandate. The approach is judged relevant for traditional commodity crops, such as citrus, cacao, coconut, coffee, cotton, oil palm, pineapple, rubber, sugar cane etc. as well as for underutilized crops which, while important on a local/regional level, are not of global importance. The commodity chain has technical, organisational, economical and consumption aspects that could be looked at in a system-based approach to identify constraints that act as limiting factors in the system, as well as unexploited potential (Frison et al., 2000).

Global and Regional Commodity Programs will be initiated that take into account all stakeholders, competitiveness within the chain itself and external competitiveness (land-use and consumption alternatives, substitute products etc.), and the initiation of partnerships. An example of a Global Program is PROMUSA, focusing on the genetic improvement of Musa. The international Bambara Groundnut Network could become a Regional Program.

4 UNDERUTILIZED/NEGLECTED ANIMAL BREEDS

4.1 Some figures about the evolution of the use of animal breeds

According to numerous publications of FAO, ILRI and others, an estimated 12 % of the world's population live in areas where people depend almost entirely on products obtained from ruminant livestock – cattle, sheep and goats. Approximately 40 % of the total land available in developing countries can be used only for forage production. Animals account for 19 % of the world's food directly. They also provide draught power and fertilizer for crop production, bringing their overall contribution to above 30%. In addition, animals serve as very important cash reserves in many mixed farming and pastoral systems.

Within the Global Strategy for the Management of Farm Animal Genetic Resources (AnGR) FAO is developing the Global Early Warning System. The bases of this system are databases for breed inventory and description, and for monitoring the conservation of animal genetic resources. The first breed survey was undertaken in 1991 in all countries outside Europe (where such a survey had already been conducted by the European Association for Animal Production), and concentrated on the ass, buffalo, cattle, goat, horse, pig and sheep. Later on further groups of species such as the camelidae and birds were also added.

Data on AnGR is recorded in the FAO Global Databank for Animal Genetic Resources which forms the basis for the Domestic Animal Diversity Information System (DAD-IS). DAD-IS can be found in the Internet: http://dad.fao.org/en/Home.htm. Registration is required. Access to DAD-IS is free of charge. Training tools for animal genetic resources are under development. FAO also produces the journal "Animal Genetic Resources Information – AGRI". All volumes of AGRI as well as further relevant documentation on AnGR management are available from this website.

When the second edition of the World Watch List on Domestic Animal Diversity (WWL – DAD) was prepared in 1995, the database comprised 3,882 breeds from 28 species. By 1999 it already contained information on 5,300 breeds from 35 species. As of July 2000 the Global Databank for Farm Animal Genetic Resources contained 6,379 breeds from 30 mammalian and avian species.

In the analysis of the Global Databank for Farm Animal Genetic Resources, breeds are classified into one of seven categories: extinct, critical, critical-maintained, endangered, endangered-maintained, not at risk, unknown.

This categorization is based on overall population size, number of breeding females and the trend in population size, i.e. whether the population size is increasing, decreasing or stable. A further consideration in categorization is whether active conservation programs are in place for critical or endangered populations. When relevant information is not available, a conservative approach is taken and the breed is categorized in the higher risk category. Box 4 shows the criteria used to categorize the status of breeds, as formulated in the Global Databank:

BOX 4: Criteria to categorize the status of breeds

Extinct breed	A breed where it is no longer possible to recreate the breed population. Extinction is absolute when there are no breeding males (semen), breeding females (oocytes), nor embryos remaining. In reality, extinction may be realized well before the loss of the last animal, gamete or embryo.
Critical breed	A breed where the total number of breeding females is less than 100 or the total number of breeding males is less than or equal five; or the overall population size is less than or equal to 120 and decreasing, and the percentage of pure-bred females is below 80 %.
Endangered breed	A breed where the total number of breeding females is between 100 and 1,000 or the total number of breeding males is less than or equal to 20 and greater than five; or the overall population size is greater than 80 and less than 100 and increasing and the percentage of pure-bred females is above 80 %; or the overall population size is greater than 1,000 and less than or equal to 1,200 and decreasing and the percentage of pure-bred females is below 80 %.
Critical-maintained breed and endangered-maintained breed	Categories where critical or endangered breeds are being maintained by an active public conservation program or within a commercial or research facility.
Breed not at risk	A breed for which none of the above definitions applies and where the total number of breeding females and males is greater than 1,000 and 20 respectively; or the population size is greater than 1,200 and the overall population size is increasing.

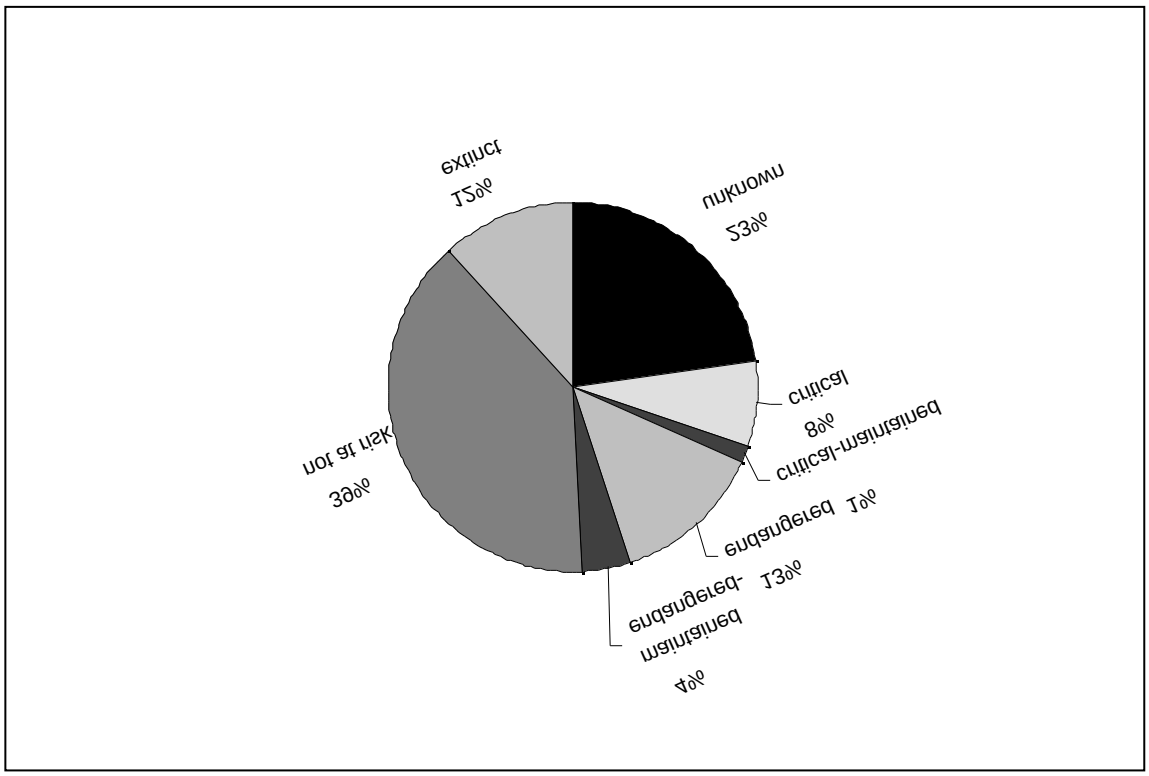
Population size data is now available for 4,198 (66%) of the 6,379 breeds which are in the Global Databank. Of those with population data 1,334 breeds (32%) are classified at a high risk of extinction. Breeds classified at a high risk of extinction are those that are categorized as critical or endangered but which are not maintained, as maintained breeds are presumed to be at less risk of extinction than those that are not under such management. Because the quality and effectiveness of management programs under which breeds are maintained are likely to vary considerably, 32 percent is considered to be a conservative figure. When all breeds, including those that are maintained, are considered, 1,686 breeds are classified at risk – or 30 percent of breeds with data on population size. Extrapolating this figure to include all breeds (including those without population data) recorded in the Global Databank for Farm Animal Genetic Resources would mean that 1,913 breeds are at risk (Scherf 2000, personal communication).

The following table shows the respective numbers of mammalian and avian breeds. The figure further down shows the percentages of each category for the sum of both mammalian and avian breeds (Data was provided by Scherf (FAO) in July 2000).

Table 4.1: Numbers of animal breeds categorized following the criteria formulated in the Global Databank:

	unknown	critical	critical-maintained	endangered	endangered maintained	not at risk	extinct
Mammalian breeds	1247	338	62	602	177	2200	704
Avian breeds	209	142	20	253	93	296	36
Total	**1456**	**480**	**82**	**855**	**270**	**2496**	**740**

Figure 4.1: Percentage of each category for the sum of both mammalian and avian breeds



The quality of data on Domestic Animal Diversity is variable. Breeds in developed countries are much better documented than those in developing countries. It is up to the country focal points and contact persons (government nominated) to provide correct, comprehensive and up-to-date data on all AnGR. In some cases, the judgement if a breed is in danger of extinction or not seems to be quite subjective, and many breed descriptions in the DAD-IS are still incomplete.

Only some of the breeds at risk that have been mentioned by resource persons from all over the world to the author of the study, such as the I-Pig or the Sahiwal cattle, have already been included in the 1995th World Watch List. Nevertheless, they can be found in the DAD-IS, and the World Watch List is currently being revised. In this context FAO is preparing the "first report on the State of the World's animal genetic resources". Draft guidelines for Country Reports have just been formulated and are accompanied by a set of background questions to support the preparation of the Country Reports. "***Subject to approval by the Commission***", it is anticipated that the preparatory process for Country

Reports will be launched in September 2000 and the deadline for the submission of the Country Reports will be 31st December 2001" (FAO, 2000a).

4.2 The farmer's perspective

An important reason for the loss of animal genetic resources is the fact that husbandry and breeding approaches have been transferred from high input – high output production systems in developed countries to the developing world, where most agricultural production involving domestic animals occurs in stressful, medium-input and high stress, low-input production systems. The performance of high-input high-output breeds may be appealing to farmers and may lead to a loss of interest in local breeds.

Many people, scientists and farmers alike, believe that indigenous breeds are not productive, that they are incapable of contributing to increased agricultural production; that they are, in a word, redundant. According to several studies conducted by the International Livestock Research Institute (ILRI), indigenous breeds can be as productive as 'exotic' breeds under improved smallholder management where their adaptation to the environment gives them an advantage over the 'exotic' animals (ILRI, 1997).

The key question is the same as for crops: "Why are most breeds neglected and/or underutilized?" from the farmer's point of view.

The following table compares high-yield and local breeds under farm management, commercialization, ecological, and cultural criteria. The criteria may represent advantages as well as disadvantages, and some of them fit into more than one category.

Table 4.2: Main differences between high-yield and local animal breeds

High-yield breeds	Local breeds
Farm management criteria	
High production – high risk	Low production – low risk
High production cost	Low production cost
One product (e.g. meat or milk)	Several products (meat, milk, leather, wool etc.)
No uses other than production	Several uses possible, e.g. draught, transport, meat-production
Production as first objective, manure for fertilizer and fuel in second place	Manure for fertilizer and fuel may be more important than production
Sensitive to diet, special feed demands	Adapted to local food supplies, moderate diet and feed demands
Generally not hardy	Generally hardy
Highly vulnerable to diseases	Disease resistance, tolerances, e.g. trypanosomiasis

High veterinary input	Low veterinary input, traditional veterinary existing practices
Often not well adapted to mixed farming systems	Traditionally adapted to mixed farming systems
Extension of new techniques necessary	Traditional knowledge in most cases sufficient
Needs mating partner of the same breed	Stock exchange and selection on community level
High dependency on supply networks (veterinary products, semen etc.)	Communal or local supply networks
Highly subsidized, provision of exotic genetic material	Not subsidized
Commercialization criteria	
Product corresponds to “modern” nutrition habits (e.g. low fat content)	Product corresponds to local nutrition habits (e.g. high fat content, taste)
Products mainly for commercialization	Animals as savings account, products for subsistence and for commercialization
High private sector interest	Low private sector interest
Poor longevity	High longevity, less costly to system
Ecological criteria	
Highly sensible to stress (low nutrition level, disease, water, temperature, altitude, swamp etc.)	Locally adapted to a range of stressors
Sites in extreme climates (arid climates, high altitude, cold and long winters) rarely usable by exotic breeds	Locally adapted breeds offer an important potential for the use of special sites like semi-arid or mountainous regions
From the ecological point of view often an “alien element” which can even devastate the environment (heavy cattle breeds on slopes)	Locally adapted to vegetation cover etc.
Low genetic variability	High genetic variability
High input demanding	Low input demanding and very efficient
Cultural criteria	
Rarely cultural or religious importance	Often cultural or religious importance
Internationally recognized names and breed standards	Vernacular names for different pheno-types (may correspond to different genotypes)
Traditional role of women may be undermined	Traditional role of women often promoted
Internationally promoted and often subsidized (aggressively promoted by private sector)	Mostly neglected by research and the international donor community

Source: own elaboration

The table shows that high production exotic breeds demand high input and that breeding of them is only reasonable if the farmer can verifiably benefit from the better commercialization potential. That is: easy access to markets, access to transport facilities, access to particular feed and veterinary products, appropriate mating partners or access to semen etc.. If, on the contrary, farmers need a wide variety of products, first for subsistence and second to sell on the local markets, and if site conditions are difficult and if farmers wish to minimize risk, high-yield varieties will not fulfill the promise of sustainable economic development. Moreover, they will create new dependencies and farmers will have to accept higher levels of risk.

However, local breeds do not a priori automatically represent an optimum choice. Carefully-targeted crossbreeding, for example, can have dramatic effects of dairying on household income, as a study in East Africa, carried out by ILRI in close collaboration with the Kenya Ministry of Agriculture and the Kenya Agricultural Research Institute (KARI), has demonstrated. Households on the Kenyan coast with crossbred cows earned more than one-third of their cash income from dairying, compared with only 6% for households with local cows. Even more dramatic was the difference in actual household income — households with crossbred cows had monthly incomes nearly 21 times those of households with local cows (ILRI, 1997).

Köhler-Rollefson (2000) cites a number of traditional breeding practices and objectives from community-based management of Animal Genetic Resources in India and Africa:

- Social restrictions against selling female breeding stock outside the community
- Stock Exchange
- Selection based on various criteria
- Offspring testing
- Communal ownership of male breeding animals
- Avoidance of inbreeding
- Castration
- Pedigree keeping
- Maintaining adaptation

These breeding practices and objectives have to be studied in view of their transferability, taking into account the particular breed, the socioeconomic and cultural framework as well as the site conditions. An important challenge will be to better understand these practices, the vernacular names, the concepts about races and breeds (for local tradition defines more races than science recognizes), and the farming systems.

One important question for Plant as well as for Animal Genetic Resources is what kind of diversity is needed to keep a maximum range of choice for later breeding options. In any case, new livestock breeding strategies are needed in order to meet the increasing demands for milk, eggs, meat and other animal products of growing human populations. ILRI therefore has developed a project called “Genetic Diversity for Improving Livestock”. With this project, ILRI is pursuing “a new paradigm" which involves the genetic characterization of indigenous livestock breeds and the conservation and use of this valuable biodiversity through modern breeding techniques. The goal is to develop a basis for more effective conservation and utilization of indigenous genetic populations of cattle,

Asian buffalo, sheep, goat and yak. The identification of the ancestral species and of the domestication events should lead to a further increase in productivity through crossbreeding within species. The first phase of this covers a 5-year period (ILRI, 2000, homepage). However, additional funding is still being sought for implementation.

The GEF Council adopted a framework for GEF activities concerning the conservation and sustainable use of biological diversity important to agriculture in October 1998. A respective draft operational program has been prepared for discussion at the GEF Council meeting in May 2000 (GEF/C.15/Inf.). The draft program stipulates among the numerous expected outcomes the following monitoring outcome: “Surveys of trends in using land races, under-utilized crops, and other rare species, as well as breeding of traditional livestock and the ***in situ*** conservation of their wild relatives”.

5 RELEVANT GTZ-PROJECTS AND COLLABORATORS

In the following those GTZ-projects and collaborators contacted by the author in the context of another study[1] that are working more or less directly on neglected and underutilized crops and breeds are listed. Further resource persons and references can be found in the annex.

Table 5.1: Relevant GTZ-Projects and collaborators

Burkina Faso	· **PSB** (Program Sahel Burkina): In daily work it is difficult to distinguish between Agrobiodiversity and Biodiversity. Many multipurpose trees are as important as crops for subsistence. Thus, the project has chosen a wider approach in the sense of integrated resource management.
Bolivia	· **PROQUIPO** (Potosi): Transformation and commercialization of Quinoa · **IRUPANA** (La Paz): Transformation and commercialization of Kaniwa · **CERETARHUI** (Cochabamba): Transformation and commercialization of Tarwi · **PROSANA:** In the project region rice and noodles are often substitutes for traditional food, but their nutrition value is inferior. In addition, cultivation of the Andean cereals is more time-consuming than the cultivation of other crops, which leads to an ongoing reduction of the area under traditional crops. In order to reverse this situation, public and private initiatives seek to promote the cultivation and consumption of traditional crops. In the department of Santa Cruz, for example, incentive measures, such as better technical and institutional advice and better access to micro credits, are being developed. Genetic improvement of traditional crops is done in several institutes, but it seems that the improved breeds are quite sensitive to pests and plant diseases.
Dominican Republic	· Work is being done on ***Cajanus cajan***. In the Dominican Republic "gandul" (***Cajanus cajan***) is considered to be very important. The autonomous University of Santo Domingo (Universidad Autónoma de Santo Domingo) and the Secretaría de Estado de Agricultura have done successful research on varieties not sensitive to photoperiodism. However, examples of the "San Cristóbal" variety disappeared in 1979 and this strain has not yet been restored. Gandul is important for both local and exterior markets (Country report, FAO 1996).
Gambia	· **International Trypanotolerance Center** (ITC): trypanosoma-tolerant N'Dama-cattle, Baoulé-cattle, Djallonké-sheep and West-African goat

[1] Thies, E., 2000. Bottlenecks and needs of German development cooperation in the field of management of agricultural biodiversity.

Morocco	· **Arganeraie**: Local multipurpose tree species ***Argania spinosa***. Oulmes cattle, Deman sheep · **Project ANOC/DLG**: Oulmes cattle, Deman sheep · **PROLUDRA**: Date palms, 223 varieties and 2337 natural hybrids
Pakistan	· **Livestock and Dairy Development Project**: Various local breeds
Peru	· **Proyecto de Desarollo Regional** Jaen, San Ignacio, Bagua: some wild form of fruit: Passiflora/Granadilla and Chirimoya; Coffee variety "typica", some local cacao breeds
SADC Malawi	· **SACCAR**: Studies: "Evaluation of indigenous livestock genotypes in Zimbabwe"; "Evaluation of biodiversity, production and socio-economic impact of rural poultry in Lilongwe and Mzuzu agricultural development divisions"; "Valuation of indigenous farm animal populations and breeds in comparison with imported exotic breeds"; "Some socio-economic factors affecting the Conservation and Utilization of farm animal genetic resources in Malawi". · Several regional projects and networks coordinated by SACCAR
SADC Zimbabwe: SSSP NGO-activities	♦ **SSSP** has had some success with improved sorghum varieties, especially with the variety "Macia" developed by ICRISAT ♦ **ENDA-ZW**: Cereal crops landrace germ plasm collection, characterization and development ♦ **CTDT**: Seed-Fairs-collection of all crop germ plasm important for marginal low resource farming communities; characterization of indigenous crop varieties, ***in situ*** village based gene-banks and participatory extension approaches in quality seed provision systems. Reintroduction of cultivation and utilization of indigenous vegetables ♦ **ITDG-ZW:** Seed-Fairs for identifying, accessing and multiplication of crop variety diversity used in low potential farming sector; germ plasm exchange between farmers and communities; bee-keeping and honey processing ♦ **VECO:** Promotion of quality local seed supply systems based on both the farmer and improved varieties
Vietnam	· **SFDP**: Study on the conservation of autochthonous pig breeds: I-pig

6 RECOMMENDATIONS TO THE GTZ SECTOR PROJECT

Bearing in mind that being informed is part of the terms of reference of the staff, the author has preferred to formulate only recommendations which can function as a catalyst, but do not constitute important additional activities. The activities proposed in the following mainly aim at enhancing collaboration with field projects concerned with underutilized/promising crops and breeds.

- The GTZ Sector-Project should get in contact with the most relevant projects and resource persons listed in chapter 5 and the annex, respectively, and initiate case studies on the promotion of underutilized/promising species within project work.
- Document success-stories and lessons learned (failures), particularly on neglected and underutilized crops and breeds, will facilitate awareness-raising within GTZ and other partners.
- Promote concept to stress sustainable farming systems that require adapted genetic resources.
- In order to raise awareness within GTZ and partner-countries, a brochure on selected underutilized/promising crops and breeds should be produced. Starting with some eight species, this brochure could be progressively completed in cooperation with interested projects and other partners.
- Projects concerned with agricultural development should be initiated to choose a region-typical animal or plant as an “agrobiodiversity-logo”.
- The Regional Program concept of the commodity chain approach developed by the Global Forum on Agricultural Research should be promoted, especially in regionally-functioning projects such as ITC, SSSP and the Project “Postgraduate Education in Agriculture” (SACCAR) in the SADC region.

Analysis of the main publications and documents treating the issue of underutilized/promising species, crops and breeds illustrates that dialog and concepts concerning PGR are more developed than those concerning AnGR. However, further analysis might show whether and which of these concepts are transferable from PGR to AnGR. This analysis should be done at two levels: the field level and the international conceptual level. The GTZ-Sector Project could contribute to this analysis through the encouragement of field projects to “test”, for example, the commodity chain approach while dealing with underutilized/promising breeds.

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